

A National and Regional Analysis of the Effects of Ageing and Education on Demand for Commercial Health Insurance in China.

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Abstract

Background: Social health insurance (SHI) in China has reached 95% coverage and facilitated progress toward Universal Health Coverage (UHC). However, elderly populations are currently under-represented, amplifying regional disparities and threatening progress toward UHC. Some households seek commercial health insurance (CHI) to complement SHI. This study is the first to investigate the effect of ageing and education on demand for CHI by region in China.

Methods: Drawing on 2011 to 2018 data for 31 out of 34 provinces from the *China Insurance Yearbook* and *Statistic Yearbook*, fixed effects models were built for national and regional multivariate regression analyses. The analysis included CHI demand as the dependent variable, education level and elderly dependency ratio as independent variables, and disposable income per capita, SHI coverage, as well as health expenditure per capita as control variables.

Results: Findings from the national analysis indicate a significant positive relationship between CHI demand and education level (17.3, $p=0.01$), elderly dependency ratio (24.1, $p<0.001$), disposable income per capita (179.5, $p=0.04$), and health expenditure per capita (0.12, $p<0.001$). However, no significant association is found between SHI coverage and CHI demand. In the regional analysis, a significant positive between education level and CHI demand is only found for the Eastern region (29.1, $p<0.05$). Similarly, a significant positive relationship between the elderly dependency ratio and CHI demand is observed for the Eastern (25.9, $p<0.05$) and Central regions (18.5, $p<0.05$). Of the three control variables investigated, disposable income per capita is not found to have an effect on CHI demand in any of the three regions.

Conclusions: Results from this study build on existing evidence and draw attention to regional disparities in China, particularly in terms of education, and the resulting effect on CHI demand. Findings support calls for more elderly-oriented public health policy and insurance reform in China.

1. Background

China has the largest population globally and is experiencing one of the fastest rates of ageing. People aged 65 or older accounted for 11.9% of the total population in 2018 and this is expected to increase to around 26.7% by 2050 [1]. Compared with high-income countries, the growing elderly population is outpacing economic growth [2]. In addition, rates of aging are heterogeneous across regions and are higher in Eastern China, where income levels are high, compared with other regions such as Western China [1].

Ageing is also resulting in an increasing disease burden more prevalent than in other countries, particularly in terms of chronic non-communicable diseases (NCDs) such as heart disease, chronic obstructive pulmonary disease and dementia [3, 4]. Consequently, overall demand for health services, long-term care and associated medical expenditures are all projected to rise [4]. This introduces challenges that may undo progress made toward Universal Health Coverage (UHC) [5], a United Nations

Sustainable Development Goal (SDG) which involves access to good quality healthcare for all those that need it, equity and financial risk protection [6, 7]. There is therefore an urgent need to reform the health, social and welfare systems in China to effectively address the health and economic burdens associated with an ageing population [8, 9].

Health insurance is one of the key existing mechanisms that could finance and improve access to health services to meet the needs of the ageing population. China's health insurance system is predominantly based on social health insurance (SHI), which includes three main schemes: Urban Employee Basic Medical Insurance (UEBMI, launched in 1998) [10], New Cooperative Medical Scheme (NCMS, launched in 2003) [11], and Urban Resident Basic Medical Insurance (URBMI, launched in 2007) [12]. SHI has enabled substantial progress toward UHC in the country [3, 13], reaching 95% coverage [1].

However, despite the high coverage of SHI, large disparities exist for the elderly and the scheme does not sufficiently cover diseases common among older populations [9]. SHI predominantly focusses on catastrophic diseases such as cancer, acute myocardial infarction and other acute conditions [13–15], which can lead to large economic shocks and financial hardship. Given that the elderly often have less disposable income and higher levels of healthcare utilization, they are more likely to experience financial hardship from medical expenses [2, 3] – not only from catastrophic diseases, but also from chronic conditions for which care is not covered by SHI. The existing SHI scheme is therefore unlikely sufficient to ensure continuing progress toward UHC in China.

Commercial health insurance (CHI) is an alternative sought by households to complement SHI and cover against health conditions which are not included in the latter [16]. Currently, the fledgling introduction of CHI in China mainly focuses on urban areas, providing additional coverage to individuals that are able to afford it. Rural areas have only recently become a priority [17]. However, while CHI presents a potential opportunity for addressing the health needs of elderly populations, the demand for CHI in China has largely been underestimated [16, 18]. To date, the growing CHI market has been inaccessible and paid insufficient attention to elderly groups with the greatest need [15]. This is due to several reasons, one of which is the lack of knowledge about CHI, especially among the elderly with lower levels of education. High SHI coverage has been achieved because of its compulsory or semi-compulsory nature. By comparison, CHI is voluntary and thus much less known among the elderly [15]. There is insufficient education and knowledge to distinguish between the role and function of CHI and SHI, and a belief that it is not necessary to have supplementary insurance due to SHI coverage [18].

