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Education as a key determinant of health: A case study from rural Anhui, China

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Abstract

Introduction: Recent attention has focused on the emergence and causes of substantial health disparities between rural and urban residents in China. This study aims to identify which social determinants contribute to the poor health status of rural Chinese.
Methods: Quantitative analysis (multivariate logistic regression) of survey data was utilized to determine significant social determinants of health affecting the health of adult people from the rural province of Anhui, China. Diagnosis of chronic diseases was the main measure of health used as the outcome variable. Predictor variables included in the statistical model were major social determinants of health (education, income, sex, age, occupation, as well as health behaviours related to smoking, drinking, and exercise).
Results: Our findings indicated education had the largest impact on chronic disease diagnoses in rural Anhui. Generally, as education level increases, incidence of chronic disease diagnosis decreases.
Discussion and Conclusion: Healthcare reform in Anhui China should focus on increasing the education level of rural residents, particularly for vulnerable groups such as farmers, women, the elderly, and homemakers.

KEY WORDS: China; education; health policy; SDoH (social determinants of health).

Riassunto

Obiettivo: Recentemente l'attenzione si è concentrata sulla comparsa e le cause delle sostanziali disparità di salute tra i residenti di aree rurali ed urbanizzate della Cina. Questo studio ha l'obiettivo di identificare i determinanti sociali che contribuiscono allo scarso livello di salute degli abitanti della Cina rurale.
Metodi: Un'analisi quantitativa (regressione logistica multivariata) dei dati dell'indagine è stata utilizzata per studiare i determinanti sociali che hanno un effetto significativo sulla salute di adulti della provincia rurale di Anhui, in Cina. Le diagnosi di malattia cronica come principale misura di salute è stata usata come variabile dipendente. Le variabili indipendenti incluse nel modello sono state i principali determinanti sociali di salute (livello di educazione, reddito, sesso, età, occupazione, cosi come gli stili di vita che influenzano la salute correlati al fumo, all'assunzione di alcolici ed all'esercizio fisico).
Risultati: I nostri risultati hanno indicato che l'educazione ha l'impatto più importante sulla diagnosi di malattie croniche nella rurale Anhui. In generale, mentre il livello di educazione aumenta, l'incidenza della diagnosi di malattie croniche diminuisce.
Conclusioni: La riforma sanitaria in Anhui, Cina, dovrebbe concentrarsi sull'aumento dei livelli di educazione per i residenti delle zone rurali, in particolare in gruppi di popolazione vulnerabile come i contadini, le donne, gli anziani e le casalinghe.

TAKE-HOME MESSAGE

Educational attainment is a significant social determinant of health for adults in the rural province of Anhui, China.

Competing interests - none declared.

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INTRODUCTION

Background

Decades of economic growth concentrated in urban regions has led to unbalanced development between rural and urban China, with rural residents having more difficulty gaining access to social services such as education and healthcare. Generally, rural residents tend to have lower socio-economic status, lower life expectancy, less education, and reduced access to healthcare [1]. Rural residents are also more likely to suffer from infectious diseases, malnutrition, and face a stagnant job market [2, 3]. The Chinese government has made attempts to address existing challenges by instituting policy reforms, increasing fiscal spending in healthcare, and introducing rural-specific policies to combat existing health inequities.

Health policy reform in rural China

At least 44% of China's population were registered as rural residents in 2015 [4], making the need for healthcare access and related policy reform especially important for rural regions.

Following the establishment of the People's Republic of China in 1949 and during the decade long Cultural Revolution under Mao (from 1966 to 1976) [5], China's healthcare system was dedicated to prevention, sanitation, and financial independence. The government relied on barefoot doctors – local farmers who received minimal medical training – to increase the scope of coverage to rural residents [6]. During this period, overall population health metrics increased, and a vast array of healthcare institutions were established across the country [7]. Healthcare access surfaced as a serious issue after 1978 reforms introduced privatization and commoditization. The shift towards a market economy resulted in less state healthcare financing [8]. Healthcare institutions and healthcare professionals began to rely on profits to circumvent reduced state funding, resulting in a dramatic increase to healthcare service costs. Hospitals and clinics began to upsell expensive medical tests and procedures, such as x-rays, injections, high cost medications, and lab tests [8]. This combined effect of reduced medical coverage and increased medical care costs has been detrimental to the health of rural Chinese residents.

