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Spatial Pattern of Population Ageing and Household Health Spending in India

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Abstract

Studies on the association between population ageing and health spending are inconclusive. Though per capita health spending has a strong age gradient, evidence from the developed countries attributes increasing health expenditure to high spending in terminal year of life. In India, though studies have examined the level, trends and determinants of health care spending, no attempt has been made on association of population ageing and per capita health spending across the districts of India. The objective of this paper was to examine the spatial dependencies and heterogeneities of population ageing and per capita health spending across 640 districts of India. Data from the Census of India (2011) and the consumption expenditure rounds of the National Sample Survey Organisation (NSSO) (2009–10 and 2011–2012) were used in the analysis. Univariate and bivariate LISA analysis, ordinary least square regression, and spatial error model were used to decipher the spatial pattern of population ageing and health spending in the districts of India. Results suggest that per capita health expenditure is positively associated with the proportion of the older adults (aged 60 years and above) in the districts of India. Districts with less than 5% older adults have an annual per capita health expenditure of ₹629 compared to ₹2432 in districts with older adults 12% or more. Districts of India also exhibit large spatial heterogeneity in household health spending. Bivariate Moran's I statistic of proportion of older adults and per capita annual health expenditure was 0.48, suggesting spatially association of the share of the older adults and the per capita annual health expenditure in India. Results of the spatial error model confirmed that share of urban population, mean wealth score, and mean household size are significant predictors of per capita annual health expenditure in India. This study is important to monitor the progress of universal health coverage across the disadvantaged districts and to integrate age component in universal health coverage programmes.

Keywords Ageing · Health expenditure · Districts · India · Spatial analysis

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Introduction

Population ageing and increasing per capita health spending are concomitant and a growing public health challenge worldwide (Lutz et al. 2008). Globally, the population aged 65 and above, increased from 600 million in the year 2000 to 900 million in 2017, much of this increase are from the developing countries (UN 2019). With the rise in the older population, morbidity, hospitalisation, and health expenditure have increased due to the rise in chronic ailments and disabilities (Chatterji et al. 2015; Prince et al. 2015). The per capita health spending in lower- and middle-income countries is growing faster than in the high-income countries and is largely met by out-of-pocket expenditure (Dieleman et al. 2017). Out-of-pocket expenditure (OOPE), catastrophic health expenditure (CHE), and impoverishment have consistently been higher among the older populations across geographies and socio-economic groups (Arsenijevic et al. 2016; Carreras et al. 2018; Jin Feng et al. 2015; Xu et al. 2011; Zhai et al. 2017). A recent study found that 808 million people in 2010 incurred CHE, which has been increasing over time (Wagstaff et al. 2018). While economic insecurity among the aged population remains high, increasing health care cost, low insurance coverage, and high OOPE have made the older adults more vulnerable (Baird 2016; Carreras et al. 2018; Gray 2005; Lyons et al. 2018; Ogawa et al. 2009; Zweifel et al. 1999).

The role of changing age and sex structure, particularly the increasing size and proportion of the older population, in rising health spending is unclear. While studies have invariably established the age gradient of health spending, studies from the OECD countries negate the role of population ageing as a major contributor to rising health expenditure (de Meijer et al. 2013; Dormont et al. 2006; Felder and Werblow 2008; Gregersen 2014; Howdon and Rice 2018; Ke et al. 2011; Seshamani and Gray 2004; Zweifel et al. 1999). The famous *Red Herring report* suggested proximity to death as the main reason for the increasing age-specific health care expenditure. Using empirical analysis from survivors and decedents, the study observed that the significance of age parameters weakened once variables for time to death were included in the models (Zweifel et al. 1999). End-of-life care expenditure is higher as compared with other periods of the life span (de Meijer et al. 2013; Dormont et al. 2006; Getzen 2001; Gray 2005). Given this range of possible scenarios, a better understanding of the relationship between ageing and health care expenditure (HCE) is key to tackling future challenges of older population in health care systems.

