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Individual and province inequalities in health among older people in China: Evidence and policy implications

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ABSTRACT

This paper uses multi-level modelling to analyse data from the nationally-representative Chinese Health and Retirement Longitudinal Study (CHARLS) in order to investigate the characteristics associated with poor health among older people, including individual and household characteristics as well as the characteristics of the provinces in which the older person lives (contextual effects). The results show that older Chinese women, rural residents, those with an education level lower than high school, without individual income sources, who are ex-smokers, and those from poor economic status households are more likely to report disability and poor self-rated health. Differentials in the health outcomes remain substantial between provinces even after controlling for a number of individual and household characteristics.

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1. Introduction

Improvements in life expectancy in China over the past 50 years combined with marked declines in fertility have resulted in rapid population ageing, reflected in an increase in the absolute and relative number of older people in the population and resulting in a challenge for the design of adequate social policies in health and social care (Cai et al., 2012; Woo et al., 2002). Moreover, these demographic changes have taken place alongside significant social and economic developments which are further reshaping China's population. Before 1976, which marked the death of Chairman Mao, "economics gave way to politics" and the state had a strong mandate to run the economy and organise production for the benefit of society (Chen, 2002: 571). During this time, and typically for a centrally-planned economy, Chinese citizens were promised guaranteed employment (often referred to in popular culture as the "iron rice bowl"), egalitarian distribution of resources and outputs, and cradle-to-grave welfare coverage (Li, 2012). The transition from a socialist to a market economy, which accelerated from the late 1970s onwards, created opportunities for the development of social welfare services and the solution of fundamental social problems; however inequalities between occupational groups and regions emerged as "new" social risks facing the government. Recent market reforms, decentralisation and economic globalisation have impacted different social groups, regions and industries unevenly (Zhu, 2013) with the resultant rural–urban migration rapidly altering the demographic composition of different regions in China. Increasing rural–urban migration has served to further emphasise the dual policy challenge of health and social provision for low-paid migrants in cities, and for older people "left behind" in rural areas often caring for grandchildren (Biao, 2006). Against the background of population ageing in one of the world's most populous nations, understanding the determinants which contribute to poor health outcomes among older people in China is the key to understanding future patterns of health, as well as their relationship to economic development in this region.

Existing research has highlighted that both individual and province-level factors contribute to inequalities in health among older people in China (e.g., Feng et al., 2012; Yin and Lu, 2007), with province level effects reflecting regional diversity in the extent of welfare provision and the demographic and socio-economic composition of the population. This paper investigates the characteristics associated with the risk of poor health among older people, including individual and household characteristics,

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as well as the characteristics of the provinces in which the older person lives. By adopting a multilevel approach and using nationally representative data, this paper contributes to our better understanding of the availability and appropriateness of health services for older people and policy changes necessary to protect the wellbeing of older people in the future.

1.1. Effect of individual and household characteristics on health status

A large body of existing literature from Europe and North America has evidenced the association between a range of demographic and socio-economic characteristics and an individual's health status; however such research evidence is still scarce in the Chinese context. Marmot and Bell (2012) in the British context revisited the strong link between socio-economic status and poor health status, while evidence from other countries of the developed world is compatible (Berkman and Epstein, 2008; Choi and Marks, 2013). Although the direction of the causal mechanism between poor socio-economic status and poor health status is the subject of on-going research and debate the evidence of the association between the two concepts, regardless of the way they are operationalised in empirical research (e.g. socio-economic status as individual income, and health status as self-reported health), is not disputed. The relatively scarce evidence in the Chinese context presents a more complex picture as a result of historical and socio-political factors which have shaped demographic patterns, the provision of healthcare services and access to such services alike. For instance Liang et al. (2000) examined this relationship in Wuhan city and found a socio-economic gradient in the report of poor health status, with individuals in lower socio-economic classes being more likely to report poor health than those in higher classes. More recently, however, Zimmer and Kwong (2004) found that more "traditional" socio-economic indicators such as income and education were relatively weak predictors of poor health status, while savings and pension eligibility indicated a stronger effect. In longitudinal studies, Gu and Xu (2007) found that among the oldest old (above 80 years) individuals who were literate and economically independent were less likely to develop disabilities than older individuals who were illiterate and economically dependent. By contrast, Li et al. (2009) did not find any association between educational attainment and an individual's report of self-reported health (SRH), mortality and difficulty with performing Activities of Daily Living (ADLs). Other research by Lowry and Xie (2009) has noted that although socio-economic status is positively and strongly associated with health status for individuals at younger ages in China; such an association is weaker in the latter part of the life course. Finally, Feng et al. (2013) concluded that the effect of socio-economic factors on health does indeed appear to be small when other variables (e.g. care sources and medical sources for older people) are taken into account. Crucially, this body of work suggests a couple of points: firstly, that the nature of the association between health status and socio-economic status largely depends on the indicators used in the analysis (e.g. poor self-reported health rather than the report of disability); and secondly that the nature of such an association may take a particular form for individuals in the latter part of the life course, where socio-economic status is less likely to be characterised by one's link to the labour market.

Previous research has also found an association between individuals' health status and the characteristics of their household, with older people in higher economic-status households being more likely to report good health than those in lower-status households. Feng et al. (2013) found that among older people whose family income was above the median the odds of reporting good self-rated health were 1.6 times higher than among those whose family income was in the lowest quartile of the distribution, possibly as a result of a greater ability to afford better health care and medical consumption. For older people in poverty the state provides some social protection such as the "Five Guarantees Household Scheme" for older people in rural areas with no children, income, and property (Zhu, 2013), and "Dibao" for those with household incomes lower than the standard of Minimum Livelihood of the city (village)[1]. However, older people who receive financial assistance from the state are the least likely to report good self-rated health due to the inadequacy and under-development of the state financial provision (Feng et al., 2013). Such findings point to the need to better understand the relationship between household characteristics and individuals' health, particularly among older individuals who are considered to be in the lowest socio-economic strata of the Chinese society.