1.1 Review of the literature

A number of studies have analysed the relationship between ageing, education and CHI in China. Table 1 below provides a summary of the analyses, presenting the data sources, methods used, and results of each study. Based on existing evidence, key independent variables include age [16, 19], education level [15, 20], income level [21, 22], SHI coverage [23, 24] and health expenditures [19].

Table 1

Summary of existing studies investigating the relationship between ageing, education and CHI demand.

Authors (year)	Data	Method	Geographical focus	Results: the effect on CHI	
				Ageing	Education
Jin et al. (2016)	China Health and Retirement Longitudinal Survey 2011 and 2013	Multinomial logit regression	National	Negative effect	Positive effect
Fu & Su (2016)	2011 China Household Finance Survey (CHFS)	Binary logit regression model	National	Negative effect	Positive effect in urban households but a negative effect in rural households
Liu & Wang (2012)	China Health and nutrition survey data from 2000–2006	Bivariate Probit with partial observability	National	Positive effect	Positive effect in urban households but no significant effect in rural households
Suo et al. (2015)	Panel data of 31 provinces in China from 2004–2013	Fixed effects model	National and Regional	-	Positive effect
Qi, et al. (2018)	Panel data of 31 provinces in China from 2006–2016	Gaussian mixture modelling (GMM)	National	Positive effect	Positive effect
Chen et al. (2019)	Cross-sectional data of 31 provinces in China in 2017	Multivariate linear regression	National	Positive effect	Positive effect
Ying et al. (2007)	A household survey conducted in four small cities in Sichuan and Shandong provinces in China	Contingent valuation methods	Regional	Negative effect	Positive effect
Ni and Feng (2018)	Panel data of 31 provinces in China from 2009–2015	Cross-sectional fixed effects model	National	Ageing can promote CHI demand to a certain extent	No significant effect

Ageing and CHI demand in China

Some studies report that age has a negative effect on the demand for CHI in China [15, 21, 25]. Fu and Su (2016) [25] conducted a multinomial logit regression using data from the China Health and Retirement Longitudinal Survey 2011 and 2013 and found that older populations were less likely to buy CHI. This is explained by the fact that CHI is relatively new and less well understood by the elderly with lower levels of education given the complex design of some CHI plans. Fu and Su (2016) [25] focussed on the population group aged 45 years old and above and conducted their study from the perspective of household financial burden. They use a binary logit regression model and data from the 2011 China Household Finance Survey. They find that each family adjusts their asset allocation according to their specific situation. As an important part of household financial asset allocation, the demand for CHI will also change with the financial burden experienced. Similarly to the negative relationship reported by Jin et al. (2016) [15], Fu and Su (2016) [25] found that holding other variables constant, the probability of buying CHI will reduce by 1.8% – 2.4% as household age increases by 1 year. This is again explained by the role of knowledge and education, where older residents may resist various insurance products because of a lack of understanding compared with younger individuals that are more likely to accept insurance as a risk management tool. In addition, for most types of health insurance, younger individuals are offered lower premiums, thus stimulating demand for CHI among young people while lowering demand among the elderly.

In contrast, using bivariate Probit with partial observability and China Health and Nutrition Survey data for 2000–2006, Liu and Wang (2012) [16] find that the probability of buying CHI increases with age. Moral hazard was considered and the purchasing behavior of CHI was divided into two decision-making processes: the potential demand-side decision-making for CHI and the supply-side decision-making of insurance companies. On the supply-side, insurance companies may reject individuals with higher health risks and health expenditures such as the elderly. On the demand-side the effect of adverse selection [26], where individuals with higher health risk are more willing to buy CHI [27], is combined with positive selection [28] where risk averse individuals are more likely to buy long-term care insurance but less likely to use it because of efforts to maintain good health. Another study by Qi et al. (2018) [19] also reports a positive effect of ageing on CHI demand using Gaussian mixture modelling and panel data for 31 provinces in China from 2006–2016. Their results are explained by the increased health burden associated with ageing. Lower health risks among young people means they are less likely to purchase CHI compared with the elderly that are more likely to incur medical expenses due to increased hospitalization and outpatient visits. Moreover, the growing trend of ‘empty nesters’ in China, older parents whose children have moved out of the household, also promotes the demand for CHI and long-term care insurance in particular.

