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Abstract

Ageing is associated with increased vulnerabilities, decline in social skills and other capabilities. Prevalence of depression among elderly people is much higher in Low- and Middle-Income Countries (LMICs) and adult children are considered as the primary care givers in these countries. It is the general perception that co-residence with adult children facilitates their daily activities and provide financial support. International literature shows mixed results in this context though Indian studies are showing the positive impact of co-residence with adult children on mental health of elderly patents. However, no study corrects the possible endogeneity in the relationship neither they explore the possible role of formal and informal health care services in mental health-co-residence relationship. The current study examines the effect of co-residence with children on the mental health of elderly people in the age category of 60 and above using Longitudinal Ageing Study in India (LASI) 2017-18. After correcting for endogeneity through Propensity Score Matching and Instrumental Variable method, the results suggest that elderly parents living with their children are less likely to be in a state of depression. However, this relationship crucially depends on the formal or informal health care the parents need.

Keywords*: Ageing population; Mental health; Living arrangement: LASI*
JEL Codes: *J14, I12, J11*

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INTRODUCTION

Population ageing is a remarkable human achievement. The advancement in public health, medicine and socio-economic development plays a pivotal role in controlling diseases, preventing injuries, and reducing the risk of premature death. In 2019, the global population recorded 703 million individuals aged 65 or older (World Population Ageing 2019). Global life expectancy has risen dramatically, increasing from 34 years in 1913 to 72 years in 2022, with projections indicating a continued upward trend in the long term. This demographic transition resulted in health, social and economic challenges in coming decades (Bloom, D. E., & Zucker, L. M., 2022) and is more complex in low- and middle-income countries (Banerjee et al., 2023).

Ageing often leads to increased vulnerabilities, including a decline in social skills and other capabilities. Overall well-being of all individual irrespective of their age is challenging in developing countries because of urbanization and changing family structure (Irshad et al., 2024). In addition to these factors increased education, migration for employment and better economic opportunities have led adult children to move out of traditional households (Deshingkar and Akter 2009). Absence of public support system increase the health and economic vulnerability of elderly people (Bloom et al., 2010; Irudaya Rajan, 2007). In these countries adult children are expected to be the primary care givers to the elderly parents with mental and physical ailments such as dementia or other chronic diseases (Blieszner et al, 2017). Co-residence with adult children facilitates their daily activities and provides financial support (Bianchi et al., 2007).

Attias-Donfut et al. (2005) report that co-residence is in higher proportion in Asia as compared to Africa. Co-residence is not uncommon in Europe (Keasberry, 2001). Having more siblings provides health benefit for parents who live with any of their children, possibly because siblings share the caregiving responsibilities in Indonesia (Johar &

Maruyama, 2014). In other Asian countries like Japan, India, and China patriarchal family structure is followed (Wakabayashi and Horioka 2006; Ngin and DaVanzo 1999).

In India the decision to co-reside is influenced by factors like sex of parent, marital status, wealth, number of children, and health of the elder people (Mandal & Subaiya, 2024). Living arrangements for elderly parents with health issues can significantly impact their health, well-being, and access to formal and informal care (Hays 2002). Samanta et.al (2015) report that multigenerational living has a positive impact on health of elderly parents in India and solitary living results in worst health outcomes. In contrary Mandal & Subaiya (2020) report that excellent and good health is associated with independent living and elderly people co-reside with their children if they suffer from vision and memory disability.

According to LASI (2017-18), the likelihood of single or multi-morbidity as well as limitation in activity of daily living (ADL) or instrumental activity of daily living (IADL) of elderly people in India increases with age. The decline in mental health is also a prominent feature of ageing, with depression being a significant component of mental health. There is a two-way relationship between depression (mental health) and physical health. Decline in physical health causes depression and vice versa (Banerjee et al., 2023).

In low and middle-income countries (LMICs) like India, mental health issues are often underemphasized. High-income countries allocate an average of 3.4 percent of total government expenditure to mental health, whereas LMICs allocate only 0.3 percent (Ridley et al., 2022). This limited spending leads to a shortage of trained professionals and treatment availability; for instance, in India, there are only 3,900 psychiatrists for a population exceeding 1.3 billion (WHO, 2018). Within this context, the mental health and well-being of elderly individuals remain a low priority in both policy and research agendas (Banerjee et al., 2023). In addition to low priority, published research on public health

which focuses on mental health is also less. In LMICs, only 2.7 percent of published works are there compared to 8 percent in rich countries (WHO, 2021). Data availability is a significant challenge; the Global Burden of Disease database lacks data for 88 out of 134 LMICs.