In 2009, the Chinese government introduced several reforms to address rural healthcare access and improve basic healthcare coverage nationwide. Specified directives involved providing basic healthcare coverage to all Chinese residents by the year 2020 [9], with specific emphasis on rural regions. The plan involved a financial commitment of 850 billion RMB (about US $126 billion) to the 'four beams' of reform: public health care, medical care, essential drugs and health insurance (including the Rural Cooperative Medical Scheme, the Urban Employee-based Basic Medical Insurance Scheme and the Urban Resident-Based Basic Medical Insurance Scheme) [10]. However, high out-of-pocket costs continue to be a major barrier for healthcare access, especially with respect to vulnerable populations in rural areas such as those living in poverty, the elderly, and the disabled.

Social Determinants of Health (SDoH): The role of education

Research has revealed the significance of social, economic, and environmental conditions on health [11]. Collectively, these factors are referred to as the social determinants of health (SDoH). They include 'income and social status; social support networks; education; employment/working conditions; social environments; physical environments; personal health practices and coping skills; healthy child development; gender; and culture' [12]. A variety of studies have shown a strong correlation between education and health outcomes. Out of all the SDoH, education is consistently ranked among the most important factors with respect to health disparities. An Organisation for Economic Co-operation and Development (OECD) report found global evidence indicating that education is a strong predictor of health, specifically with re-

lation to shaping individual health behaviours and preventive health service utilization [13]. A study published by Statistics Canada found significant differences in mortality rates across all levels of education – those with higher education generally had lower mortality rates for almost all causes of death [14]. Additionally, research in the United States has found the following trends on health and education: a) 'At age 25, U.S. adults without a high school diploma can expect to die 9 years sooner than college graduates'; b) 'College graduates with only a Bachelor's degree were 26 percent more likely to die during a 5-year study follow up period than those with a professional degree'; c) 'Americans with less than a high school education were almost twice as likely to die in the next 5 years compared to those with a professional degree'; d) 'Among whites with less than 12 years of education, life expectancy at age 25 fell by more than 3 years for men and by more than 5 years for women between 1990 and 2008'; e) 'By 2011, the prevalence of diabetes had reached 15 percent for adults without a high school education, compared with 7 percent for college graduates' [15].

Rural versus urban health in China

The health of China's population is a relatively well studied field. However, most research is focused on population-level health metrics (e.g., mortality rates, morbidity rates, life expectancy, physician to population ratio), disease incidence, effects of health system reform, and general healthcare access issues. There is less literature emphasising the SDoH in China. On Chinese urban health, one study reviewed how urbanisation had led to changing social conditions, which were found to cause poor health. In particular, environmental concerns such as air quality, water sanitation, changing diets, reduced levels of exercise, increased road and/or industrial accidents all contributed to poor health outcomes for urban residents [16]. Other research has focused on rural-urban health comparisons in China. A Chinese study that reviewed the effects of socioeconomic reforms found the following: health disparities are evident across a variety of health metrics when comparing rural-urban residents; urban residents tend to have better health than their rural counterparts; urban residents are far more likely to have health insurance coverage; and, the rural elderly are the most vulnerable group and exhibit the worst health status [17]. A more recent investigation by Lie et al. found major access issues when comparing urban and rural hospitalization rates. In particular, hospital use was significantly lower among rural Chinese [18]. On the issue of healthcare access, one study explored rural-urban health disparities by surveying respondents in the urban center of Suzhou, China. Results illustrate that 'rural subjects have poorer access to and utilisation of healthcare facilities, and a lower insurance utilisation rate' [19]. Finally, Zimmer et al. found that later in life, urban residents have major social advantages such as higher socio-economic status and healthcare services access, increased resources, and better social support compared to rural residents in Beijing [20]. In general, research on health in rural China has largely focused on self-rated health, healthcare access, medical insurance availability, use of health services, and healthcare financing. There is a gap in literature with respect to the SDoH, particularly in the area of education.

Research Questions

This study aims to identify the potential causes of poor health in rural China. More specifically, this study will focus on the following research questions:

1. How does education level impact chronic disease diagnosis in Anhui, China?
2. Apart from education, what other SDoH have an impact on chronic disease diagnosis in Anhui, China?