1.2. Effect of province characteristics on individuals' health status

Contextual effects on individuals' health status have also been evidenced by previous research (e.g. deprivation and mortality (Jones et al., 2000), income inequality and self-rated health (Feng et al., 2012)). The features of the areas where people live (such as social environment, healthcare access, and social cohesion) have been shown to make a difference to health outcomes, for example by linking strong social cohesion to better individual health (Jones and Moon, 1993; Diez Roux and Mair, 2010; Gu et al., 2009). Due to the history of socio-economic transition witnessed in the Chinese society China is highly spatially differentiated in terms of its economic development and social security, resulting in variability in the quality and availability of health care between provinces. In macro-level studies, inequalities in terms of the availability of health care services, income and social status at the province level have been found to be associated with health inequalities between provinces in China (Fang et al., 2010; Li and Wei, 2010). By contrast micro-level studies have found no evidence of a significant improvement in the health of poorer older people living in provinces with better health facilities (Feng et al., 2013) while Yin and Lu (2007) found that the prevalence of medical conditions at the province level had an impact on elderly persons' report of disability, defined as difficulty with specific Activities of Daily Living (ADLs). Such disparities in the literature call for a close examination of the relationship between individual, household and province-level factors and the health status of older individuals in China.

This paper aims to contribute to the literature by investigating health outcomes for older people in China and examining the extent to which such outcomes are influenced by both individual and household, and province-level characteristics. The paper addresses the following research question: *how does the health of older people vary according to demographic characteristics, socio-economic indicators, household/family factors and provincial level factors*? The next section discusses the data and methods to be used. The results of a series of multivariate regression models are then presented followed by a discussion of the results, drawing out the implications for policy makers.

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[1] The Five Guarantees refer to food, clothes, housing, medical care, and burial after death. The Dibao is a minimum living standard guarantee (Wang, 2007). The benefit varies between urban and rural areas as well as different provinces. It was approximately 330 Chinese Yuan per month (about US $ 47) in urban areas and 172 Chinese Yuan (about US $ 24) in rural areas in 2013. In Shanghai (one of the most developed provinces), the Dibao is 570 (US $ 81) and 430 (US $ 61) respectively for urban and rural residents (People.com, 2013; The Central People's Government of the People's Republic of China, 2012).

Table 1
Variables reflecting the province characteristics.

Indicator	Meaning
Urban	Percentage of urban population (based on household register) (%)
GDPpc	GDP per capita (1000 Yuan)
Migrants	Percentage of migrants[a] (%)
Income	Mean income (1000 Yuan)
VATpc	Value added tax per capita (1000 Yuan)
GovExpen	Government expenditure per capita (1000 Yuan)
Fixedassets	Fixed-asset investment per capita (1000 Yuan)
Stateown	Share of state-owned enterprises in fixed-asset investment (%)
ForInvest	Share of foreign direct investment in fixed-asset investment (%)
StateCom	Percentage of state owned employees in the total of employees (%)
PrivateCom	Percentage of private owned employees in the total of employees (%)
FandHCom	Percentage of foreign and overseas Chinese employees in the total of employees (%)
SocSec	Percentage of expenditure for social safety net and employment incentives in total revenue of province (%)
MedIns	Percentage of expenditure for medical and health care in total revenue of province (%)
Hosp	Number of health care institutions per 10,000 population
Doctor	Number of medical technical personal in health care institutions per 1000 population
Bed	Number of beds in health care institutions per 1000 population
UrbEng	Urban Engel's coefficient[b] (%)
RurEng	Rural Engel's coefficient (%)

[a] Migrants refer to individuals who have lived in a place which is different from their permanent household registration for more than 6 months.

[b] Engel's coefficient is a measure of the percentage of total food expenditure in the total of personal income. It is treated as a reflection of the living standard of such area. This value is between 0 and 1, and the closer to the latter, the poorer the living standard.

2. Data and methods

2.1. Data

The analysis in this paper combines data from two different sources to explore the impact of individual, household and province level characteristics on the health of older people. The province information comes from the Chinese Statistics Yearbook in 2012. In order to understand the effect of province-level differentials 19 variables were selected to reflect the contextual effects of each province, including urbanisation, economic development, degree of marketisation, spending on health care, health facilities and quality of living (Table 1). Based on existing research we would expect indicators of higher economic development to be associated with urbanisation and marketisation, and for higher health expenditure to be associated with better healthcare facilities and ultimately the report of better health among older people. However, differences in the demographic composition between provinces and the individual and household characteristics of older people may mitigate such associations. Table 1 presents the description of the 19 variables for the province characteristics.

The individual and household level data are from wave 1 of the national baseline of the China Health and Retirement Longitudinal Study (CHARLS) conducted in 2011–2012. The CHARLS covers 450 villages/urban communities in 150 counties/districts located in 28 provinces across the country[2] and is based on a randomly selected sample of people aged 45 and over. The data employed in this study includes 10,717 interviewees aged 50 and above with complete responses, living in 7,114 households. Age 50 is taken as the cut-off point in order to be comparable to similar studies using data from the English Longitudinal Study of Ageing (ELSA) and the international SHARE datasets whose samples are made up of individuals aged 50+ rather than 45+. The dataset has a natural hierarchical structure with individuals nested within household/within provinces[3].

Drawing on existing studies, two health outcomes are considered: one's difficulty with performing ADLs and self-reported health (SRH). Such an approach allows us to gauge older persons' perceptions of their health both generally, as well as specifically in relation to performing daily activities. The indicator of difficulty with ADLs includes the six basic activities of dressing, bathing, eating, getting into/out of bed, using the toilet, and controlling urination and defecation. The response categories in these indicators were: no difficulty at all; has difficulty but can still do it; has difficulty and need help; and cannot do it even with help. Approximately 82% of the respondents reported no difficulty at all with *any* of the six ADLs. Therefore a binary variable was constructed after counting the number of ADLs a respondent reported difficulty with, with zero representing no difficulty at all for any of the six ADLs, and one representing any difficulty with any of the six ADLs. Self-reported health is a subjective measure of one's health, and is reported on the following scale: very good, good, fair, poor, or very poor. For comparability purposes, a derived variable was constructed with "positive" categories in the first category (very good or good), fair in the second category, and "negative" categories in the third (poor or very poor). The distribution for these two health indicators across the sample is shown in Table 2.

The key predictor variables are the economic status of older people and the province-level variables. These include two variables: self-rated household living standards, and whether the household receives Dibao, as reflecting the economic status of a household; and individual income sources as reflecting the economically dependent/independent status of individuals. It is also important to control for other factors to some extent so that the effects are not diluted. Therefore, individual demographic, socio-economic, social security and health behaviour characteristics (age, gender, marital status, urban/rural residence, education, has/has not medical insurance and smoking status) are included in the models. The distribution of individual variables across the sample is shown in Table 2.