India, with 104 million people aged 60 or above, has the second largest number of older population worldwide. The growth in the older population raises apprehensions about their health and financial security of the nation (UN 2019). Debilitating ailments and financial insecurity have made the aged population vulnerable to health spending (Dandona et al. 2017). Though the burden of non-communicable diseases (NCDs) has been escalating in all ages, it is predominately higher among the older adults (Mini and Thankappan 2017; Pati et al. 2014; Vellakkal et al. 2013). Sixty-three percent of the aged population in India suffer from at least one NCD, and around 31% are multi-morbid, mostly among the rural and female populations

(Mini and Thankappan 2017). Thirteen percent of older population in India have some type of disability that affects at least one activity of daily living (Kastor and Mohanty 2016). The hospitalisation rate among the older population in India was 109 per 1000 population in 2014, four-fifths of them having been hospitalised due to NCDs (Kastor and Mohanty 2018; Pandey et al. 2017). About two-thirds of them use private health care facilities, which makes them vulnerable in the matter of health spending and is a possible reason behind financial catastrophes (Brinda et al. 2015; Jeyashree et al. 2018; Pandey et al. 2018; Tiagi 2015). Age-specific health care expenditure is higher among the older population compared to the other age groups (Chowdhury et al. 2018; Dhak 2014; Dhillon and Ladusingh 2017). The per capita health care expenditure of a household with an aged member is four times higher than that of households with non-aged members (Mohanty et al. 2013). The health care expenditure is higher in households who have multiple older adults, individuals living with a disability, suffering from a chronic disease like cancer, heart disease or cardiovascular disease, and have suffering from multi-morbidity (Das and Ladusingh 2018; Ladusingh et al. 2018; Lee et al. 2015; Mahal et al. 2013; Rajpal et al. 2018; Srivastava and Mohanty 2013). Beyond the individual factors, community, districts and state level factors also affect the per capita household health spending in India (Mohanty et al. 2018).

This study was conceptualised with the following rationale. The share of the population aged 60 or above in India has increased over the last two decades due to the demographic, economic and epidemiological transition (Kastor and Mohanty 2018; Pandey et al. 2017). However, the pace of this transition not only varies with socio-economic groups but also by the geographical locations. Despite various large-scale surveys, data on household/per capita health expenditure at the district-level remains scanty in India. Moreover, the state averages relating to demographic and health spending conceal large variations across the districts. Though studies have focused on health, economic status, quality of life, and social network of the older population, no attempt has been made to investigate the association of the share of the older population with household health spending and their interlinkage in the districts of India. Second, the districts of India vary enormously in terms of stage of demographic transition and socio-economic development. Given the size of a district's population, any meaningful analysis must address the district-level variations in age structure and health spending. As such, understanding the spatial pattern of older adults and per capita health spending is bound to be useful. Third, the interlinkage of ageing and health expenditure is debated around the globe, but few attempts have been made to do so in the Indian context. Therefore, this study aims to understand the spatial correlates of per capita annual health care expenditure in the districts of India.

Methods

The study used data from the National Sample Survey (NSS) and the Census of India 2011. The unit data from the 66th and the 68th rounds of consumption (Schedule 1.0), Type 2 of NSS, was used for estimating household expenditure in the districts

of India. The NSS has a long history of collecting data on consumption expenditure, which is extensively used for research, planning and policy purposes. It collects detailed household expenditure – including on food, health, clothes, and other expenditures – from sampled households through personal interviews. The NSS uses two-stage random sampling to select households separately in the rural and urban areas. The 66th round (Schedule 1.0) covered a sample of 100,794 households in 610 districts of India, while the 68th round covered a sample of 101,651 households in 623 districts of India (NSSO, 2011; 2013). Since the NSS did not have a large enough sample size to provide the district-level estimates of health expenditure, we pooled the NSSO samples of 2009–10 and 2011–12 to find the estimates of poverty and inequality in the districts (Mohanty et al. 2016). With a national estimate of 80% of households having some amount of health spending, and a margin of error of 5%, the required sample size for a district was calculated to be 125 households. The Census of India had covered 640 districts, of which 23 had a sample household size smaller than the minimum sample size identified for our study. For a total of 40 districts (23 with less than the required sample size and 17 for which data was not available), replaced by the respective regional estimates. Since we used two rounds of NSSO, conducted at different periods of time, we had to adjust the weight of the households in the survey. The weights were adjusted for the pooled samples based on the following formula suggested by Minhas and Sardana (1990).

$$W_{adj} = \frac{\sum W_x * N_x}{\sum N_x}$$

W_{adj} is the adjusted weight for the pooled sample
W_x is the weight for round x
N_x is the sample size for round x