Study's theoretical framework: The Social Disadvantage Approach (SDA) to health

This study will draw SDoH theory to inform data analysis. This theoretical perspective combines the directives of multiple discipli-

nes (sociology, demography, epidemiology, and public health) to generate a theory on the non-medical factors that cause population health disparities, including 'individual characteristics, such as education, income, and health beliefs' [21]. SDoH include both upstream, midstream, and downstream elements that influence health. Upstream elements occur at the macro level and involve government policies and broad social and cultural systems, midstream 'determinants are intermediate factors such as health behaviours, while downstream determinants occur at the micro level and include one's genetics' [22]. As this study centres on education, the Social Disadvantage Approach (SDA) to health will be employed. This perspective focuses on the importance of education, neighborhood quality, workplace conditions, social inequality, and income as key determinants of health [23].

The Social Disadvantage Approach (SDA) and the role of education

According to the SDA, education greatly influences health by: increasing individual knowledge, literacy, and critical thinking skills; affecting occupational status and increasing job opportunities; increasing healthy behaviours and the ability to manage risky activities; and, boosting social-psychological factors [23]. The first link between education and health is related to knowledge and literacy. According to a systematic review on the effects of health literacy, persons with low levels of health literacy exhibit poorer health outcomes, and report lower utilization of available healthcare services [23]. In other words, individuals with higher educational attainment are hypothesized to exhibit better health literacy. Education also impacts health by expanding available employment opportunities. This is especially important as jobs are a main predictor of economic resources. Education is believed to contribute to the use of preventative health services, while also promoting healthy behaviours, 'supporting and nurturing human development, human relationships and personal, family and community well-being' [13]. Lastly, the SDA also argues that educational attainment impacts health through indirect factors such as increased prestige and broader social networks.

The Social Disadvantage Approach (SDA) and the role of workplace conditions

As mentioned, education has an impact on employment. However, workplace conditions also influence health. Job conditions, employment benefits, and employment earnings have all shown to have a significant impact on health. The 'physical aspects of work (occupational health and safety) can influence health by affecting an individual's risk of musculoskeletal injuries and disorders, sedentariness, and obesity and obesity-related chronic conditions (e.g., diabetes, heart disease)' [23]. Examples of employment benefits include medical insurance (dental, vision), paid leave, retirement benefits, employee wellness programs, schedule flexibility or lack of shift work, and daycare programs.

The Social Disadvantage Approach (SDA) and the role of income

Educational attainment also influences level of income or wealth through employment opportunities. Income is believed to influence health since it may dictate neighborhood quality, environment, housing, level of nutrition, and stress. Housing and neighborhood quality 'can influence health through physical characteristics (air and water quality, exposures, access to parks), the availability and quality of neighborhood services (transportation, schools, employment resources, housing), and social relationships within a geographic community (mutual trust among neighbors has been linked to lower homicide rates)' [23]. Higher income individuals are able to afford nutritious foods more often, whereas low-income families are more likely to face resource barriers and food scarcity [24]. Income also affects stress levels, with those of lower income often reporting higher levels of general stress and the worst health outcomes [25]. Finally, income inequality may also affect population health by destabilizing trust in gover-

nment, weakening social infrastructure, and affecting social cohesion.

Based on the theoretical framework discussed, our hypotheses are as follows:

1. Education will have the strongest impact on chronic disease diagnosis. It is predicted individuals with less education will have a higher prevalence of chronic disease diagnosis (CDD).
2. Most social determinants of health (sex, age, income, occupation, health behaviours) controlled for in the study are predicted to be have at least *some* impact on chronic disease diagnosis (CDD).

METHODS

Data collection and research design

This study employs quantitative analysis of secondary survey data collected by one of the co-authors of this study (Dr. Weizhen Dong from University of Waterloo) in partnership with the Anhui Medical University. Survey data was collected in Chinese (Mandarin) and translated into English using professional services. The sample involved purposeful selection of Anhui, China as a province due to its high proportion of rural residents. Stratified sampling was used in order to capture geographic and socioeconomic variance. The province of Anhui was first stratified into 3 districts (strata) based on geographic location: northern, central, and southern (see Table 1). One county was chosen from each geographic region via simple random sampling. In the second stage, 4 to 5 villages within each county were selected using simple random sampling. The sample included a total of 12, 239 unique individuals across 15 townships in the province of Anhui. During survey administration, each participant was briefed on research implications. All townships were invited to participate on a voluntary basis. The data collection period was carried out from June to August of 2015. The survey collected information related to individual characteristics (age, gender, education, marital status, income), health behaviours (exercise, smoking, drinking), and the information related to the SDoH. As the study focus was on the health of adults, cases that reported an age below 18 years of age were omitted. The study's participation was voluntary. The study design and questionnaire were approved by the Anhui Medical University Research Ethics Committee.