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[2] Mainland China includes a total of 31 provinces, however the provinces of Tibet, Ningxia and Hainan are not included in this survey.

[3] In preliminary analysis, the variation in health at the household level is negligible when compared to that at the province level (about 0.8% of the province level variance). In addition, the estimated effects of household factors are virtually

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(footnote continued)

identical to those estimated in the model without the household level. Therefore, we decided to use a two-level hierarchal structure in this study rather than including household as a separate third level.

Table 2
Descriptive univariate information of individual variables[b].

Response	
Difficulty with ADLs (%)	
No difficulty	82.1
Reports difficulty	17.9
Self-reported health (%)	
Positive	22.5
Fair	47.1
Negative	30.4
Predictors	
Individual characteristics, n = 10,717	
Age	Ranging between 50 and 96, mean = 62 (Year)
Gender (%)	
Male	50
Female	50
Marital status (%)	
Married	86.1
Other (separated, divorced and never married)	2.2
Widowed	11.7
Residence (%)	
Urban	40.6
Rural	59.4
Highest educational qualification (%)	
High school and above	12
Elementary and middle	39.5
Below primary	19.5
Illiterate	29
Income sources (%)	
Wage	10.9
Wage and pension	2.1
Wage and others[a]	0.6
Pension	22.6
Others[a]	4.6
No income sources	59.3
Medical insurance (%)	
Yes	94
No	6
Smoking status (%)	
Has never smoked	58
Current smoker	31.8
Ex-smoker	10.2
Household characteristics, n = 10,717	
Self-rated standard of family living (%)	
Positive	3.2
Fair	53.6
Negative	43.2
Receipt of Dibao by the household (%)	
No	89.4
Yes	10.6

[a] Others includes: unemployment compensation, pension subsidy, Workers' compensation from Industrial Accident Compensation Insurance including wage-replacement benefits, disability benefits, survivors' benefits, elderly family planning subsidies, medical aid, other government subsidies, social assistance, other income sources (including alimony or child support).

[b] The first category is the base reference in the models.

2.2. Methods

Nineteen variables are chosen to reflect the province characteristics. Some of these are highly correlated (e.g. the correlation between the percentage of urban population in a province and GDP per capita is 0.935), indicating significant multi-collinearity in the model. Thus, in order to capture overall province characteristics, factor analysis was employed to generate a summary factor score for each province (Johnston, 1978). The results of this factor analysis are discussed in Section 3.

Since the CHARLS dataset has a natural hierarchal structure with individuals nested within provinces and the aim of this paper is to analyse the effects of individual and household characteristics and province characteristics on the health indicators simultaneously, multilevel logistic regression models are appropriate (Hox, 2002). In terms of the different numbers of categories in the health indicators, binomial logistic regression is used to examine the determinants of reporting difficulty with ADLs while

multinomial logistic regression is used to examine the determinants of SRH. All the models were estimated using the MLwiN 2.27 software (Rasbash et al., 2009). Since there are only 28 provinces representing higher level units, Bayesian Markov Chain Monte Carlo estimation is used. This method uses the actual posterior distributions of model parameters and constructs the credible intervals without reference to a hypothetical sampling distribution, thus providing more accurate model estimates than those of the maximum-likelihood procedures (the latter one finds maximum likelihood point estimates for the unknown parameters of interest in the model and the confident interval is constructed from the normal sample distribution) (Browne et al., 2012; Stegmueller, 2013).

Separate models for men and women were investigated but, with the exception of sources of income, there were no significant differences in pattern effects and therefore it was decided not to provide a sex-stratified analysis but rather to include gender as a control variable. All possible combinations of interactions between

individual characteristics and province factors were also tested to investigate whether different older people in different provinces factors have different health outcomes; however, no significant differences were found.

3. Results

The factor analysis of the 19 variables at province level generated three factors based on the number of the Eigenvalues that exceed 1.0, with a communality of 78.8%, which means that the majority of observed variances of the data could be explained by these three factors. Sorted rotated factor loadings and communalities for the variables are shown in Table 3. Factor loadings of less than 0.6 (only 36% of variance in common) were set to 0.

From Table 3, it can be seen that 52 per cent of the observed variability of the original variables is accounted for by factor 1. This factor was labelled as a province being "Developed, marketised and with a lower level of spending on health care and lower provision of health facilities (D&M)", since it refers to provinces with a higher level of urbanisation, GDP per capita, migrant rates, average income, VAT per capita and foreign investment, a higher proportion of employees working for private or foreign and overseas enterprises, but a lower proportion working for state-owned enterprises, lower expenditure for medical and health care in total revenue of province and a low level of health care institutions per 10,000 population. This is consistent with previous literature; Li and Wei (2010) also find that the health care level of the five prosperous coastal provinces was below the national average level between 1990 and 2000, and the health care level in Guangdong province (the highest average annual GDP in China) resembled that of western provinces in 2008. This phenomenon reflects the fact that health care reform has lagged behind economic reform in China (Zhu, 2013).

Approximately 16 per cent of the observed variance is accounted for by factor 2. This factor was labelled as "Higher level of health facilities and quality of life (HLQ)", since it represents a higher number of health care facilities and lower Engel's coefficients in urban and rural areas. Lower Engel's coefficients reflect a higher socio-economic status in that province (Fang et al., 2010)

Table 3
Factor loading of province characteristics[a].

	Factor 1 (D&M)	Factor 2 (HLQ)	Factor 3 (SSI)	Communality
Urban	0.87	–	–	0.94
GDPpc	0.82	–	–	0.94
Migrants	0.87	–	–	0.83
Income	0.92	–	–	0.96
VATpc	0.85	–	–	0.91
GovExpen	–	–	–	0.92
Fixedassest	–	–	–	0.39
Stateown	–	–	0.85	0.75
ForInvest	0.91	–	–	0.86
StateCom	−0.75	–	–	0.79
PrivateCom	0.85	–	–	0.84
FandHCom	0.84	–	–	0.78
SocSec	–	–	0.76	0.74
MedIns	−0.64	–	–	0.83
Hosp	−0.76	–	–	0.65
Doctor	–	0.82	–	0.78
Bed	–	0.72	–	0.59
UrbEng	–	−0.83	–	0.80
RurEng	–	−0.84	–	0.71
% Var	52.60	16.10	10.10	78.80

[a] "D&M" stands for "Developed, Marketised and with a lower level of spending on health care and lower provision of health facilities"."HLQ" stands for "Higher Level of health facilities and Quality of life"."SSI" stands for "Strong State Influence and social security".