Variables

We defined older adults as the proportion of the population aged 60 years and above. Per capita annual health expenditure (PAHE) was the main outcome variable. The NSSO had asked a set of questions on household expenditure on inpatient (institutional) care in a reference period of 365 days. The institutional expenditure included expenditure on medicines, tests, doctor's fees, hospital or nursing home charges, etc. The sum of these expenditures divided by the household size was called the per capita annual institutional health expenditure (PAIHE)

$$PAIHE_i = \frac{Total\ institutional\ health\ expenditure\ of\ ith\ household}{Household\ Size\ of\ ith\ household}$$

Similarly, information on the non-institutional medical expenditure was collected from the households for a reference period of 30 days. The non-institutional medical expenditure included the expenditure on medicines, tests, doctor's fees, family planning devices, and other medical expenditures. These expenditures were annualised with a multiplier of 12.16 (365/30) to find the estimates for 365 days. The sum of

these expenditures divided by the household size was called the per capita annual non-institutional health expenditure (PANHE)

$$PANHE_i = \frac{Total\ noninstitutional\ health\ expenditure\ of\ ith\ household}{Household\ Size\ of\ ith\ household}$$

The sum of PAIHE and PANHE was called the per capita annual health expenditure (PAHE) of the i^{th} households.

$$PAHE_i = PAIHE_i + PANHE_i$$

The independent variables at the district level were estimated from the unit data of Census of India 2011. These include the percentage of population aged 60 or above, percentage of female literate population, percentage of urban population, mean household size, percentage of disabled persons, mean wealth score, etc. These were estimated from the Census of India 2011, for 640 districts of India. A composite index called wealth index was constructed based on the percentage of households that had a TV, bicycle, motor cycle, refrigerator, telephone, and mobile at the district level. A data file on the key indicators of household health spending and demographic and socio-economic variables was prepared, with district as the unit of analysis. Our estimates refer to the period of 2011, as the census variables were for the year 2011. The variables derived from the NSS were pooled from the periods 2009–10 and 2011–12; we referred to these as estimates for the year 2011.

Spatial Analysis

Moran's I univariate and bivariate Local Indicator of Spatial Association (LISA) analysis were used to assess the spatial dependencies of PAHE and the proportion of older adults in the districts of India. The spatial autocorrelation was computed using the spatial weight matrix that provided the spatial proximity between each possible pair of districts. Spatial weight matrix (W_i) was computed using the Geo-Da software in the queen contiguity method of order one. The queen contiguity method is the simplest and the most suitable method for polygon analysis to define neighbourhoods, where the unit of analysis (districts in our case) shares either a border or a corner with the neighbour. Moran's I value is a global indicator for spatial autocorrelation, which provides the degree of autocorrelation among the index and spatial neighbors. The formula for calculating Moran I is as follows:

$$I = \frac{\sum_i \sum_j W_{ij} Z_i . Z_j / S_0}{\sum_i {Z_i}^2 / n}$$

where Z_i and Z_j are percentage of older adults and PAHE in districts i and j respectively.

W_{ij} is the weight matrix, $S_0 = \sum_i \sum_j W_{ij}$ is the sum of all weights, and n as the number of observations.

Moran's I value varies between -**1** and +**1**. A positive Moran's I indicates that the observations in the space are clustered, whereas a negative value indicates that the observations are more scattered. A zero-autocorrelation value indicates that the arrangement of the. Univariate LISA analysis was used to find out clustering (hot and cold spots) of the share of older adults and the PAHE at the district level in India, while bivariate LISA analysis was carried out to examine the association between the two. Ordinary least square (OLS) regression and spatial error model (SEM) were used to estimate the contextual correlates of the PAHE in the districts of India. The SEM has merits over the OLS model as it adjusts for the spatial heterogeneity of the distribution of the dependent variables. Both the models and their efficiency were tested with the same correlates.

Results

The socio-demographic and economic characteristics by the proportion of older adults in the districts of India have been shown in Table 1 (computed from Census of India 2011). The proportion of disabled population, percent urban, female literacy, and mean wealth score increased with an increase in the proportion of the older adult population. For example, the mean wealth score for the districts with share of older adult less than 5% was 24, while it was 40 for the districts with an older adults share more than 12% . Similarly, total fertility rate and mean household size declined with a rise in the share of the older adults. The total fertility rate (TFR) for districts with older adults less than 5% was almost half of that of districts with older adults more than 12 %.