Instruments and variables

In order to collect information about socio-demographic data, dependent and independent study variables, we set up a self-administered questionnaire *ad hoc*. This study used chronic disease diagnosis (CDD) as the dependent variable. The variable was dichotomous (1 = yes, 0 = no), and captured whether a respondent had been diagnosed with a chronic disease by a physician. For the purpose of this study, chronic disease is defined as a condition, disease, or illness that is ongoing and/or persistent in its effects, lasting a minimum of 3 months [26]. In our study we considered only the following most common chronic diseases: stroke, ischemic heart disease (IHD), cancer, chronic respiratory diseases and diabetes. Chronic diseases such as 'stroke, cancer, chronic respiratory diseases and diabetes, are by far the leading cause of mortality in the world, representing 60% of all deaths' [27]. In China, it was estimated that chronic diseases accounted for almost 80% of all deaths in 2005, a number that is projected to grow [28]. This study used education level as the main independent variable. This variable measured formal education, and had 4 possible responses: illiterate, primary school, middle (junior) school, secondary (senior) school or higher. The illiterate response category also captured cases with no formal education. In China, primary and middle school education takes 9 years to complete, and it is obligatory under the Compulsory Education Law of the People's Republic of China implemented in 1986 [29]. Due to the limited number of responses, the secondary (senior) school or higher category was used to collapse all cases who have attended some level of formal education beyond the 9-year compulsory education system in

Table 1. Study sites in Anhui Province.

Study Sites in Anhui Province		
County	***Township*** *(Village)*	***Sample*** *(n)*
Lujiang	Yefushan (Luogang, Magang)	2,355
	Tangchi (Songyuan, Jincong, Baihua)	2,035
Fanchang	E-qiao (Shenrong)	1,281
	Pingpu (Xinlin, Maren, Longgang)	1,423
	Diegang (Yangwan, Yaocong)	1,474
Taihe	Daxin (Xinji, Xinzhuang)	1,751
	Xiaokou (Wangzai, Qianzhuang)	1,920
Total Sample Size		12, 239

China. This includes, secondary (senior) school, vocational school, college, and university attendance. Access to free local health education by townships was controlled for as a secondary educational element. This variable was dichotomous (1 = yes, 0 = no), and measured whether individuals have access to free local health education. The control variables selected in this study were directly related to the social determinants of health. Basic demographic characteristics were incorporated, including sex, age, income, and occupation. Sex was a dichotomous variable (1 = male, 2 = female). Age and income were both continuous variables, with age measured in years (18+ only) and income representing total household income in the last year, measured in RMB ¥ (Renminbi, also known as Chinese Yuan). The occupation variable measured occupational status using 6 distinct categories: farmer, student, homemaker, general worker, professional, and retired. To clarify, the professional category collapsed all cases who identified their occupational status as businessman, executive, teacher, or doctor. The general worker category denotes non-farmer rural residents whose occupational status falls outside that of the professional category. Ethnicity was not controlled for due to the homogenous ethnic make-up of the sample. The following health behaviours were controlled for in this study: smoking, drinking, and exercise. Smoking measured frequency of smoking in the last 12 months (1 = daily, 2 = not daily, 3 = never), separating respondents into daily smoker, casual smoker, and non-smoker groups. The drinking variable was dichotomous and measured whether subjects drank any alcohol within the last 12 months (yes/no), dividing respondents into drinker and non-drinker groups, respectively. The exercise variable measured weekly exercise habits and had 5 response categories, ranging from 0 days of weekly exercise to 6+ days of weekly exercise. In order to increase confidence in the survey results of the dependent variable (presence of chronic disease), an additional health indicator was incorporated into the model – hospitalization (within the last year). The hospitalization variable was dichotomous (1 = yes, 0 = no), and measured admission to hospital for treatment purposes. A significant relationship between hospitalization and presence of chronic disease will indicate a higher degree of confidence in the final results.

Statistical analyses

The study involved multivariate analysis using logistic regression multivariate analysis. In order to correct for stratified sampling, survey-corrected models were used to account for variance within each geographic stratum at the county level. A p = 0.05 was the standard of significance used across all levels of statistical analyses.