The existing studies primarily focused on the support from adult children to parents in the form of shared house, motives for intergenerational transfers and strategic use of bequests by parents for the attention from children (Pezzin & Schone, 1999). The general perception is that elderly parents are happy to live with their adult children. Previous research has shown mixed results on the impact of co-residence on the subjective well-being of elderly parents. Given this background, the current paper intends to explore the role of formal and informal care in the relationship between elderly mental health and co-residence with children after controlling for the possible endogeneity, which has been largely ignored in the extant literature The rest of the paper is arranged in the following way. The next section delineates the existing literature whereas section 3 gives an overview of the data and methodology. Section 4 discusses the results, and the final section puts forward the concluding remarks.

REVIEW OF LITERATURE

This section briefly delineates both the theoretical and empirical literature which are relevant for the current study.

Theoretical underpinning

Works by Mushkin (1962), Becker (1964) and Fuchs (1966) considered health as one of the components of the stock of human capital. While Grossman (1972b) in his theory of demand for health explains that people care about better health, and medical care is one of the inputs for producing health, he utilizes the household production function model of consumer behavior. Van Houtven and Norton (2004) extended the Grossman model of health demand by including informal caregiving. In

addition to the factors affecting demand for healthcare among the general population, the use of informal care plays a significant role in the case of elderly people. The study proposes that parent's health status is a function of informal care, formal care and stock of human capital. Stabile et al. (2006) propose a choice-theoretical model where there is a two-person household; one is a care recipient and the other is a healthy caregiver. Dependent elderly people require "long-term care" for doing household management and personal care. Pezzin et al. (1996) use a neo-classical household production model of family decision making, where the family is the single decision maker and tries to maximize the household utility. In this framework elderly person's functioning is produced in two settings: either in a community setting (formal and informal care) or in an institution (nursing home services). Following the models of Grossman (1972b) and Rosenzweig and Schultz (1983), Kutty (2000) develop a household production function of elderly functionality. The study uses the framework of utility maximization.

Empirical Evidence

Co-residence and Elderly Health

The traditional family system, which has long been the foundation of economic security and social support for the elderly, is weakening due to socio-economic changes, a common trend observed in both less developed and developed regions. Co-residence is more common in Asia and Africa; in 13 countries - Afghanistan, the Gambia, Guinea, India, Iraq, Lao People's Democratic Republic, Maldives, Morocco, Nepal, Pakistan, Senegal, Yemen, and Tajikistan - more than 75 percent of elderly people live with their children (Kamiya & Hertog, 2020). Co-residence with children is less common in the US and Europe; however, studies by Shailen and Selwyn (2011) and Caputo (2019) report that the proportion of elderly people living with their children increased following the Great Recession of 2007–2009. Living arrangement of elderly people is closely linked to their economic well-being, physical and psychological health and life satisfaction (Henning- Smith et al., 2018). Depression is a

major indicator and component of poor well-being and low life satisfaction (Kahneman and Krueger 2006).

The ageing population increase the cost of both market-provided care, demand for informal and long- term care (Pezzin & Schone, 1999(Pezzin et al., 1996)). Formal and informal care is considered as the inputs in the elderly health production function (Barnay & Juin, 2016). Elderly parents' health is a function of total informal care, formal care (Byrne et al, 2009; Van Houtven and Norton, 2004) and human capital (Van Houtven and Norton, 2004). Additionally, elderly parents and their families have a strong preference for care in their homes rather than the institutions (Pezzin et al., 1996). Barnay & Juin (2016) report that informal care lowers the likelihood of depression among dependent elderly people.

In developing countries like India, adult children take care of their elderly parents (Mandal & Subaiya, 2024). The Census of India (2011) reports that in 2011, the older adult population of India constituted 8%, whereas by 2026, it is expected to increase by 12.6% of the total population. The primary reason for elderly people to move in with their adult children is poor health, economic hardship from independent living, and widowhood (Crimmins and Ingegneri 1990). Previous studies (Samanta et al, 2015; Agrawal, 2012; Mandal & Subaiya, 2024) show that elderly parents living independently suffer from worse health conditions (chronic as well as acute). The increase in the elderly population demands an urgent need for elderly care and support (Jadhav et al., 2003).