The APCE, PAHE, PAIHE and PANHE by percentage of older adults in India are given in Table 2. The APCE, PAHE, PANHE, and PAIHE increased with a rise in the share of the older adults. The mean APCE in India was ₹20,124 per annum,

Table 1 Percentage of disabled older adults, percent urban, percentage of female literate, households having no assets, mean wealth score, percentage of workers having disability in agriculture, TFR, and mean household size by percentage of older adults by districts of India, 2011

Percentage of older adults	Any disability (%)	Urban population (%)	Female literacy (%)	Households with no asset	Mean wealth score	Total Fertility Rate (TFR)	Mean household size	Number of districts
< 5	1.71	29.37	55.71	28.46	24.8	3.58	5.82	62
6	2.07	34.89	59.95	18.69	33.21	3.15	5.93	91
7	2.24	26.48	58.35	21.41	29.71	3.12	5.85	148
8	2.18	29.76	64.39	16.58	32.95	2.66	5.93	122
9	2.29	34.84	69.32	14.63	36.7	2.11	5.32	91
10	2.32	29.75	67.76	16.69	33.54	1.79	4.87	62
11	2.41	34.32	71.68	13.29	37.85	1.66	4.86	37
12 +	2.35	39.72	81.76	11.3	40.95	1.66	4.84	27
Total	2.21	31.14	64.26	17.77	33.17	2.60	5.60	640

Table 2 Annual Per Capita Consumption Expenditure, Per Capita Annual Institutional Health Expenditure, Per Capita Annual Non-Institutional Health Expenditure, and Health spending as percentage of APCE by percentage of older adult population in India, 2011

Percentage of older adults	Annual Per Capita Consumption Expenditure (in ₹)	Per capita Annual Health Expenditure (in ₹)	Per capita Annual Institutional Health Expenditure (in ₹)	Per capita Annual Non-Institutional Health Expenditure (in ₹)	Health spending as percentage of APCE
< 5	16,608	629	205	424	3.17
6	20,991	987	303	684	4.20
7	18,513	916	274	642	4.36
8	18,716	1119	373	746	5.03
9	20,922	1256	384	871	5.16
10	20,863	1357	454	903	5.41
11	23,403	1581	557	1024	5.73
> 12	27,499	2432	1113	1319	7.07
Total	20,124	1164	386	778	4.88

which was ₹16,608 in districts with share of older adults less than 5% and increased with a rise in the share of the older adults. This suggest that districts with a higher proportion of older adults were possibly economically better-off. The PAHE in India was ₹1164, two-thirds of it being non- institutional and one-third being institutional. The mean PAHE in districts with share of the older adults more than 12% was ₹2432, which was approximately four times higher compared to the mean PAHE in districts with less than 5%. The mean per capita non-institutional health expenditure was higher than the mean per capita institutional health expenditure at all levels of the older adults. Apart from that, PAHE as a proportion of APCE rose gradually with the rise in the proportion of older adults in the districts of India.

Spatial Pattern of Ageing and Health Spending

The district-level estimates of percentage of older adults and the PAHE for all 640 districts have been laid out in Fig. 1. The percentage of the older adults and the household health expenditure varied enormously across the districts of India. Out of the 640 districts, 62 districts had share of older adultsof less than 6% while 239 districts had share of older adults between 6%-8%, 213 districts had share of older adults between 8%-10%, 99 districts had share of older adults between 10%-12%, and 27 districts had share of older adults more than 12%. Similarly, 150 districts had PAHE of less than ₹500, 120 districts had PAHE between ₹500-₹ 750, 114 districts had PAHE between ₹ 750-₹ 1000, 150 districts had PAHE between ₹1000-₹1500, and 106 districts had PAHE of more than ₹1500. Pathanamthitta district of Kerala had the highest share of older adults in India, followed by Sindhudurg district of Maharashtra, whereas Papum Pare and Kurung Kumey districts of Arunachal Pradesh had the lowest share of older adults. Tara Taran district of Punjab had the