RESULTS

Descriptive statistics

As shown in Table 2, participants in our study

totalled 3,416 (F: *n* = 2021, 59%; M: *n* = 1395, 41%; response rate 27.9%). The sample ranged from 18 to 98 years of age (*M* = 55, *SD* ± 13.48). Across counties, Taihe County had the fewest number of respondents with 29%. Approximately 51% of the sample reported presence of a chronic disease (F: *n* = 1065, 52.7%; M: *n* = 674, 48.3%). More than 44% of the sample reported being illiterate with no formal education, compared to only 6.6% who attended secondary (senior) school or higher. Almost a quarter of the respondents (22.5%) attended middle (junior) school which has been compulsory in China since 1986 [29]. In terms of health behaviours, most respondents reported not smoking (75.5%) or drinking (78.5%) within the last 12 months, whereas females were far less likely to smoke (0.9% smokers) or drink (3.2% drinkers). Most respondents (75.5%) reported no weekly exercise, with only about 15.2% engaging in daily exercise. Finally, in terms of income the median household income for the sample was 3,400 RMB (¥), with the average at 10,071 RMB (¥), and males were more likely to report a higher average and median income (17,432 RMB; 10,000 RMB) compared to females (4,991 RMB; 1,500 RMB).

Multivariate analysis

Controlling for all other independent variables, our results showed statistical significance ($P < 0.05$) for education, age, hospitalization, drinking, and occupational status as a general worker or professional. On the other side, access to free health education, sex, income, smoking, exercise, and occupational status as student, farmer, or homemaker were not found to be statistically significant ($P > 0.05$). Education was observed to have a correlation with chronic disease diagnosis (CDD moving forward), and was found to be significant across all response categories ($P < 0.05$). Generally, as education level increases, the presence of chronic disease decreases. More specifically, the category that reported being illiterate with no formal education was used as the reference point. Overall, a low to moderate, negative relationship was observed between individuals with a primary school education and CDD. Compared to those who are illiterate, persons with a primary school education were 26% less likely to be diagnosed with a chronic disease. A moderate to strong negative relationship was observed between those who had a middle/junior level education (Odds ratio (OR) = 0.59, 95% CI 0.47 to 0.73, *P* = 000) and those who had achieved a secondary/senior or higher educational level (Odds ratio (OR) = 0.58, 95% CI 0.40 to 0.83, *P* = 0.003). Compared to persons who reported being illiterate, individuals with middle/junior education were 41.5% less likely to exhibit CDD; and, individuals with secondary/senior or higher education were 42% less likely to be diagnosed with a chronic disease. Results support and substantiate the first hypothesis, as education was found to have the strongest overall impact on CDD. Age was found to have a positive relationship with CDD (Odds ratio (OR) = 1.4, 95% CI 1.03 to 1.05, *P* = 0.000). For each additional year of age, the likelihood of chronic disease diagnosis increased by 4.2%. Certain occupational categories were found to be statistically significant, exhibiting a moderate negative relationship with CDD. General workers (non-farmer rural residents) were found to be 38.1% (Odds ratio (OR) = 0.62, 95% CI 0.49 to 0.78, *P* = 0.000) less likely to be diagnosed with a chronic disease when compared to all other occupational categories. Professional workers, a response category that included business executives, teachers, and doctors, were 31.3% (Odds ratio (OR) = 0.69, 95% CI 0.47 to 1.00, *P* = 0.050) less likely to be diagnosed with a chronic disease. Status as a student, farmer, or homemaker had no significant effect on CDD ($P > 0.05$). Out of the health behaviours controlled for in this study, only drinking was found to be statistically significant ($P < 0.05$). There was a moderate negative relationship observed between drinking and CDD (Odds ratio (OR) = 0.69, 95% CI 0.55 to 0.86, *P* = 0.001). Individuals who reported drinking behaviour in the last 12 months were 31.4% less likely to be diagnosed with a chronic disease compared to those

Table 2. Socio-demographic characteristics of the study participants (*n* = 3,416).