Mental Health

Mental health is a crucial aspect of the overall well-being of older adults, and its decline is a prominent feature of ageing. The Diagnostic and Statistical Manual of Mental Disorders describes depression as a family of disorders characterized by "the presence of sad, empty, or irritable mood, accompanied by related changes that significantly affect the individual's

capacity to function" (American Psychiatric Association 2022). Mental health issues are underemphasized in LMICs, resulting in inadequate results 1.4 mental health workers per 100,000 population (Ridley et al. 2020). Early identification of depression improves the quality of life (Pilania et al., 2019).

In LMICs well-being and mental health of the elderly population is the least policy and research priority (Banerjee et al., 2023). Globally, 3 to 4% of the population suffers from depression (James et al., 2018), and the prevalence of depression among elderly people is much higher in LMICs as compared to the US (Banerjee et al., 2023). Thornicroft et al. (2017) report that in LMICs, 90 percent of cases of major depressive disorder are untreated. Depression, a significant element of mental health, contributes to disability, dementia, and increased mortality risk (LASI 2017- 18). The study by Kahneman and Krueger (2006) also finds that physical health, poverty and social isolation are strongly connected with depression.

Banerjee et al (2023) report that the prevalence of symptoms of depression among the elderly is higher in poor countries. In India, 26 percent of men and 31 percent of women aged 61-70 have a higher likelihood of depression. Global ageing and adult health (WHO 2007-10) reports that the prevalence of depression is higher in the Indian elderly population as compared to other countries like China, Ghana, Mexico, Russia and South Africa. Solitude living in India is associated with negative health outcomes, including mobility issues, pain or discomfort, and anxiety or depression. In contrast, co-residential living enhances the overall satisfaction of elderly individuals (Srivastava et al., 2021; Sarkar et al., 2023).

Ageing is associated with physical decline like falling, inability to carry out daily activities, such as bathing, walking, and household chores. Poor physical health acts as one of the factors for depression and vice versa; it reflects a two-way causal relationship. In addition to this, factors

like social isolation and poverty (Banerjee et al., 2023) add to depression. Mental health problems are significantly associated with poor life satisfaction. There is a clear difference in life satisfaction between individuals with poor mental health issues and those without symptoms (Bramhankar et al., 2023). Previous studies report that there is a strong association between poor self-rated health, limitation in ADL and IADL and low cognitive judgement of life satisfaction (Perianayagam, A et al., 2022; Kulkarni et al., 2023).

Ageing is associated with long-term care, for which elderly people depend upon family members (Pezzin & Schone, 1999) and formal care also plays an important role (Byrne et al, 2009; Van Houtven and Norton, 2004). The role of formal care obtained from medical facilities and informal care that family members can provide has largely been missing from existing Indian studies. The majority of studies (Samanta et al, 2015; Agrawal, 2012; Mandal & Subaiya, 2024; Srivastava et al., 2021; Sarkar et al., 2023) primarily focus on the physical health of elderly people and living arrangements. These studies ignore the possible endogeneity in the relationship between the health of the elderly and co-residence with children. Without addressing the endogeneity issue, the results will be biased and inconsistent. This study tries to find the association between the mental health of elderly people and living arrangement by addressing the endogeneity in the relationship; it also proposes a theoretical framework for elderly mental health and care provided by family members, which forms the backbone of the empirical study.

Theoretical Framework

We propose a theoretical framework for elderly well-being and formal-informal care following Kutty (2000) and Stabile et al (2006). We consider a simple model using a representative household with both caregivers and care-receivers. In a two-person household, where one person is a care receiver and the other is a healthy caregiver (we assume that the caregiver is the adult child of the elderly), household utility is defined as

$$U = U(x, l, F, W, \tau) \quad (1)$$

Where x= market goods and services, not related to daily functional health of elderly
l= leisure time
F= ability of the care-recipients to perform daily activities or functional health
W= mental wellness of care recipient
τ= household preference
A care recipients mental wellness is defined by the production technology:

$$W = W(M_1, M_2, F, H) \quad (2)$$

Where M_1= formal care (hospitalization, medicines, out-patient care, nurse, etc.)
M_2= informal care (mostly given by care givers, here the adult child)
H= care recipient's health status (initial health endowment including genetic condition)
A care recipient's functional health is defined by the production technology:

$$F = F(M_1, M_2, h) \quad (3)$$

h= exogenous health conditions, such as hypertension/ stroke/ diabetes
The production function for W can be rewritten as:

$$W = W(M_1, M_2, h, H) \quad (4)$$

The following is the budget constraint for the household:

$$\mathrm{I} = \sum_{t=1}^{3} Z_t p_t \quad (5)$$

Where Z= consumption goods, formal care, informal care
I= exogenous money income (include wage and non-wage income)
p_t= exogenous prices

The household's reduced form demand function for M_1\ and\ M_2\ can be derived from maximization of the utility function (given by equation (1)), subject to the production function of W and F and the budget constraint.

$$M_1 = f(I,,h,H,p)$$
$$M_2 = g(I,,h,H,p)$$

p= price vector

These values can be inserted in equation 4 to get:

$W =$

$W(I,,h,H,p)$ (6)

p includes cost of personal assistance and comorbidities, which decides whether assistance is required for daily activities or not.

Equation (6) also explains role of comorbidities, which decides whether assistance is required for daily activities or not, on mental wellness of the elderly.

Data and Methodology

Data source

The data for this study is sourced from the Longitudinal Ageing Study in India (LASI) conducted during 2017–2018. LASI provides nationally representative data collected from individuals aged 45 and above, along with their spouses regardless of age. The first wave of LASI included a panel sample of 73,396 participants aged 45 and older, encompassing 31,902 elderly individuals (aged 60 and above) and 6,880 oldest-old individuals (aged 75 and above) across all Indian states and union territories.

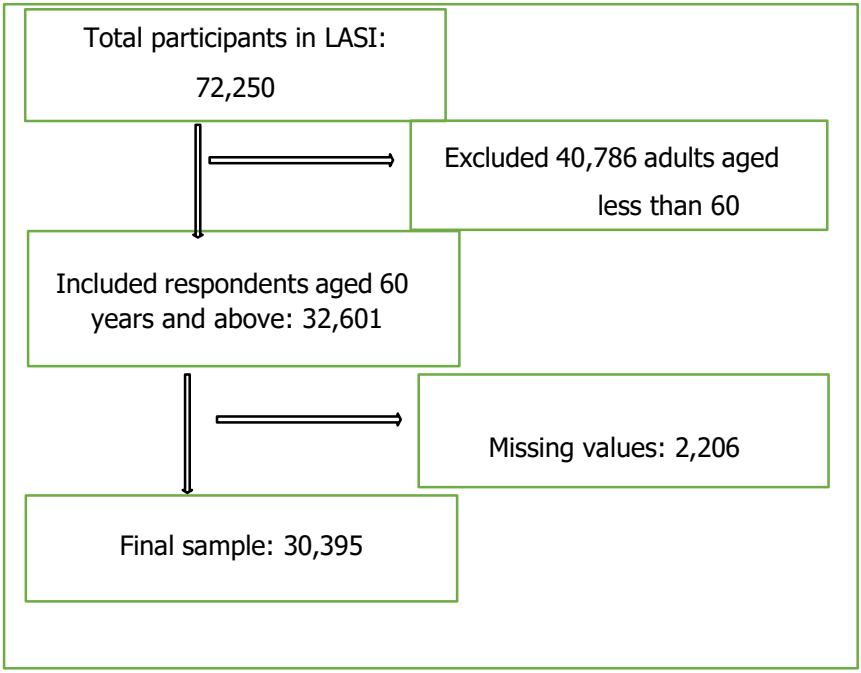
LASI employed a multistage area probability cluster sampling design, with a three-stage design used in rural areas and a four-stage design in urban areas. In the first stage, Primary Sampling Units (PSUs), such as tehsils or taluks, were selected. The second stage involved selecting villages in rural areas and wards in urban areas. For rural areas, households were chosen from the selected villages in the third stage. In

urban areas, an additional stage was included: one Census Enumeration Block (CEB) was randomly selected within each urban ward in the third stage, and households were then selected from these CEBs in the fourth stage.

The LASI survey instrument includes a household survey schedule, an individual survey schedule, and biomarker surveys. For this study household roster, household, individual and community survey schedules are merged.