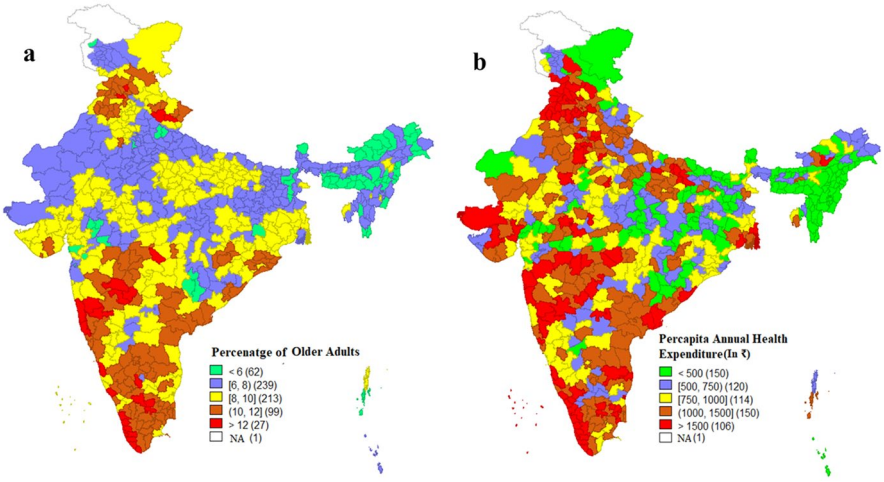

Fig. 1 Distribution Map of (**a**)Percentage of older adult population, 2011 (**b**) Per capita Annual Health expenditure in districts of India, 2011

highest PAHE in India, followed by Dakshina Kannada of Karnataka, whereas North Districts of Sikkim had the lowest PAHE, followed by Thoubal district of Manipur. Figure 2 shows the distribution of PAHE by the wealth quintile of the districts of India. The economic gradient of the health expenditure is evident from this figure. Districts which had a higher wealth index also had a higher PAHE.

The scatter plot of the percentage of older adults and PAHE is shown in Fig. 3. The pattern confirms that there was a significant association of ageing with household health expenditure in India. The correlation coefficient between the two was found to be 0.53, and the coefficient of determination was found to be 0.28. About 28% of variation in PAHE was explained by the percentage of the older adult population alone.

spatial distribution map was constructed for the percentage of older adult population and PAHE at the district level in India. The Global Moran's I of the percentage of the older adult population was 0.71 (P value < 0.01, 999 permutation), while that of PAHE was 0.58 (P value < 0.01, 999 permutation). The LISA univariate cluster map of the above characteristics in the districts of India is shown in Fig. 4. It depicts the significant spatial clusters of the older adult population as well as the health expenditure in the districts of India.

Bivariate LISA analysis was performed to understand the spatial association between the share of the older adults and the mean PAHE in the districts of India. Moran's I value of bivariate LISA analysis was found to be 0.48, which suggests a significant positive spatial autocorrelation of PAHE with the percentage of the older adults in the districts of India (Fig. 5). The cluster map was divided into four groups: high-high cluster (Red colour), labelled as hotspot; low-low cluster (Blue colour) labelled as cold-spot, and high-low cluster and low–high cluster labelled as outliers. Out of the 640 districts, 110 were found to

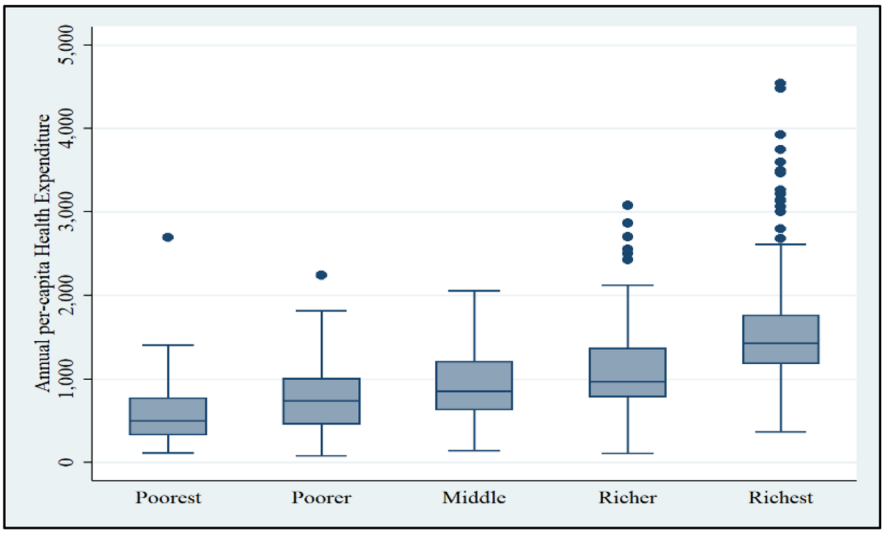

Fig. 2 Box plot of per capita annual health expenditure (PAHE) by wealth quintile of districts in India