**Table 4**
Factor scores for the provinces[a].

Province	D&M	HLQ	SSI
Beijing	1.56	2.07	0.25
Tianjin	1.52	0.31	−0.05
Hebei	−1.17	0.69	−1.12
Shanxi	−0.93	1.20	0.04
Inner Mongolia	−0.33	1.53	0.05
Liaoning	0.01	1.09	−0.62
Jilin	−0.58	0.92	−0.39
Heilongjiang	−0.51	0.61	0.53
Shanghai	3.13	0.47	1.04
Jiangsu	1.12	−0.23	−1.10
Zhejiang	0.89	0.17	−0.99
Anhui	−0.29	−0.91	−0.63
Fujian	1.06	−1.33	−0.57
Jiangxi	−0.33	−1.13	−0.40
Shandong	−0.51	0.79	−1.63
Henan	−1.14	0.34	−1.03
Hubei	−0.18	−0.56	−0.25
Hunan	−0.62	−0.59	−0.30
Guangdong	1.20	−1.33	−0.95
Guangxi	−0.45	−1.10	−0.08
Chongqing	0.21	−0.72	0.03
Sichuan	−0.45	−0.73	0.29
Guizhou	−0.62	−1.28	0.71
Yunnan	−0.12	−1.63	0.71
Shaanxi	−0.78	0.79	0.47
Gansu	−0.90	−0.61	1.72
Qinghai	−0.09	0.13	3.28
Xinjiang	−0.69	1.04	0.96

[a] "D&M" stands for "Developed, Marketised and with a lower level of spending on health care and lower provision of health facilities"."HLQ" stands for "Higher Level of health facilities and Quality of life"."SSI" stands for "Strong State Influence and social security".

which means that individuals may be more likely to afford other consumption in addition to food (daily necessities); hence such coefficients reflect a higher potential quality of life. Finally, approximately 10 per cent of the observed variance accounted for factor 3, which was labelled as "Strong state influence and social security (SSI)", reflecting provinces which have a higher proportion of state owned enterprises in the total of fixed asset investment and higher percentage of expenditure for social safety net. These strong state influence provinces were favoured by state-own enterprises, which reimburse the majority of health care expenditures and provide pensions for both retired employees and former employees of defunct state-owned enterprises (Wu, 2013).

Table 4 presents the factor scores for the provinces. From the labelled factors, it is possible to categorise the province characteristics. For the first factor (D&M) Shanghai is the most economically developed province, with lower health care expenditure and facilities, whereas Hebei is the opposite. In terms of the second factor (HLQ) Beijing shows the best quality of life and better health facilities, while Yunnan shows the worst one. In terms of Strong State Influence (SSI) Qinghai has the strongest state influence and social security, while Shandong is the province with the weakest state influence and social security. In order to have a clearer visualisation of the geographical distribution of provinces across these factors, Fig. 1A–C maps the three factors scores for each province with darker colours representing a higher factor score. There is a clear pattern showing coastal regions (Shanghai, Beijing, Tianjin, Guangdong, Zhejiang and Fujian) as the most economically developed, albeit with less developed health care and facilities (Fig. 1A), compared to Central and western regions (Xinjiang, Gansu, Inner Mongolia, Sichuan, Yunnan, Guizhou), Northeast regions (Heilongjiang). Xinjiang, and north and northeast regions (Inner Mongolia, Heilongjiang, Jilin and Liaoning) and Beijing score higher in terms of health facilities and life quality than the
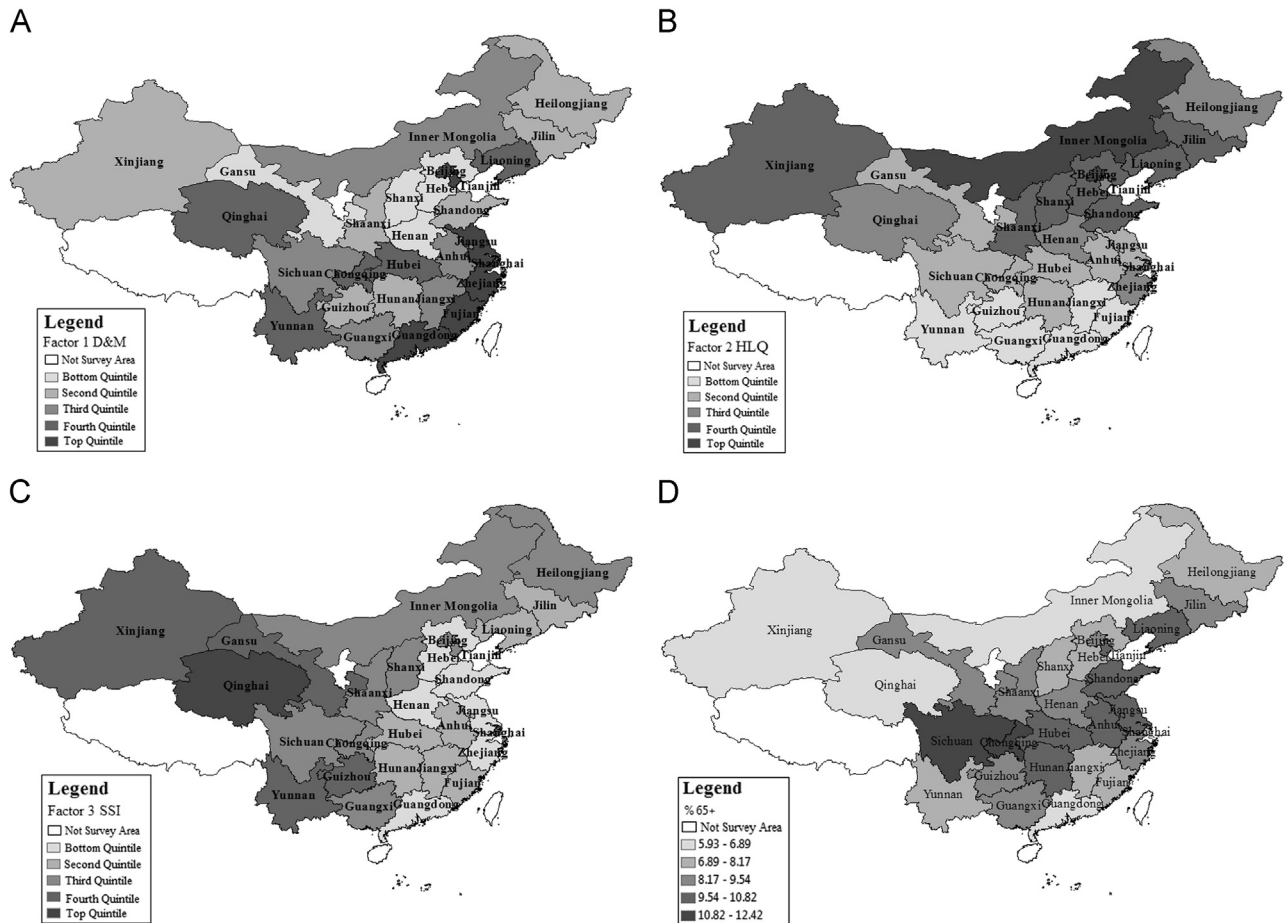
Fig. 1. Mapping factor scores (quintiles) in China by province "D&M" stands for "Developed, Marketised and with a lower level of spending on health care and lower provision of health facilities"; "HLQ" stands for "Higher Level of health facilities and Quality of life"; "SSI" stands for "Strong State Influence and social security". "% 65+" stands for "percentage of aged above 65 in the total population".