Figure 1 describes sample selection procedure of this study. After merging the household roster, household and individual survey schedules, the total number of respondents is 72,250. The current study focuses on those who are aged 60 and above so the sample was reduced to 31,464. The final sample was further reduced to 30389 due to the missing values in the variable depressive symptoms created using different variables given in the LASI dataset.

Figure 1: Sample Selection of the Study



Variables

Depression

Depression serves as the primary dependent variable and is characterized as a prolonged period (minimum of two weeks) during which an individual experiences a depressed mood or a loss of interest or enjoyment in previously pleasurable activities (Gururaj et al., 2016). Older adults having depressive symptoms tend to have worse functioning compared to those with chronic medical conditions (WHO, 2017). Major depression among elderly is measure using Centre for Epidemiologic Studies Depression Scale (CES-D). the original CES-D scale is a 20- item scale but LASI uses a shortened version with 10 items and four response categories.

The 10 items include seven negative symptoms (trouble concentrating, feeling depressed, low energy, fear of something, feeling alone, bothered by things, and everything is an effort) and three positive symptoms (feeling happy, hopeful, and satisfied). The response options included: rarely or never (<1 day), sometimes (1–2 days), often (3–4 days), and most or all of the time (5–7 days) during the week preceding the interview. For negative symptoms, responses of rarely or never (<1 day) and sometimes (1–2 days) were assigned a score of zero, while often (3–4 days) and most or all of the time (5–7 days) were scored as one. The scoring for positive symptoms was reversed. The total score ranges from zero to ten, with a score of four or higher used to determine the prevalence of depressive symptoms (Mandi et al., 2023, Irshad et al., 2024). In this study prevalence of depression is categorized as ordinal variable; no depression (CES-D score=0), moderately experiencing depression (CES-D score between 1 and 3), higher depressive symptoms (CES-D score is greater or equal to 4).

Living arrangement

Living arrangements represent an individual's social support and play a crucial role in determining overall life satisfaction and quality of life. LASI provides information about living arrangements and the number of living

children. Using these variables, a new variable called living arrangement is created, and it is categorized as a binary variable which takes the value 1 if the elderly parents are living with their children and 0 if the elderly parents are not living with their children.

Control Variables

Functional health

As age increases, the individual's ability to perform survival-related activities decreases. Functional health is measured using the Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL). ADL reflects daily self-care activities such as bathing, dressing, grooming, movement from bed, changing position from sitting to standing, feeding and personal hygiene. IADLs are not related to fundamental functioning but allow an individual to live independently in society. It includes activities like preparing meals, shopping for groceries, managing money, making telephone calls, taking medication, doing work around the house or garden and getting around or finding an address in unfamiliar places. The LASI dataset provides information about whether they have limitations in these activities or not.

A new variable called total assistance is created by combining these variables and takes a range of 0 to 13. Using total assistance, an ordinal variable with three categories is created. First category "no assistance" takes a score of 0, second category "some assistance" takes the value between 1 and 5, third category "full assistance" takes the value between 6 and 13.

Socio-economic and demographic variables like age, gender, MPCE, place of residence, working status, education and so on are included as control variables.

Insights from data

Descriptive statistics

Table 1: Descriptive statistics (elderly people aged 60 and above)

	No depression	Prevalence of depression
N	79,865,623 (69.8%)	34,571,714 (30.2%)
Place of residence		
Rural	15,303 (69.9%)	6,279 (73.8%)
Urban	6,586 (30.1%)	2,227 (26.2%)
Religion		
Hindu	18,029 (82.4%)	7,095 (83.4%)
Muslim	2,314 (10.6%)	945 (11.1%)
Christian	638 (2.9%)	245 (2.9%)
Others	908 (4.1%)	220 (2.6%)
Social category		
SC	3,870 (18.1%)	1,886 (22.5%)
ST	1,909 (8.9%)	653(7.8%)
OBC	9,635 (45%)	3,699 (44.1%)
None of the above	5,988 (28%)	2,145 (25.6%)
MPCE quintile		
Poorest	4,497 (20.5%)	2,102 (24.7%)
Poorer	4,858 (22.2%)	1,770 (20.8%)
Middle	4,589 (21.0%)	1,724 (20.3%)
Richer	4,340 (19.8%)	1,513 (17.8%)
Richest	3,605 (16.5%)	1,397 (16.4%)
Age group		
65- 64 years	6,804 (31.1%)	2,475 (29.1%)
65- 69 years	6,473 (29.6%)	2,361 (27.7%)
70-74 years	4,136 (18.9%)	1,584 (18.6%)
75+ years	4,476 (20.4%)	2,087 (24.5%)
Gender		
Female	11,173 (51.0%)	4,849 (57.0%)
Male	10,716 (49.0%)	3,657 (43.0%)
Education		
Illiterate	11,666 (53.3%)	5,421 (63.7%)
Less than 5 years	2,573 (11.8%)	949 (11.2%)
5-9 years completed	4,177 (19.1%)	1,310 (15.4%)
10 years or more	3,474 (15.9%)	827 (9.7%)
Working status		