Variable	**Male (*n = 1,395*; 41%)**	**Female (*n = 2021*; 59%)**
Chronic Disease Diagnosis	*n* = 674 (48.3%)	n= 1065 (52.7%)
Educational Level		
Illiterate	n = 374 (26.8%)	n = 1132 (56%)
Primary School	n = 442 (31.7%)	n = 476 (23.5%)
Middle School	n = 430 (30.8%)	n = 337 (16.7%)
Secondary School or Higher	n = 149 (10.7%)	n = 76 (3.8%)
Age years groups		
18-30	n = 54 (3.8%)	n = 108 (5.3%)
31-49	n = 368 (26.4%)	n = 663 (32.8%)
50-69	n = 706 (50.6%)	n = 999 (49.4%)
Above or equal to 70	n = 267 (19.1%)	n = 251 (12.4%)
Occupation		
Farmer	n = 652 (46.7%)	n = 879 (43.5%)
Homemaker	n = 6 (11.1%)	n = 12 (42.6%)
Student	n = 155 (0.4%)	n = 861 (0.6%)
General worker	n = 434 (31.1%)	n = 176 (8.7%)
Professional worker	n = 108 (7.8%)	n = 81 (4%)
Retired	n = 40 (2.9%)	n = 12 (0.6%)
Income (RMB ¥)		
0-5,000	n = 530 (38%)	n = 1515 (75%)
5,001-10,000	n = 239 (17.1%)	n = 234 (11.6%)
10,000+	n = 626 (44.9%)	n = 272 (13.4%)
Smoking habits		
Daily smoker	n = 650 (46.6%)	n = 12 (0.6%)
Casual smoker	n = 68 (4.9%)	n = 6 (0.3%)
Non-smoker	n = 677 (48.5%)	n = 2003 (99.1%)
Exercise		
Never	n = 1033 (74%)	n = 1547 (76.6%)
1-3 days a week	n = 133 (9.5%)	n = 184 (9.1%)
≥ 4 days a week	n = 229 (16.4%)	n = 290 (14.4%)
Drinking (within last 12 months)	n = 669 (48%)	n = 65 (3.2%)
Access to free local health education	n = 347 (24.9%)	n = 418 (20.7%)
Hospitalization (within last 12 months)	n = 191 (13.7%)	n = 292 (14.5%)

who reported no drinking behaviour. Lastly, those who reported hospitalization in the last year were 3.14 (214%) times more likely to be diagnosed with a chronic disease. Results somewhat support the second hypothesis. Sex, income, and most health behaviours were predicted to have some impact on chronic disease presence. However, 2 out of 3 health behaviours controlled for (smoking, exercise), income, and sex were not found to be statistically significant. Additionally, only certain occupations (non-farmer general workers, professionals) were found to impact CDD (see Table 3).

DISCUSSION

Education and access to health education

Final results support the initial hypothesis, as education was found to have the strongest impact on chronic disease diagnosis when controlling for major SDoH. Generally, the higher the education level, the lower the chance of being diagnosed with a chronic di-

Table 3. Association of socio-demographic characteristics with chronic disease diagnosis.

	Presence of at least one chronic disease diagnosis		**No presence of any chronic disease diagnosis**			
	n	**%**	***n***	**%**	**OR (95% CI) ***	***P***
Age, years					1.04 (1.03-1.05)	0.000
18-30	9	0.5	153	9.1	**	**
31-49	344	19.8	687	41.0	**	**
50-59	1023	58.8	682	40.7	**	**
Above or equal to 70	363	20.9	155	9.2	**	**
Gender						
Male	674	38.8	721	43.0	**	**
Female	1065	61.2	956	57.0	0.83 (0.66-1.05)	0.118
Level of Education						
Illiterate	967	55.6	539	32.1	**	**
Primary	453	26.0	465	27.7	0.74 (0.61-0.90)	0.002
Middle	252	14.5	515	30.7	0.59 (0.47-0.73)	0.000
Senior or higher	67	3.9	158	9.4	0.58 (0.40-0.83)	0.003
Occupation						
Farmer	901	51.8	630	37.6	**	**
Homemaker	563	32.3	453	27.0	0.94 (0.79-1.13)	0.524
Student	5	0.3	13	0.8	0.62 (0.21-1.87)	0.395
General worker	179	10.3	431	25.7	0.62 (0.49-0.78)	0.000
Professional worker	57	3.3	132	7.9	0.69 (0.47-1.00)	0.050
Retired	34	2.0	18	1.0	1.30 (0.67-2.50)	0.437
Income (RMB ¥)					1.00 (1.00-1.00)	0.526
0-5,000	1192	68.6	850	50.8	**	**
5,001-10,000	237	13.6	236	14.1	**	**
10,000+	309	17.8	589	35.1	**	**
Smoking habits						
Daily smoker	285	16.4	377	22.5	**	**
Casual smoker	36	2.1	38	2.3	1.16 (0.65-2.08)	0.612
Non-smoker	1418	81.5	1262	75.2	1.26 (0.99-1.61)	0.062
Exercise						
Never	1314	75.6	1266	75.5	**	**
1-3 days a week	151	8.7	166	9.9	1.15 (0.89-1.50)	0.275
≥ 4 days a week	274	15.8	245	14.6	0.96 (0.77-1.18)	0.679
Drinker group	294	16.9	440	26.2	0.69 (0.55-0.86)	0.001
No-drinker group	1445	83.1	1237	73.8	**	**
Yes access to free local health education	364	20.9	401	23.9	1.00 (0.84-1.20)	0.966
No access to free local health education	1375	79.1	1276	76.1	**	**
Hospitalization (within last 12 months)	374	21.5	109	6.5	3.14 (2.48-3.96)	0.000
No hospitalization (within last 12 months)	1365	78.5	1568	93.5	**	**