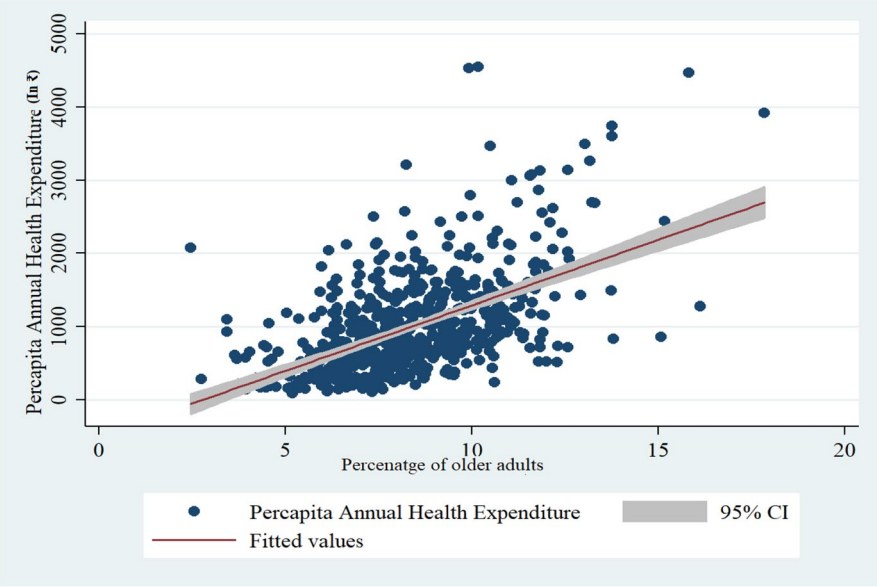

Fig. 3 Scatter plot of percentage of older adult population with per capita annual health expenditure in districts of India, 2011

be hotspots, which means these ditsricts had a higher share of aged population have higher PAHE compared to the neighbouring districts. These districts were mainly loctated in the states of Maharashtra, Goa, Tamil Nadu, Kerala, and Punjab. By contrast, around 90 districts were found to be cold spots and were located in the states of Assam, Manipur, Nagaland, Meghalaya, Jharkhand, and Chhattisgarh.

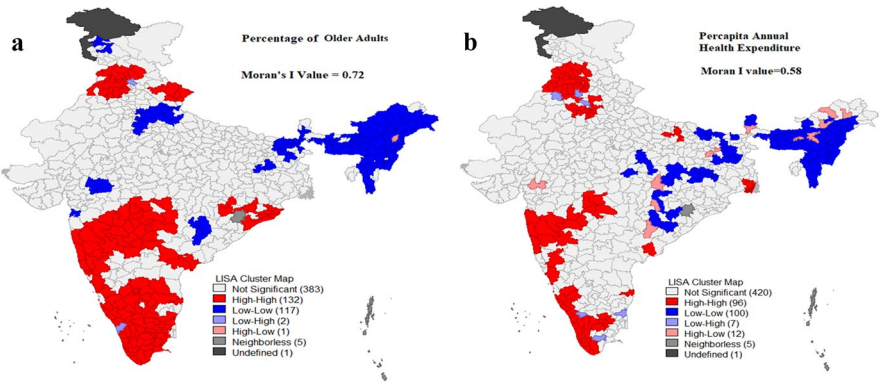

Fig. 4 Univariate LISA Map of **a** percentage of older adults and **b** logarithm of per capita annual health expenditure among the districts of India, 2011