Never worked	7,205 (32.9%)	2,391 (28.1%)
Currently working	8,909 (40.7%)	3,836 (45.1%)
Currently not working	5,775 (26.4%)	2,276 (26.8%)
Marital status		
Currently not in union	7,797 (35.6%)	3,763 (44.2%)
Currently in union	14,092 (64.4%)	4,743 (55.8%)
Number of alive children		
No alive children	657 (3.0%)	394 (4.6%)
One child	1,716 (7.8%)	657 (7.7%)
Two children	3,539 (16.2%)	1,251 (14.7%)
Three or more children	15,967 (73.0%)	6,204 (72.9%)
Self-reported depression		
Inaccurate	402 (1.8%)	8,124 (95.6%)
Accurate	21,483 (98.2%)	(4.4%)

Source: LASI 2017-18
Note: Author's own calculation

The socio-economic and demographic profile of elderly people aged 60 and above is given in Table 1. The data suggest that those who are depressed them 74% rural and only 26% are urban. Among the social categories, the incidence of depression is highest among the elderly of the OBC category and those who are Hindu by religion. The poorest people are more depressed so as are people with only primary education. The elderly who are currently not working are more depressed, whereas people currently living in union are showing more depressive symptoms. The depressed elderly population is, however, dominated by the age group 65-64 and people with 3 or more children. More female elderly are depressed than males. Among those who have the prevalence of depression, 95.6% inaccurately report self-reported depression and only 4.4% report they have depressive symptoms. 98% of people who haven't any kind of depression accurately report self-reported depression, and only 2% report depression inaccurately.

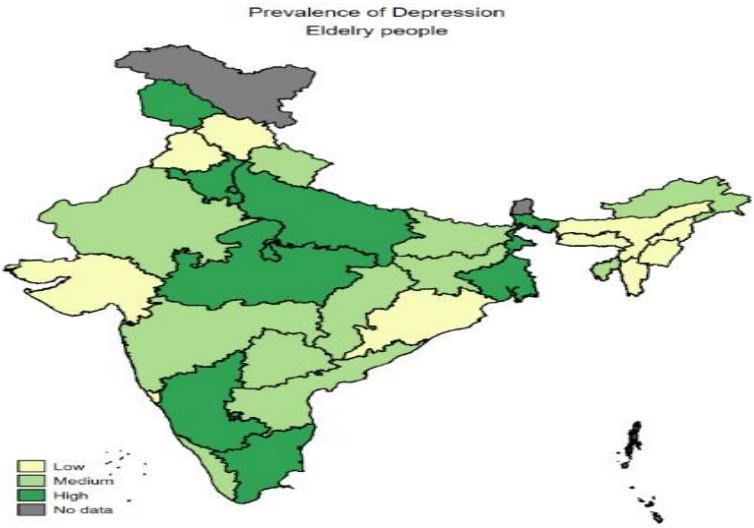
Living arrangement and depression

Table 2: Prevalence of Depression and Living Arrangement

Living arrangement	Depression (%)		
	No depression	Prevalence of depression	Total
Living alone	53.90	46.10	100
Living with spouse/ others	68.32	31.68	100
Living with children	71.64	28.36	100

Source: LASI 2017-18
Note: Author's own calculation

Table 2 shows the incidence of depression over different living arrangements. The prevalence of depression among those who live with children and spouses is 28.36 percent, and 71.64 percent of elderly people do not have any depressive symptoms. Among those who live with spouse/ others, 68.32 percent do not experience any kind of depressive symptoms, while 31.68 percent show prevalence of depression. 53.96 percent of elderly people live alone, do not have depression and 46.02 percent have depression. Thus, elderly people who are living alone or not living with spouse/ others are experiencing more depression than those who are living with children and spouse.