Education and CHI demand in China

All except for one study by Ni and Feng (2018) [29] report that education has a significant positive effect on CHI demand. Chen et al. (2019) [30] conducted a multivariate linear regression using cross-sectional data for 31 provinces in China in 2017 and found that a higher education level is associated with higher demand for CHI. On the one hand, individual health status is affected by the surrounding environment

and social context. Education levels are generally higher in ‘mega cities’ such as Beijing and Shanghai, although pollution and work pressures may also be higher, which have adverse effects on the health status of residents – thus promoting the demand for health care and health insurance. However, findings also show that the higher the level of education, the better the understanding of how CHI functions as well as associated claims and reimbursement processes.

Suo et al. (2015) [20] built fixed effects models based on panel data from 31 provinces in China for 2004–2013. They identify that education level is one of the most important influencing factors of CHI development while considering regional differences. A higher level of education is suggested to lead to higher risk awareness, as well as improved understanding of the nature of insurance products and long-term health planning at the individual level. In addition, results from the regional regressions highlight a more pronounced effect of education level on CHI demand in the Central and Western regions than in the Eastern region. This is explained by a declining marginal effect. As the overall education level in the Eastern region has risen to a higher level, the marginal effect of education on CHI demand is smaller. In contrast, in the Western region where the education level is comparatively low, the marginal effect of education level on CHI demand is more significant.

Liu and Wang (2012) report that education level has a positive effect on CHI demand among urban households while no significant effect is observed in rural households [16]. This is because insurance companies often carry out student group insurance programs in schools in urban areas, but in rural areas, schools generally do not have similar plans due to lower purchasing power. Fu and Su (2016) [25] argue that education level has a positive effect among urban households and a negative effect in rural households, as urban households are relatively more independent and the mutual influence of household decision-making is small. The acceptance of insurance products by households depends on the education level and life experience of each household’s decision-maker. However, rural households may rely on each other’s behaviours to a larger extent due to more social interaction and close communication, while also possessing a poor understanding of insurance products.

However, to our knowledge no study has investigated ageing, education and CHI demand together while taking into account variations across regions in China. This paper aims to fill this gap by investigating the effects of ageing and education on CHI demand across regions in China between 2011 and 2018, ultimately to help inform governments and insurance companies in formulating policy reform.

2. Methods

2.1 Data

Sufficient data was available on dependent, independent and control variables, to generate a sample of 31 out of 34 provinces in China for the years 2011 to 2018. The data sources used were the *China Insurance Yearbook* and *Statistic Yearbook* for each province [31-32]. Both yearbooks are annual, nationwide and based on cross-sectional surveys. Data for all the variables selected and described below

are collected by sampling surveys, except for CHI premium which is provided by insurance companies in different provinces. Data on the elderly dependency ratio and education level were collected through a 1% population sampling survey for the year 2015 and the national population change survey which also accounts for about 1 % of the total population for other years. Data on disposable income and health expenditure were collected using stratified, multi-stage sampling surveys, from a sample that is rotated periodically to ensure representativeness.

The data from the yearbooks are collected based on resident population instead of registered population, avoiding bias associated with population mobility. In addition, to minimise potential bias, only data for urban populations were considered in this study because CHI in rural areas developed relatively late and has grown at a slower pace. Current CHI market data are therefore predominantly available for urban areas. In turn, to reduce the influence of population sizes in different provinces, all variables were used in per capita or percentage form.

2.2 Selected variables, justification and expect effect on CHI demand

Average CHI premium per capita for each province was used as the dependent variable to quantify CHI demand. CHI premium is considered a predominant measure of CHI demand and has been previously used in a number of similar studies [21, 29]. The premium refers to the amount that people pay to maintain CHI cover.

Education and ageing were the two independent variables used (Table 2). Ageing at the provincial level was measured using the elderly dependency ratio, an international demographic measure of ageing represented by the ratio between the number of the elderly dependents (aged 65 years old and above) and the total labor force (aged 15 to 64 years old) in a population [33]. As the overall age of a country or region increases, the ratio can reflect the increasing health and social needs associated with an ageing population. It is calculated as follows:

$$\text{elderly dependency ratio} = \frac{\text{number of people aged 65 or over}}{\text{number of people aged 15 - 64}}$$

The percentage of the total population that received higher education was used to represent the overall education level of each province. Higher education was defined as possessing a college degree or above. This is a widely used measure of the overall education level of a region in China and is consistent with previous studies [29,30].