southern regions (Fig. 1B). Finally, Qinghai, Gansu and Shanghai are high in terms of "Strong state influence and social security (SSI)" (Fig. 1C).

In order to have an understanding of the distribution of older people across China Fig. 1 also shows the percentage of people aged 65 and over (Fig. 1D) in each province, indicating that Shandong, Jiangsu, Liaoning and Sichuan are the "oldest" provinces in the country. This shows also that the highest concentration of older people in China tends to be in central and eastern provinces, where provinces report a high degree of economic development and marketisation, coupled with a relatively low level of healthcare services, both of which can impact on the health status of older people.

3.1. Multilevel analysis results

Table 5 presents the results for the binary multilevel logistic regression models of reporting difficulty with ADLs, while Table 6 presents the results for the multinomial multilevel logistic regression models of self-reported health. In order to compare between the effects of individual, household characteristics and province characteristics on health outcomes, the tables present two sets of results: Model 1 shows the individual and household effects, and Model 2 shows the additional contribution of province effects.

In terms of the effect of individual characteristics on one's difficulty with ADLs Table 5 highlights that individual demographic characteristics have a significant effect on one's difficulty with ADLs, with the risk of reporting such difficulty increasing by

age, as every year of age increases the odds of reporting a difficulty with ADLs by 0.05. Females are 35% more likely to report a difficulty with ADLs than males; however there are no substantial differences according to marital status. Variables reflecting one's socio-economic status are an important part of the determinants of reporting difficulty with ADLs. Individuals living in rural areas are more likely to report difficulty with ADLs than urban residents (ORs = 1.44), while those with higher educational qualifications (high school and above) face a lower risk of reporting difficulty with ADLs. Income sources are also important in explaining difficulty with ADLs, as individuals receiving income from wages are the least likely to face a risk of difficulty with ADLs compared to individuals receiving income from other sources, while the receipt of Dibao by the household is strongly associated with the report of difficulty with ADLs. No substantial differences are found between individuals having medical insurance or not.

The subjective economic status of the family also contributes to one's individual risk of reporting difficulty with ADLs, with those who rated their standard of living as low showing higher odds of reporting difficulty with ADLs (ORs = 1.71) than those reporting a high standard of living. Finally health-risk behaviour was also part of the explanation as ex-smokers show higher odds of reporting difficulty with ADLs than those who have never smoked (ORs = 1.45) and, at the 95% level, ex-smokers are also significantly more likely to report difficulty with ADLs than those who are currently smoking. This result may indicate a more complex effect of the differential level or amount of smoking among ex-smokers, which negatively impacts on their chances of reporting difficulty

Table 5
Binomial multilevel regression estimates (odds ratios and 95% confidence intervals in fixed part) and variance component in random part for reporting difficulty with ADLs.

	Reporting difficulty with ADLs					
	Model 1			Model 2		
Fixed part						
Age	1.05***	1.04	1.06	1.05***	1.04	1.06
Female (ref: male)	1.35***	1.16	1.56	1.34***	1.15	1.58
Marital status (ref: married)						
Other	0.93	0.65	1.33	0.94	0.65	1.31
Widowed	0.97	0.83	1.14	0.98	0.83	1.15
Rural (ref: urban)	1.44***	1.27	1.63	1.43***	1.27	1.61
Education (ref: high school and above)						
Illiterate	1.82***	1.42	2.31	1.82***	1.41	2.33
Below Primary	1.91***	1.51	2.44	1.92***	1.5	2.44
Elementary and middle	1.44***	1.15	1.80	1.43***	1.13	1.80
Income sources (ref: wage)						
Wage and pension	1.04	0.61	1.7	1.04	0.62	1.72
Wage and other	1.87*	0.87	3.79	1.86*	0.88	3.82
Pension	1.45***	1.12	1.9	1.46***	1.11	1.91
Others	2.31***	1.69	3.16	2.31***	1.65	3.18
No	1.69***	1.35	2.15	1.69***	1.31	2.16
Have not medical insurance (ref: yes)	0.89	0.71	1.1	0.88	0.70	1.11
Smoking status (ref: never)						
Current smoker	0.9	0.78	1.04	0.9	0.77	1.05
Ex-smoker	1.45***	1.21	1.74	1.44***	1.19	1.74
Self-rated living standard (ref: positive)						
Fair	1.07	0.77	1.53	1.08	0.76	1.54
Negative	1.71***	1.24	2.45	1.73***	1.22	2.49
Household receipt of Dibao (ref: no)	1.80***	1.54	2.1	1.79***	1.54	2.07
Province-level effect						
Developed, marketised and lower health care and facilities				0.83*	0.68	1.01
Higher health facilities and quality of life				0.96	0.79	1.14
Strong state influence and social security				0.88	0.69	1.15
Percentage of elderly population				1.11*	0.98	1.23
Random part (variance component)						
Province variance	0.23***	0.11	0.43	0.20***	0.10	0.39

** $p < 0.05$.

*** $p < 0.01$.

* $p < 0.1$.

with ADLs. On the other hand, the damaging effect of smoking may have led ex-smokers to quit smoking and the surviving healthy smokers may be a select group in this study.