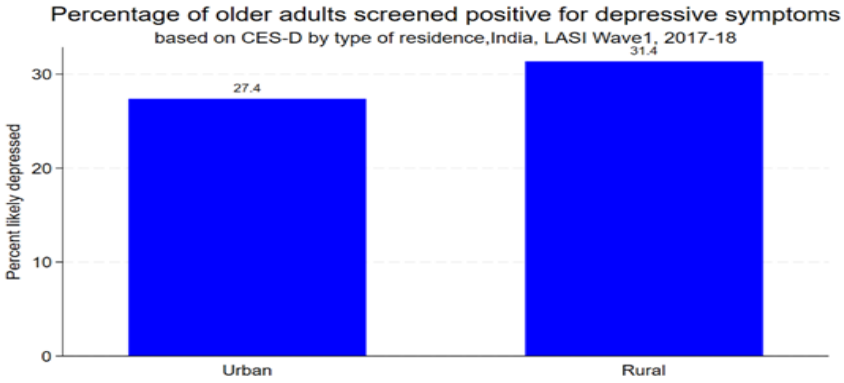
Source: LASI 2017-18
Note: Prevalence of depression in India (Author's own calculation)

Figure 2 shows how the prevalence of depression among elderly people varies across the states.A higher rate of depressive symptoms is observed in states like Tamil Nadu, Karnataka, Madhya Pradesh, Uttar Pradesh, West Bengal, Haryana and Delhi. States like Kerala, Andhra Pradesh, Telengana, Maharastra, Rajastan, Bihar, Jharkhand, Arunachal Pradesh and Tripura show a medium prevalence of depression. Gujarat, Himachal Pradesh, Odisha, Manipur, Mizoram, Nagaland and Assam show a lower prevalence of depression among elderly people.

Rural urban difference in prevalence of depression

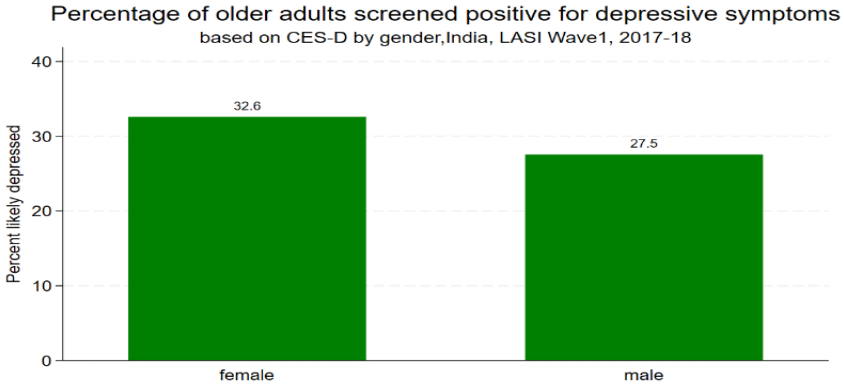
LASI data shows that in rural areas, 68.63 percent of elderly people (60 and above) do not have any kind of depressive symptoms, and 31.4 percent of elderly people suffer from depression. While in urban areas, 72.6 percent of elderly people don't experience any depressive symptoms, and 27.4 percent of elderly people report a prevalence of depression. Elderly people living in rural areas are more vulnerable to depression as compared to urban counterparts.

Figure 3 shows that in rural areas 31.4 percent of elderly people suffer from depression whereas in urban area it is 27.6 percent of elderly suffering from depression (refer to Figure 3).