Table 2: Justification and expected effect of independent and control variables on CHI demand

Category	Variable name	Description	Expected effect	Justification
Independent variables				
Ageing	edr	Elderly dependency ratio (%)	+	Elderly groups are likely to demand health care services more frequently, which could result in increased demand for CHI.
Education level	edu	Ratio of people with higher education level (%)	+	A higher level of education may be associated with a better awareness and understanding of risk, the function of health insurance products, and be associated with higher disposable income. Together, these may result in higher demand for CHI.
Control variables				
Purchasing power	dinc	Disposable income per capita (yuan).	+	Higher disposable income provides households with more flexibility on how much they allocate to health and increases the likelihood that CHI premiums are affordable – both of which can result in increased demand for CHI.
SHI coverage	shi	Ratio of number of SHI participants to total population (%)	+ or -	SHI coverage may have a promoting or substituting effect on demand for CHI.
Health Expenditure	hexp	Health expenditure per capita (yuan)	+ or -	Higher health expenditure indicates higher willingness to spend on health, which may result in higher demand for CHI. However, increased health expenditure per capita may also indicate a higher disease burden that can dis-incentivise CHI companies from offering coverage, which would result in a negative relationship being observed with CHI demand.

Disposable income, also known as disposable personal income (DPI), was used as one of three control variables (Table 2). It is considered a key economic indicator and influencing factor of CHI demand, representing the amount of money available for households to spend and save after accounting for income taxes. In other words, the income that households are free to use. Many studies have identified the positive effect of disposable income on CHI demand in China [15, 21-22]. When disposable income is low, the limited income available to households is sufficient only to meet necessary living expenses [21, 22]. Currently, CHI mainly targets higher socioeconomic population groups in China [13]. Premiums are therefore usually high and few people are able to afford them. As disposable income per capita increases, for example following economic growth, more households will retain a surplus of income after the consumption of necessities. This enables households to adjust their asset allocation and spend more on health, which could result in increased demand for CHI.

The number of SHI participants expressed as a percentage of the total population is widely used in representing SHI coverage and was used as a control variable [15]. However, there is a lack of consensus on whether SHI participation positively or negatively effects CHI demand. Potential effects can be grouped into two categories: promoting and substituting effects. In the latter, SHI participants will be less likely to purchase CHI, demonstrating a possible substituting effect between SHI and CHI [15]. For example, Liu, Wang and Bian (2010) [34] report a net substituting effect of SHI on CHI, suggesting the substituting effect outweighs the promoting effect. Given that some of China's health insurance reforms are nascent, CHI companies have not sufficiently adopted a supplemental role in the health system and continue to promote SHI substitutes. Considering the compulsory nature and the advantage of fee remission of SHI, the inevitable result is that competing CHI products are crowded out. In contrast, Li (2011) [22], Wang (2011) [23] and Liu and Liu (2014) [24] find that SHI can boost CHI demand. Wang (2011) [23] argues that instead of crowding out, SHI has driven the development of CHI and the competition has greatly contributed to CHI. SHI improves household health, wealth, and increases individual awareness of health insurance. In addition, the degree of protection provided by SHI is limited, which provides opportunities for CHI development – especially in disability care, other debilitating diseases, an income loss compensation. CHI companies can also cooperate with SHI institutions to develop various health insurance products to meet the needs of different residents through information sharing mechanisms.

The third control variable included was health expenditure per capita. Similarly to SHI participation, there are differing views on whether health expenditure per person has a positive or negative effect on CHI demand. On the one hand, health expenditure per capita can be a proxy for people's willingness to spend on health. The more individuals spend on health, the more likely they are to purchase CHI products [17]. On the other hand, high per capita health expenditure may be due to a higher disease burden which translates into greater financial risk for CHI companies. In this case, while individual may be more willing to participate in CHI plans, insurance companies may reject them to avoid potential high-risk claims [16]. While this is not a demand-side problem, if people with high health expenditure are rejected by insurance companies the data may result in a negative association being observed between health expenditure and CHI demand.

2.3. Econometric model specification and set-up

A multivariate regression model was selected, which has been widely used in similar studies of insurance demand. The log form of disposable income per capita was taken to study the effect of the rate of change of disposable income per capita on CHI premium per capita.