*Odds Ratio (OR) (95% Confidence Interval (CI) adjusted for age, gender, educational level, and other independent variables.
** Reference Category or Continuous Variable

sease. Interestingly, both middle school and secondary school or higher level of education had a similar effect on chronic disease diagnosis – both categories were about 42% less likely to have CDD than others. As such, focus of policy reform should be on raising the minimum education level to middle school for the most efficient use of resources in order to better rural health in Anhui. Access to free health education at the community level was not found to be statistically significant. It is important to note the health education variable only measured access to local health education, and was not able to measure or speak to the frequency of seminars, attendance levels, or quality.

Socio-demographic predictors: Income, sex, age, occupation

Findings indicate that income and biological sex were not significant when controlling for major SDoH. According to the SDA, income is a subcomponent of education. Non-significance may be attributed to this association, with education more accurately predicting income. This finding provides support for the Social Disadvantage Approach. Descriptive statistics from the sample found that women in rural Anhui had less education, lower incomes, and were more likely to be homemakers when compared to males. It can be argued that sex influences health by impacting other macro determinants of health, such as education and income level. For instance, due to social pressures, women may follow traditional cultural or family roles and, therefore, have limited access to education and employment opportunities.

Age remained a significant factor. This is consistent with current health research and conventional knowledge related to the aging process. As people age, they become more susceptible to negative health outcomes, including an increased prevalence of chronic illnesses such as cancer, heart ischemic disease, and stroke. Certain occupations were associated with better health and reduced chronic disease presence. In particular, students showed only a 5% likelihood of disease diagnosis. This finding may be a by-product of age rather than occupational status, as students had a much lower median age comparted to other response categories. However, this finding also greatly supports education as a major SDoH. Since the study only involved respondents aged 18 and over, the student group was the most likely to have obtained a secondary or higher level of education. General workers (non-farmers) and professionals (teachers, doctors, and businessmen) also had a lower chance of chronic disease diagnosis. This finding is consistent with the SDA as well, as education is believed to shape employment opportunity. General workers and professionals were found to have better educational attainment when compared to other occupational categories of farmer, homemaker, or retired.

Health behaviours

Results related to individual health behaviours (smoking, drinking, and exercise) were fascinating**.** Smoking and exercise frequency were not found to have a significant impact on chronic disease diagnosis. This finding may have been caused by a variance in the response categories, as a majority of the sample did not smoke (n = 2,680, 78.5%) or drink (n = 2,682, 78.5%) within the last 12 months. Also, the measurement validity of exercise may have been impacted by the high rate of labour intensive occupations, such as farming (n = 15,323, 44.8%). Specifically, as exercise frequency does not measure occupational labour, this may have impacted the level of significance. Most surprising were findings on drinking behaviours. Results indicate those who reported drinking in the last 12 months had a 31.4% lower chance of being diagnosed with a chronic disease. Perhaps, those who were diagnosed with a chronic disorder ceased drinking alcohol at the direction of a physician, or to help alleviate chronic disease symptoms.

In general, these findings support SDoH theory and the SDA, as it has been argued that larger systemic conditions and social environments are predicted to have a greater impact

on health rather than individual behaviours. For instance, persons with higher educational attainment may exhibit better health literacy and therefore live healthier lifestyles. Also, a 2017 study by Dong et al. found that 'health risk behaviour such as drinking and smoking have positive effects on SRH' [30].