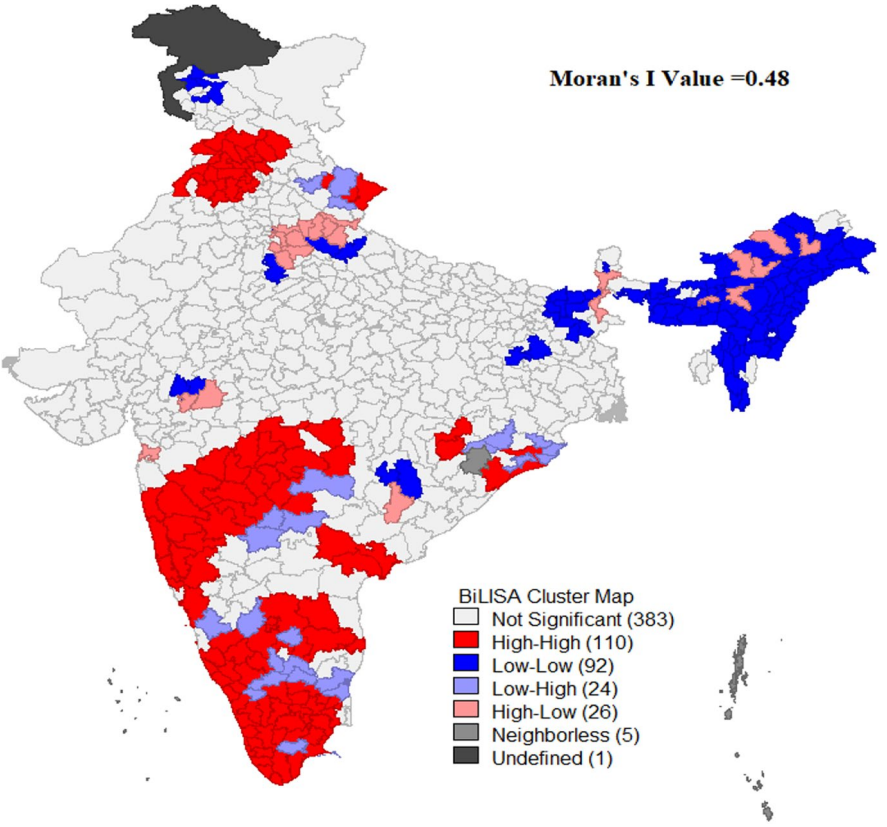

Fig. 5 Bivariate LISA Map of percentage of older adults and logarithm of per capita annual health expenditure among the districts of India, 2011

Table 3 presents the results of the OLS and SEM estimation by using the logarithm of PAHE as dependent variable against the various socio-economic variables in the districts of India. The OLS model did not adjust for the estimates of the spatial endogenity, while the SEM model did adjust for them. Results from the OLS model and the SEM confirmed that the proportion of the older adults significantly determined the health care expenditure across the districts of India. The coefficient of proportion of the older adults was 0.098 (SE 0.015) for PAHE. This signifies that a 1% rise in the older adults led to a 9% increase in PAHE, adjusting for the spatial variation in the districts of India. Among all other correlates, the logarithm of APCE showed a significant role in the rising health expenditure. The coefficient of APCE was found to be 1.17 (SE 0.015), which means a positive association with PAHE. Apart from these, mean household size and percent urban contributed significantly to the high health expenditure.

Table 3 Estimated results from the ordinary least square model (OLS) and the spatial error model (SEM) for household health expenditure in districts of India, 2011

	Ordinary Least Square Model (OLS)		Spatial Error Model (SEM model)	
District level meso scale correlates	Coefficient(SE)	P value	Coefficient(SE)	P value
Percentage older adult population	0.184 (0.012)	0.000	0.098 (0.015)	0.000
Logarithm of annual per capita consumption expenditure (APCE)	0.886 (0.09)	0.000	1.17 (0.097)	0.000
Percentage of urban households	0.005 (0.002)	0.001	0.001(0.002)	0.753
Percentage of female literate	-0.016 (0.002)	0.000	-0.005(0.003)	0.116
Mean household size	0.133 (0.028)	0.000	0.08 (0.031)	0.011
Mean wealth index	0.008 (0.003)	0.003	0.005 (0.003)	0.149
Percentage disable person	0.001 (0.004)	0.757	0.003 (0.004)	0.401
Constant	-3.716 (0.871)	0.000	-6.036 (0.929)	0.000
R square	0.56		0.68	
No of districts	640		640	

Numbers within brackets represent standard error

Discussion and Conclusion

The share of the population aged 60 and above in India has grown at a fast pace in the last two decades, owing to declining fertility and rising life expectancy. The health and social care systems in the country are not much prepared to adapt to this unprecedented demographic change. Increase in longevity across the socio-economic spectrum, rising non-communicable diseases, increasing income levels, and increasing use of medical technology are all associated with increasing health spending (Ghosh 2011; Kastor and Mohanty 2018; Kumara and Samaratunge 2016; Ladusingh et al. 2018; Mahal et al. 2013). This study is an attempt at exhibiting the spatial variations in the health expenditure and the proportion of the population aged 60 and above across the districts of India. The following are the salient findings of the study.