The basic model was specified as follows:

$$chi = \beta_0 + \beta_1 edu + \beta_2 edr + \beta_3 \ln(dinc) + \beta_4 shi + \beta_5 hexp + u$$

where signs show the direction of relationships, and the significance of β_1 and β_2 . β_1 and β_2 respectively measure the effect of education levels and of ageing on CHI demand, which is expected to be significantly positive in both cases.

As the time period considered in the analysis is relatively short (eight years), the unit root test was not conducted due to reduced validity when timeframes shorter than 20 years are used [20,35]. The influence of heteroscedasticity was mitigated by the use of robust standard error [36]. In addition, it was considered that the overall education level of each province could be a potential endogenous variable. This is because parental education levels have a positive effect on children’s education attainment and motivation [37,38]. Individuals’ education level may therefore be influenced by their parents’ education, which is difficult to quantify at the provincial level due to population mobility. Based on the premise that parents’ education levels are unlikely to change much over the time, a fixed effects model, which can control for each province’s unobserved and time-invariant characteristics that are potentially correlated with the included dependent variables, was considered to overcome potential sources of endogeneity [39]. Pooled Ordinary Least Squares (OLS), fixed effects models and random effects models were tested. The selection of a fixed effects model as the main model was decided based on the F test and Hausman test results shown in Table 3, which suggested that a fixed effects model is more efficient than pooled OLS and random effects model.

Table 3: Results of the F Test and Hausman Test

Model	Type of Test	p-value	Selection of Model
Fixed effects model & Pooled OLS	F test	0.000	Fixed effects model
Random effects model & Fixed effects model	Hausman test	0.001	Fixed effects model

Furthermore, separate regressions using regional samples were conducted to account for key differences between regions. Regional disparities in terms of public resources, economic, education and health resources are substantial in China, which can influence CHI demand. For instance, households in regions with more developed economies may earn higher incomes and possess more savings, thus making it more likely that they will spend more on health compared with less economically developed areas [16]. In turn, regions with better education resources may have a more favourable environment overall for the development of CHI. Residents in such regions may have a better understanding of CHI and awareness of insurance as a means of protection against risk, which can lead to an increase in the demand for CHI [40]. With regards to health resources, regions with limited health resources may have poorer health infrastructure and medical facilities that hinder the provision of some healthcare services, thus constraining demand for CHI [35].

3. Results

3.1 Descriptive statistics

The final sample of 31 provinces and eight years (2011–2018) generated a total of 248 observations. National summary statistics for each dependent, independent and control variable are presented in Table 4, while the average values of variables are presented for each of the three regions in Table 5. Substantial differences are observed between the Eastern, Central and Western regions. The Central and Western regions are largely comparable with one another across all variables. In both regions, average CHI premium, education levels, disposable income, SHI participation and health expenditures per capita are lower than the national average. By comparison, the average values for all variables in the Eastern region are higher than the national average, and the average CHI premium (280.4) is more than double that of the Central and Western regions (129.5 and 129.7 respectively). However, it is important to note that the average elderly dependency ratio is similar in the Eastern (13.8) and Central (13.8) regions, and greater than in the Western region (12.8).

Table 4
Summary statistics of analysis variables, national (2011–2018)

Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum
chi	248	184.5	211.78	13.84	1487.24
edr	248	13.46	3.16	6.71	22.69
edu	248	12.4	6.87	2.14	45.95
dinc	248	22750.17	9125.16	9746.81	64182.64
shi	248	54.71	29.08	14.41	100.00
hexp	248	1425.76	542.18	424.1	3475.81

Table 5
Mean of analysis variables, regional (2011–2018)

Variable (mean)	Eastern	Central	Western
chi	284.2	129.54	129.67
edr	13.8	13.78	12.77
edu	16.65	10.25	9.88
dinc	30681.21	19586.29	17189.9
shi	64.53	47.3	49.96
hexp	1590.58	1356.49	1313.74

3.2. National regression

Results from the national fixed effects model are presented in Table 6. The findings indicate a significant positive relationship between CHI premium or demand and education level (17.3, $p = 0.01$), elderly dependency ratio (24.1, $p < 0.001$), the natural logarithm of disposable income per capita (179.5, $p = 0.04$) and health expenditure per capita (0.12, $p < 0.001$). However, no significant relationship is observed between SHI coverage and CHI demand.