No substantial differences were found in the individual effects on the risk of reporting difficulty with ADLs when the province characteristics were added to the model. The province level factor of economic development has a significant effect on an individual's risk of reporting difficulty with ADLs, with persons living in economically developed provinces, albeit with lower health expenditure and less developed health care institutions, being less likely to report difficulty with ADLs. Interestingly, older people living in a province with a higher proportion of older people are more likely to report difficulty with ADLs.

Table 6 presents the multinomial multilevel regression of reporting positive, fair or negative self-rated health. There is significant positive effect of age on reporting negative SRH (ORs=1.02), while females are more likely to report fair and negative SRH than males. In terms of marital status, widowed persons are less likely to report negative SRH than married persons. Those living in urban areas, who have higher educational qualifications, who receive income from wages, and who do not have medical insurance are more likely to report positive SRH. Ex-smokers show 71% higher odds of reporting negative SRH than those never smoke, while individuals reporting a low standard of living and the receipt of Dibao by their household are more likely to report fair or negative SRH. Finally, no province effects are found in the risk of reporting fair and negative SRH.

3.2. Health inequality among provinces

Tables 5 and 6 show evidence of the between-province variance in terms of various health indicators. Although the models include both individual and province characteristics, there is nevertheless significant variance for all health outcomes. Figs. 2 and 3 plot the between-province variation (known as "residual" at level 2) on an odds scale for the two health outcomes of the models with individual characteristics, and the value 1 represents the all-province level of reporting difficulty with ADLs or fair/negative self-reported health, conditional on the terms included in the fixed part of the model. It is clear that the province of Jilin shows the extremely high odds of individuals reporting difficulty with ADLs, while the Qinghai province shows the extreme low odds of such a difficulty (Fig. 2). The Sichuan and Jiangxi provinces show higher odds of individuals reporting fair/negative SRH than the national average, while the provinces of Zhejiang and Shanxi show lower odds of individuals reporting fair/negative SRH than the national average (Fig. 3).

4. Discussion and conclusion

The analysis presents strong empirical evidence that older people in China in lower individual level economic-status are more likely to report a poorer health status as defined in this paper. Such an evidence is in line with existing research, which

Table 6
Multinomial multilevel regression estimates (odds ratios and 95% confidence intervals in fixed part) and variance component in random part for reporting fair or negative self-rated health.

	Reporting fair or negative self-reported health											
	Model 1						Model 2					
	Fair			Negative			Fair			Negative		
Fixed Part												
Age	1.00	1.00	1.01	1.02***	1.01	1.03	1.01	1.00	1.01	1.02***	1.01	1.03
Female (ref: male)	1.17**	1.02	1.34	1.54***	1.3	1.80	1.17**	1.02	1.36	1.54***	1.31	1.82
Marital status (ref: married)												
Others	0.89	0.62	1.31	1.19	0.82	1.75	0.89	0.62	1.29	1.18	0.82	1.74
Widowed	0.90	0.76	1.08	0.74***	0.62	0.89	0.90	0.75	1.07	0.73***	0.61	0.88
Rural (ref: urban)	1.06	0.94	1.18	1.54***	1.36	1.75	1.06	0.94	1.18	1.53***	1.35	1.74
Education (ref: high school and above)												
Illiterate	1.05	0.86	1.27	1.65***	1.31	2.08	1.05	0.87	1.27	1.66***	1.33	2.08
Below primary	1.36***	1.12	1.66	1.97***	1.56	2.51	1.37***	1.13	1.65	2.00***	1.60	2.49
Elementary and middle	1.23**	1.05	1.43	1.42***	1.17	1.75	1.22**	1.04	1.43	1.43***	1.18	1.73
Income sources (ref: wage)												
Wage and pension	1.01	0.72	1.40	0.78	0.49	1.24	0.98	0.72	1.36	0.75	0.46	1.18
Wage and other	1.09	0.59	2.09	1.22	0.57	2.57	1.11	0.61	2.05	1.25	0.56	2.62
Pension	1.30***	1.07	1.58	1.94***	1.53	2.53	1.30***	1.07	1.57	1.92***	1.52	2.43
Others	1.28	0.95	1.75	2.10***	1.51	2.99	1.25	0.93	1.71	2.06***	1.46	2.89
No	1.24**	1.06	1.46	2.06***	1.67	2.55	1.24**	1.05	1.48	2.04***	1.67	2.53
Have not medical insurance (ref: yes)	0.85	0.7	1.04	0.73***	0.58	0.92	0.84	0.68	1.04	0.72**	0.56	0.91
Smoking status (ref: never)												
Current smoker	0.97	0.84	1.10	0.91	0.77	1.07	0.97	0.84	1.12	0.91	0.77	1.07
Ex-smoker	1.00	0.82	1.22	1.71***	1.38	2.10	1.01	0.82	1.23	1.71***	1.37	2.12
Self-rated living standard (ref: positive)												
Fair	1.66***	1.29	2.15	1.60***	1.18	2.20	1.65***	1.29	2.12	1.61***	1.19	2.21
Negative	2.32***	1.77	3.02	4.14***	3.03	5.72	2.30***	1.81	2.94	4.14***	3.05	5.60
Household receipt of Dibao (ref: no)	1.19*	0.97	1.44	1.93***	1.57	2.37	1.20*	0.98	1.44	1.94***	1.58	2.34
Province-level effect												
Developed, marketised and lower health care and facilities							1.03	0.87	1.28	0.96	0.82	1.17
Higher health facilities and quality of life							0.95	0.75	1.17	0.99	0.83	1.20
Strong state influence and social security							1.06	0.84	1.26	1.14	0.93	1.34
Percentage of elderly population							1.08	0.96	1.19	1.06	0.96	1.17
Random part (variance component)												
Province variance	0.19***	0.1	0.34	0.15***	0.08	0.27	0.21***	0.1	0.39	0.15**	0.07	0.3