Rural China's health challenges

Resource barriers in China are correlated with uneven economic development. Along with economic growth, success in China continues to be concentrated in urban areas [8]. This includes jobs, housing, businesses, social welfare programs, and healthcare providers. Large urban centres such as Beijing or Shanghai provide the typical example of a successful, economically developed region with access to jobs and high-quality healthcare facilities. Almost 80% of all health and medical services located in urban areas [2]. Rural China's geographic obstacles are furthered by the natural landscape. The prevalence of rugged mountains, rivers, streams, and uneven terrain complicate efforts to build transportation infrastructure (e.g., roads, railroads). Remoteness of rural regions contributes to the overall lack of healthcare infrastructure and lack of medical staff. Rural medical clinics are uncommon, and it is estimated that almost 10% of rural residents are required to travel 30 minutes or more to receive medical care, compared to only 1% for urban residents [31]. Economic outmigration is another major public health challenge for rural China. The movement of working-age rural residents to cities for the purpose of work has led to a higher prevalence of senior citizens in rural villages [32]. Commonly referred to as the Rural Old, seniors living in villages are at an increased risk for poor health. Seniors are more likely to be diagnosed with chronic disorders, have lower yearly household income, and less education when compared to their younger rural counterparts [32]. Additionally, as China's public resources are managed locally and based on registration status (rural versus urban), rural residents who migrate to urban areas for work have limited access to healthcare, education, and housing subsidies. As rural migrant workers are not covered by the urban healthcare system, their health needs are often unmet and their health status largely goes unmonitored.

Policy implications and recommendations

General policy recommendations below are associated with reducing socio-economic inequalities between rural and urban Chinese populations, while emphasizing the importance of education as a SDoH:

1. Reduce prevalence of illiteracy and increase education level among rural residents, particularly within the following groups: farmers, women, the elderly, and homemakers.
2. The state education policy reforms should provide free and local education opportunities for adults in rural areas. At minimum, the goal should be to eliminate (or drastically reduce) prevalence of illiteracy.
3. Increase employment opportunities and diversify rural economies at the community level.

This directive is aimed at reducing stagnant job growth, as well as providing increased household income through better job prospects.

Limitations and future research

The sample uses cases from the province of Anhui only, meaning it is not representative of all rural residents in China. Further research on rural residents in other Chinese provinces will prove beneficial. Also, the study design did not allow for the investigation of compound effects. For example, the study could not differentiate between those who have been diagnosed with only one chronic disease, or with multiple chronic diseases. Further research will require a sample and variables with the ability to provide more nuanced information in the area of chronic disease diagnosis. It is important to point out drawbacks related to the reduced number of cases (n = 3,416) in the final multivariate model. In order to maintain model fit and theoretically control for all variables based on the

SDoH, the final number of cases was greatly reduced. This is due to two main factors: first, only about a third of respondents answered the survey question related to the free access to local healthcare education variable; and, over 2,000 cases were dropped after omitting respondents below 18 years of age from the sample (from n = 12,239 to n = 10,053). The variable measuring free access to local healthcare education was included in the final model in order to better evaluate or control for the potential effect of health literacy on CDD.

A constraint of this study and any research in health involves the problem of causality and the temporal order of variables. Causal direction between chronic disease diagnosis (CDD) and education level is difficult to establish. In particular, it cannot be determined whether chronic disease affects educational attainment, or whether education attainment influences chronic disease diagnosis. As such, in the area of health, it is essential to note that determinants of health are under study, rather than direct or singular causes. Determinants are 'entities that can be simply defined as single specified causes—that is, something making a difference to outcome' [33]. Studies in health focus on associations between an exposure variable and a health metric, and criteria of association are often based on the principles of strength, consistency, specificity, and plausibility [34] according to the Bradford Hill framework. The results of this study found a strong correlation between education and health, the findings were generally plausible, specific, and consistent with SDoH theory. As this study met the Bradford Hill criteria, the findings can be trusted.

The major strength of this study involves the ability to inform social and health policy reform for rural residents in the province of Anhui. Moreover, as this study incorporates a review of the major social determinants of health, it has the capacity to provide insights into the most crucial areas for priority for the purposes of bettering general rural health. Areas of future research include the impact of education on chronic disease diagnosis within urban China, the impact of health education on individual health behaviours (e.g., nutrition, exercise, smoking) in rural China, and the influence of education on medical care access in rural China.

CONCLUSIONS

The objective of this study was to uncover the social determinants affecting rural residents in Anhui, China. Above all, this study focused on education levels, and measured its correlation with chronic disease diagnosis. Using a framework based on the Social Disadvantage Approach (SDA) and controlling for major social determinants of health (SDoH), our results indicated: education has a strong association with the health of rural residents in Anhui; individual health behaviours such as smoking and exercise do not significantly affect rural health; and, basic demographic factors such as age, income, and sex do not have a significant correlation on rural health when controlling for major SDoH factors. The major policy recommendation developed from this study suggests the need to focus on the social determinants of health in rural China, giving specific attention to increasing rural resident educational attainment.

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