Table 6
Fixed effects model regression results, national

Variable	Coefficient	Std. Error	t statistic	p-value	95% Conf. Interval	
edu	17.25763	6.268167	2.75	0.010	4.45633	30.05894
edr	24.14004	4.238383	5.70	0.000	15.48411	32.79597
ln(dinc)	179.4894	56.74849	3.16	0.040	63.59354	295.3853
hexp	0.1170826	0.0227496	5.15	0.000	0.070622	0.1635435
shi	-0.4205171	0.4542482	-0.93	0.362	-1.34822	0.5071815
R-squared	0.7015					
Number of obs	248					

As the ratio between the number of people with higher education and the total population increases so does CHI premium per capita, which is as expected (Table 2). For each percentage point increase in the education level ratio, CHI premium per capita increases by 17.3 Yuan. Similarly, as expected, CHI premium per capita increases as the elderly dependency ratio increases. For each percentage point increase in the elderly dependency ratio, CHI premium per capita increases by 24.1 Yuan. In terms of control variables, as disposable income per capita increases by 1%, CHI premium per capita increases by 179.5 Yuan, and for each 1 Yuan increase in health expenditure per capita the CHI premium per capita increases by 0.12 Yuan.

3.3. Regional Regression

Overall, the regional regression results presented in Table 7 are largely consistent with findings using the national sample (Table 6), although there are differences in the statistical significance and magnitude of coefficients between regions. Education level only has a significant positive effect on CHI demand in the Eastern region (29.1, $p < 0.05$), with no significant effect in the Central and Western regions. A significant positive relationship is also found between the elderly dependency ratio and CHI demand in the Eastern and Central regions (25.9, $p < 0.05$ and 18.5, $p < 0.05$ respectively), but not for the Western region. With regards to control variables, the effect of disposable income per capita is not significant in any of the three regions. By comparison, while health expenditure per capita does not have a significant effect on CHI demand in the Eastern region, a significant positive effect is observed for the Central and Western regions (0.11, $p < 0.001$ and 0.13, $p < 0.05$ respectively). Unlike national results where SHI participation is

not found to have any effect, a significant positive effect is observed for the Central region (0.84, $p < 0.05$) but not for the Eastern or Western regions.

Table 7
Fixed effects model regression results, regional

Variable	Eastern	Central	Western
edu	29.13303* (3.50)	4.346216 (0.97)	5.743751 (1.79)
edr	25.88773* (3.60)	18.52523* (4.16)	20.97697 (1.89)
ln(dinc)	361.37 (-0.91)	63.39149 (1.41)	84.65527 (2.16)
hexp	0.071042 (2.13)	0.1125479*** (4.13)	0.130161* (4.13)
shi	-0.915067 (-1.10)	0.8352056* (4.46)	-0.3317401 (-1)
R-squared	0.7266	0.8256	0.5359
F-statistic	20.73	167.43	68.42
Number of obs	88	80	80
Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Values between the brackets below the regression coefficients represent the t-statistic.			

4. Discussion

This paper presents the first analysis in which the effects of both education and ageing on CHI demand in China are investigated across years while taking into account regional differences. Overall, results from the analysis support existing evidence which suggests that the effects of education and ageing on CHI demand are positive and statistically significant. The results also build on previous evidence, highlighting how regional disparities result in varying demand for CHI. These findings have wider implications for policy makers involved in health and health financing reform, insurance companies and other researchers. This section will expand on and interpret the results, as well as discuss key limitations of the study.

Findings from the national and regional analyses demonstrate that an overall improvement in education levels can increase CHI demand in China. Based on the literature, the main reasons for this are likely that higher education levels generally contribute to a better understanding of the function and need for CHI or

insurance more widely, a better awareness of health risk mitigation and an improved ability to understand insurance claims processes and insurance products [30]. Individuals with higher education levels are therefore more likely to purchase CHI, and may also be better able to afford CHI premiums. However, the increase in the education level of a province is mainly driven by the improved education of young people [41]. In turn, younger populations with higher education level are more likely to purchase CHI for themselves as well as for their older relatives or dependents [41].