*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.
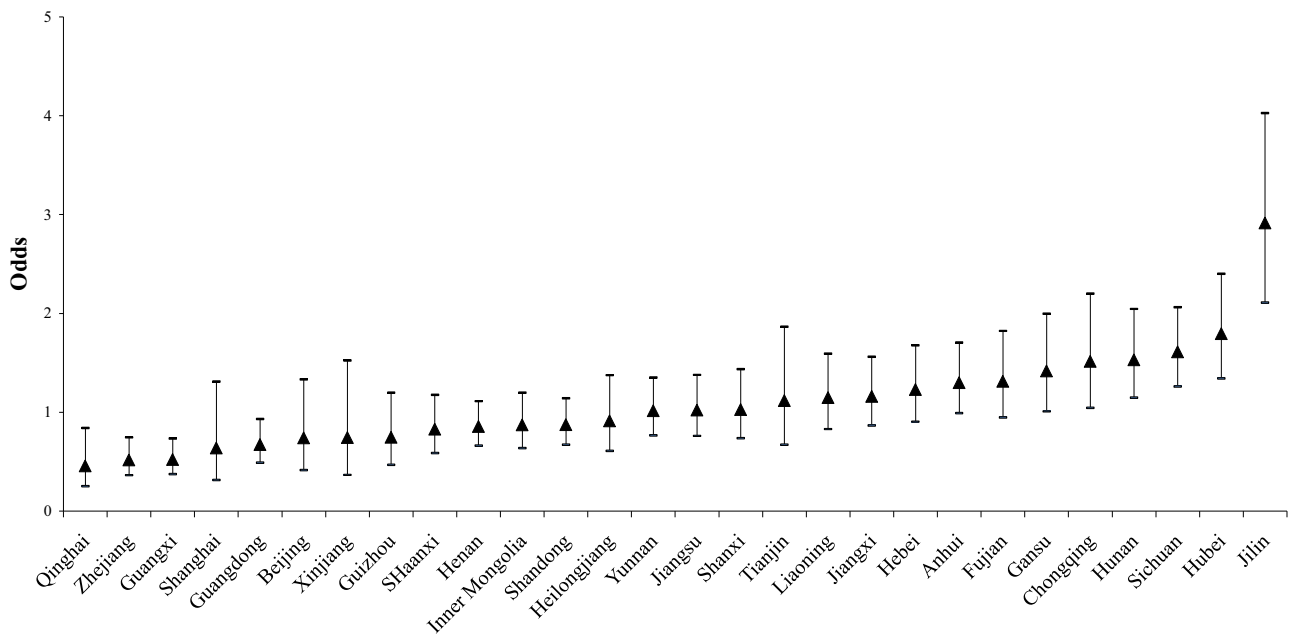
Fig. 2. Differential relative odds of reporting difficulty with ADLs for provinces, derived from individual characteristics compared to the national average (1).
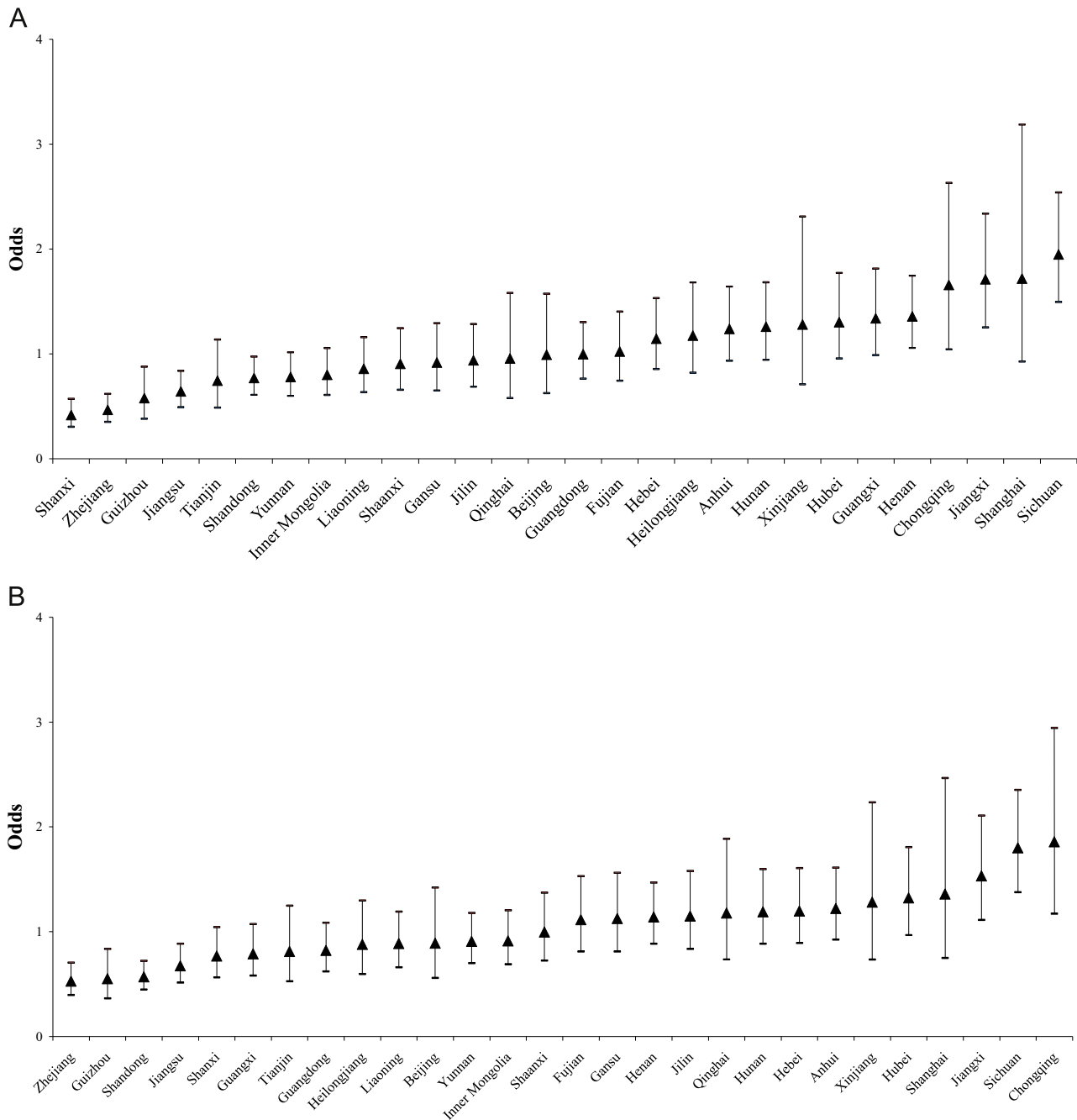
A