First, we found wide variations in the share of older adults and PAHE across the districts within each state of India. These estimates are important to understand the distribution of the above indicators in geographical administration. The differences in PAHE reflect the lop-sided development within the states. The standard deviation of PAHE confirmed that the distribution was rightly skewed and sparsely distributed from the mean, which confirms the inequality in per capita health expenditure across the districts. It was also confirmed from the analysis that the districts with a higher wealth index had a higher PAHE (see Fig. 2). This can be understood as districts with a higher capacity to pay having a higher per capita health expenditure.

Second, the study suggests a clear spatial pattern of the share of older adults and health expenditure across the districts of India. The Moran's I statistic for the proportion of older adults in the districts was 0.72, which confirms the spatial clustering in districts of India. A higher level of PAHE clustering was observed in the

demographically developed states of Kerala, Tamil Nadu, Maharashtra, Goa, and Punjab. Similarly, a lower level of PAHE was found clustered in the demographically disadvantaged north-eastern states of Assam, Manipur, Meghalaya, Mizoram, etc.

Third, we found a clear spatial interlinkage of ageing with the household health expenditure in India. The bivariate Moran I value for the share of older adults and PAHE was found to be 0.48, which depicts a clear spatial association of the population ageing with the household health expenditure. Though understanding the ageing gradient of the health expenditure was complex, our results confirmed that the share of the aged population significantly affected the health expenditure in the districts of India.

Fourth, the study, using both the OLS and the SEM models, found that the share of population aged 60 or more has a clear interlinkage with the health expenditure in India. Apart from this, we found that some other district level meso scale corelates – such as APCE, mean household size, district level wealth index, and percent urban – significantly determined the health expenditure.

The Government of India has taken initiatives to improve the health and financial security of and the social support for the population aged 60 or more, in India. The National Policy on Older Persons (NPOP) was framed in 1999 in response to the increasing number and proportion of older persons and their disadvantaged status in terms of social, economic and physical well-being (MoSJE 1999) . The Senior Citizens Act 2011, which was a modified version of the NPOP 1999, revisited the various issues related to age and ageing, focussing especially on rural aged, women, and disadvantaged groups. The Ministry of Health and Family Welfare (MoHFW) has implemented the *National Programme for the Healthcare of the Elderly (NPHCE)* for providing free, specialized health care facilities, exclusively to the older people, through the state health delivery system (Giri et al. 2011). Recently the Ayushman Bharat scheme was launched with the intent to provide financial assistance for health care for all age groups, with specific provisions for the aged population. Despite these sincere efforts, health, social care, and financial security of the aged in India remains a challenge.

The study could not use more explanatory variables to explain the variations in health spending across the districts of India. The census of India provided a limited set of variables, and key variables such as per capita income, prevalence of non-communicable diseases, and use of medical care could not be included in the analysis. In addition, we derived the estimates of health expenditure by pooling data from two different rounds of the survey due to data constraints and used regional proxies for 40 districts of the country.

Conclusion

Monitoring progress towards universal health coverage is an inherent part of the global sustainable development agenda, which also focuses on the financial mechanism. There is a need to find appropriate, valid, reliable and comparable estimates at the minimal geographical level. With that context, this study found the share of older adults and the per capita annual health expenditure in the districts of India.

This information is important for the policy makers to monitor the progress across the districts and to implement context specific programmes and policies. The districts with a high share of the older population need to be targeted for providing geriatric care, public health centres, old age homes, aged friendly parks and community centres, facilities of public transport, etc. Understanding the association of ageing with the health expenditure using geospatial analysis is another important contribution of the paper. The pattern of ageing and health spending is intriguingly important to understand the disadvantaged clusters (districts). There is a definite need to emphasize the fact that not only are disease and disability a part of old age, but rising health care expenditure is too. There is a need to address the health problems of the older adults, including financial catastrophes, through insurance as well as other security systems. Apart from that, the concept of active ageing or healthy ageing should be promoted. With the rising number of older adults, there is a rising need for care givers for informal and traditional health care at the level of the household. At the same time, the government should also focus on institution-based long-term care.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they do not have any conflict of interest.

Ethics Approval and Consent to Participate Since the survey was based on secondary data, which is available in the public domain, no prior approval was needed.

Ethical Treatment of Experimental Subjects (Animals and Humans) No experimental treatment was conducted on either human or animal subjects in this study.

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