Taking into account regional differences, the positive effect of education level on CHI demand is significant in the Eastern region but not significant in the Central and Western regions. A possible reason for this is that there are more insurance companies in Eastern China, compared with other regions, which provide a number of CHI products to meet the various needs of consumers with different characteristics [40]. Individuals living in the Eastern China that want to buy CHI can therefore find the insurance products and services they need more readily than other regions. In contrast, CHI is less developed in Central and Western regions where people are less likely to find CHI products and services suited to their needs and will instead resort to other financial protection mechanisms [22]. Education level may therefore have a larger effect on CHI demand in Eastern China than other regions where there is less formal or service sector employment and less CHI products are available. A second reason that a significant positive relationship was only found between education and CHI demand in the Eastern region could be that there is more awareness of CHI in the Eastern region [42]. Individuals that are better aware of CHI and understand CHI products as well, as how they can mitigate health risks, due to higher education levels are more likely to choose CHI as a risk protection tool [30]. It is also important to note that the likely reason why a significant effect is observed for education levels in the national sample, despite no significant effect in Central and Western regions, is the growth of CHI markets in Eastern China. Eastern China, which is more developed than the national average across all of the variables considered in this analysis, leads to the development and growth of the CHI markets nationally [14, 43] – though this currently may not be sufficiently pronounced to result in a significant effect when regions are considered separately.

The national sample results on the effect of education on CHI demand presented in this paper are consistent with the wider literature [20, 30]. However, the regional sample results differ from a study carried out by Suo et al. (2015) [20]. The latter report that the effect of education on CHI demand is more significant in the Central and Western regions than in Eastern China. This divergence of results may be due to the different samples used. Suo et al. (2015) [20] included both urban and rural populations in their sample, while the analyses in this paper focussed only on urban populations to minimise potential bias in the results given that current CHI market data are predominantly from urban areas. Central and Western regions are comprised of a higher rural population than Eastern China and overall education levels in rural areas are substantially lower than in urban areas [1, 44]. By including rural populations, the average education level therefore decreases, and the difference of education levels between the Central and Western regions compared with Eastern China would be larger. Subsequently, the marginal effect of education levels on CHI demand in Central and Western China would be amplified, which may result in a higher significance level for the effect of education than in the Eastern China.

In line with previous studies [19, 30] the analyses presented in this paper find that ageing has a significant positive effect on CHI demand. This can be explained by the fact that as individuals age, the probability of experiencing chronic disease increases as well as the likelihood of incurring associated medical expenses due to hospitalization and outpatient visits [4, 40]. Given that CHI can improve access to healthcare services, and in some cases financial risk protection from medical expenses, the demand for CHI increases accordingly with age [4, 40]. In addition, the increasing trend of 'empty nesters' in China, where children move out of parental households, also boosts CHI demand. This is because CHI can reduce the burden for carers associated with supporting dependents. As the number of empty nesters increases, CHI demand is therefore also expected to grow [19].

This paper presents the first analysis of CHI demand that considers the differences in ageing across regions in China. Placing these findings in the literature is therefore challenging. The regional regression results show that the effect of ageing on CHI demand is significant in the Eastern and Central regions but not in Western China. The reason for this could be due to the difference in the elderly dependency ratio between regions. As shown in the summary statistics in Table 4, the average elderly dependency ratio in Eastern and Central China is 13.8 which is higher than in the Western region (12.8). Individuals in the Eastern and Central regions are therefore more likely to experience chronic disease and associated expenses, and have developed a better understanding of the risks associated with ageing as well as how the operation and functions of CHI can mitigate these risks [20]. As the elderly dependency ratio continues to rise, people living in Eastern and Central China are therefore more likely to respond to the changes by purchasing CHI products.

In terms of control variables, the significant positive effect of health expenditure per capita on CHI demand in the national sample likely reflects that the willingness to pay and prioritise health over other spending from the demand-side [17] is greater than the effect of risk aversion among insurance companies from the supply side [16]. Findings are similar for the Central and Western regions, but no significant effect is observed for Eastern China. This may be because the average CHI premium is comparatively higher in Eastern China [43, 45], which may deter consumers that experience a substantial disease burden from purchasing CHI.

Disposable income per capita also has a significant positive effect on CHI demand in the national sample, with the largest coefficient, which suggests that increases in overall household income drive demand for CHI [20]. However, disposable income per capita is not found to have a significant effect on CHI demand in any of the regions. This may be because, first, income levels in the Eastern and Central regions are already high, and an increase in disposable income per capita may therefore not translate into increased CHI demand as income is allocated for other consumption [20]. Second, because a previous study has reported that the effect of income on CHI demand is greater in rural than in urban areas [17]. Given that this study is based on urban populations the effect of income may be diminished, particularly in the Western region that has the lowest income and a high rural population. Overall, these results suggest that disparities in income levels, and not only in education levels, may be driving inequitable demand for CHI in China.