B

Fig. 3. Differential relative odds of reporting fair SRH (A) and negative SRH (B) for provinces derived from individual characteristics compared to the national average (1).

shows that higher economic-status or economic independence could afford older people a higher level of healthcare which could in turn prevent the risk of poor health (Feng et al., 2013). In addition, the impact of individual characteristics appears to be consistent whichever measure of health status (difficulty with ADLs or SRH) is used. Previous research has highlighted debates regarding the protective effect of marriage on health (Zheng and Thomas, 2013). Our findings are consistent with earlier findings that marriage was not significantly associated with improvement in ADLs (Zheng and Thomas, 2013) and self-rated health (Li et al., 2011), which is in contrast to findings for Western Europe and North America where marriage is frequently found to be protective at least for older men (Lillard and Panis, 1996; Robards et al., 2012). Zheng and Thomas (2013) argued that marriage may be most beneficial when individuals enjoy relatively good health. In

addition, Li et al. (2011) found that widowed older people were less likely to report negative health if they regarded their children as supportive, which suggests that filial piety could have a buffering effect in China.

Apart from their individual characteristics, this paper has sought to understand the effect of the province in which the older persons reside on their risk of reporting poor health status. In this respect the results show that individuals living in provinces with a higher level of development and marketisation, and with lower health expenditure and health care institutions, are less likely to report difficulty with ADLs. Zeng et al. (2010) found that higher per capita GDP at the community level is associated with a higher rate of ADL disability using a 2002-5 dataset of older people in China, indicating a complex association between community-level wealth and older people's ability to perform ADL (Zeng et al.,

2010). As socioeconomic status has developed rapidly and unevenly between 2002 and 2011 our results may reflect the unique socioeconomic status of China's more economically developed provinces, where more job opportunities keep older people economically active, and where social participation is more effectively organised (Zeng et al., 2010). The fact that older people living in a province with a higher proportion of people aged 65 and over are more likely to report difficulty with ADLs may reflect the pressures on elderly care institutions in such provinces. From National Bureau of Statistics (2013), the national average was around 21 beds in elderly care institutions per 1,000 senior citizens. In provinces with a high proportion of older people, this number was much lower, highlighting that there might be inadequate levels of care and support available for older people to recover from difficulty with ADLs. It is also interesting to note the lack of an impact of having medical insurance in later life, which indicates the Chinese government's efforts to increase the effectiveness as well as the coverage of health and social provision (Zhu, 2013).

Sizeable geographical variances in the health outcomes of older people in contemporary China remain even after controlling for a range of individual characteristics and province level characteristics, pointing to the fact that there are further environmental, cultural, historic and institutional factors which should be considered. The main reason for not doing so here is that many of these variables are either difficult or impossible to measure and we recognise that in future research it will be important to try and capture additional environmental factors that may be related to health inequality. Nonetheless, Zhejiang is the province with less risk of poor health for elderly people in our findings which is consistent with previous studies (Feng et al., 2012, 2013).

The results of this study help to extend our knowledge of how the combination of individual and province characteristics can affect an individual's risk of reporting poor health status according to a range of health indicators, pointing to significant policy implications. As China's society ages, the Government needs not only to provide social subsidies to older people with low income but also to strengthen such subsidies. Such groups are already mainly dependent upon their income from social subsidies and such need is expected to increase due to increasing age, disability and difficulty with ADLs. Lower economic status (either measured through relatively low living standards or the household's receipt of Dibao) is clearly and strongly associated with the report of poorer health status. Although the Dibao programme could reduce the poverty rate of household, its effect on preventing poorer health among individuals with a lower socio-economic status appears to be weaker, based on this study. Drawing on our understanding of inequalities existing in the distribution of welfare provision (Zhu, 2013) this result also indicates that the state should consider improving its standard level of provision for older people with a low socio-economic status, including medical insurance. Most individuals living in households in receipt of Dibao do not have medical insurance as they cannot afford it. Without adequate medical treatment, older people may find it hard to recover from difficulties with ADLs and from poor health; thus their health status may deteriorate in future. Improving the efficiency of targeting is an urgent issue for the state to address.

The results also point to significant policy implications which relate to improving the immediate environment in which the individual lives, such as their family and household, and to the wider environment or province where their household is located. Such results are in line with existing research on the contribution of individual, household and province level indicators to individuals' health, and to health inequalities (Feng et al., 2012; Yin and Lu, 2007). Lower socio-economic status, whether measured through individual or household indicators, is clearly and strongly

associated with the report of poorer health status, as is health-risk behaviour measured in this study through smoking status, which itself has been independently associated with both lower socio-economic status and with poorer health status (Jarvis and Wardle, 1999). Public health campaigns against smoking, which are aimed at both younger and older cohorts of individuals, can contribute to the improvement of health status of current and future generations of Chinese individuals. The analysis shows that elderly people in provinces with a higher level of economic development are less likely to report disability, a result which is compatible with existing literature (Murthy and Okunade, 2014), but which also contributes to the debate about the future of economic development and health outcomes in China more broadly (WHO, 2005). In addition, stronger statutory assistance in the form of both cash benefits and health services for individuals at the lowest part of the income distribution may also add to a comprehensive set of social policies protecting the most vulnerable groups in society (Zhu, 2013). Finally, differences between provinces in a range of indicators, such as modernisation and the amount of expenditure on health services, reflect a need for greater redistribution of resources on the part of the state from those provinces with higher resources, to those with lower resources. Similarly, such an adjustment also requires ensuring that rural parts of provinces are not disadvantaged compared to urban parts. This is particularly important as economic migration has resulted in a higher concentration of older individuals in rural parts of mainland China.

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