Unlike health expenditure and disposable income per capita, SHI participation is not found to have a significant effect on CHI demand in the national sample regression, which is likely because the promoting and substituting effects offset each other [15, 22]. By comparison, regional regression results show that SHI participation has a significantly positive effect on CHI demand in the Central region. This may be because the degree of ageing in the Central region is similar to the Eastern region, while CHI demand in Central China lags behind levels of demand in the Eastern region. Considering that an increase in SHI participation can spread knowledge of health insurance and also improve awareness of the availability of CHI, when coverage of SHI increases, understanding of CHI may also improve resulting in increased demand [15, 40].

Overall, however, some key limitations should be considered when interpreting the results presented. First, the concept of moral hazard, which is a key factor when studying health insurance, is considered only at the theoretical level and is not explicitly included in the empirical analysis. The implication of this is that the effect of health expenditure on CHI demand observed from the data may be underestimated. If people living in provinces with high health expenditures per capita due to higher health risks and disease burden are rejected by insurance companies, the results from the data may misrepresent the latter as lower demand for CHI. Second, although this paper focuses only on urban populations to minimise possible bias, this reduces the sample size which in turn could affect the power and generalisability of the analysis and results. A more representative sample should be used in future studies as additional CHI market data becomes available. Third, attitudes to risk, or risk preferences, have a significant effect on demand for CHI and insurance in general [16] but these are not considered in this analysis.

Nonetheless, the findings from this paper can help inform health policy and insurance reform, with implications for government and insurance companies. This study suggests that while CHI demand is increasing alongside ageing to supplement existing SHI coverage, the government must consider the education level of different regions to redress regional disparities and prevent further inequity as CHI coverage expands. There is a need to implement elderly focussed health insurance reform, for example through further expansion and consolidation of the existing SHI packages of services [46, 47] so that SHI better caters for an ageing population that currently has to resort to CHI. Alongside SHI reform, the significant effect of disposable income on CHI demand found at a national level calls for the government and insurance companies to work together to lower CHI premiums and make CHI available and affordable for households in regions where coverage is low. However, further research and policy discussions are needed to explore cost-effective and sustainable solutions to motivate CHI companies to extend complementary coverage among the elderly [48]. Either way, these analyses support calls for education interventions for the elderly within a policy framework such as the World Health Organisation's 'healthy ageing'. The latter recommends making basic education, including health education and health literacy, available throughout the life-course [49] – which can also help progress toward life-long education that forms a part of the SDG on education [7]. Such basic education could cover the health insurance system and different mechanisms available to protect against health risks, which may benefit the least educated most. The government could, for example, emulate aspects of Japan's policy, which

has with some success used life-long education as a tool to alleviate both the social and household burdens associated with ageing [50].

5. Conclusions

This paper used 2011 to 2018 data from the *China Insurance Yearbook* and *Statistic Yearbook* to conduct the first national and regional analyses investigating the effect of both education and ageing on the demand for commercial health insurance (CHI) in China. Results from the national and regional analyses demonstrate that both education and ageing have a significant positive effect on CHI demand, which is consistent with wider literature. However, findings from this paper draw attention to the regional disparities in education and its effect on CHI demand after controlling for health expenditure per capita, disposable income per capita and social health insurance coverage. The results support calls for more elderly-oriented public health policy and insurance reform in China to redress inequities as CHI coverage expands.

Abbreviations

CHI: Commercial health insurance

NCD: Non-communicable disease

NCMS: New cooperative medical scheme

OLS: Ordinary least squares

SDG: Sustainable development goal

SHI: Social health insurance

UEBMI: Urban employee basic medical insurance

UHC: Universal health coverage

Declarations

Ethics approval and consent to participate

Not applicable. Ethics approval was not required for this secondary data analysis.

Consent for publication

Not applicable.

Availability of data and material

The datasets analysed during the current study are available in: (1) National data: China Statistical Yearbook from the National Bureau of Statistics of China (<http://www.stats.gov.cn/tjsj/ndsj/2019/indexeh.htm>), (2) Provincial data: Annual data by province from the National Bureau of Statistics of China (<https://data.stats.gov.cn/english/easyquery.htm?cn=E0103>), and (3) CHI premium: Provincial Statistical Yearbooks from the National Bureau of Statistics of China (<http://nj.tjj.beijing.gov.cn/nj/main/2019-tjnj/zk/indexch.htm>).

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Conceptualization: XC and GAJ. Methodology: XC, GAJ. Formal analysis: XC. Writing—original draft preparation: XC and GAJ. Writing—review and editing: XC and GAJ. Supervision: GAJ. All authors have read and approved the final version of the manuscript.

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