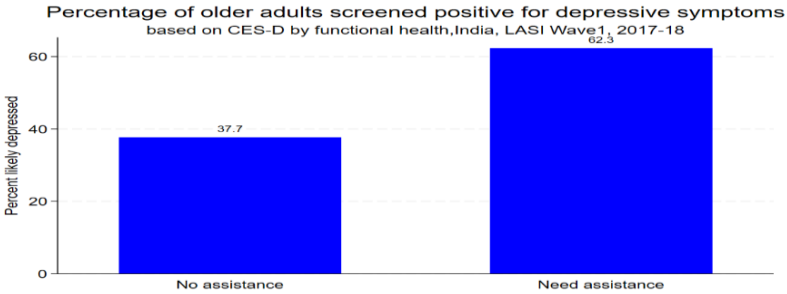
Source: LASI 2017-18
Note: Rural-urban difference in prevalence of depression (Author's own calculation)

Gender difference in the prevalence of depression



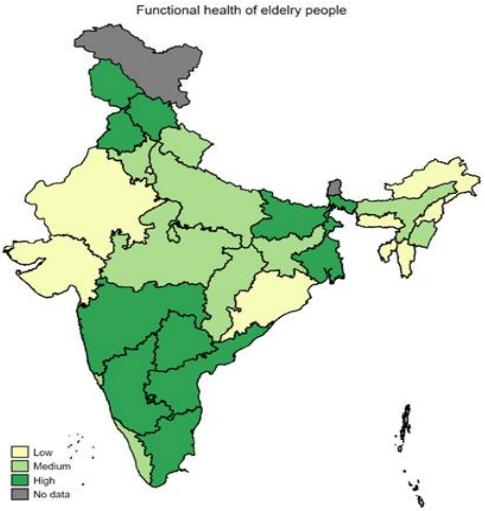
Source: LASI 2017-18
Note: Prevalence of depression in gender (Author's own calculation)
As can be observed from Figure 4, there is a gender difference in the prevalence of depression among older adults. A higher percentage of older women (60 and above) report depressive symptoms compared to their male counterparts. Specifically, 32.6% of older women experience depressive symptoms, whereas the prevalence among older men is 27.5%.

Depression and Functional Health



Source: LASI 2017-18
Note: Relationship between depressive symptom and functional health (Author's own calculation)

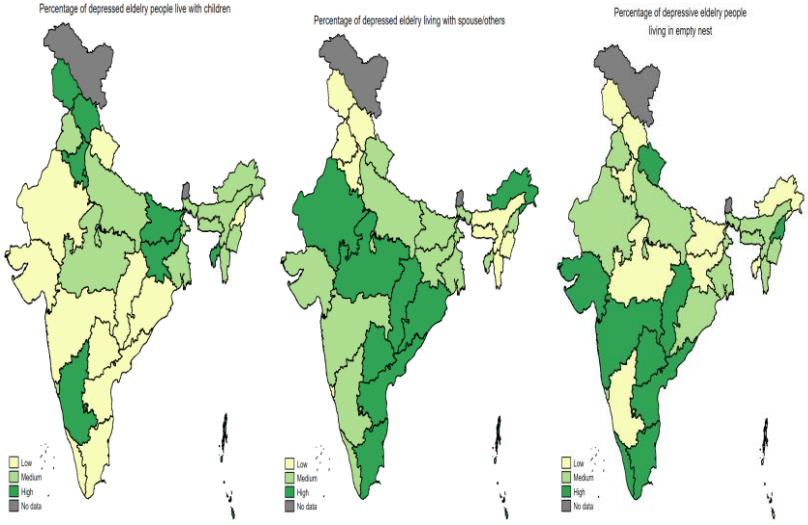
As per LASI data, among elderly people with depressive symptoms, 38 percent do not require assistance with daily activities, indicating good functional health. 62 percent need assistance, suggesting some functional limitations despite the absence of depression (refer to Figure 5).



Source: LASI 2017-18
Note: Relationship between depressive symptom and functional health (Author's own calculation)

Fiure 6 shows the functional health (ability to perform daily activities) of elderly people in India. Poor functional health is shown in states like Tamil Nadu, Karnataka, Andhra Pradesh, Telengana, Maharastra, Punjab, Himachal Pradesh and West Bengal. States like Kerala, Goa, Madhya Pradesh, Uttar Pradesh, Jharkhand, and Assam show moderate levels of functional health. Meanwhile, states like Gujarat, Delhi, Rajastan, Odisha, Meghalaya, Mizoram, Tripura and Nagaland have better functional health.

Living arrangement



(a) (b) (c)

Source: LASI 2017-18
Note: Living arrangement in India

Figure 7 shows the distribution of the living arrangements in India. Elderly people living with adult children are higher in states like Jammu and Kashmir, Himachal Pradesh, Punjab, Chandigarh, Delhi, Haryana, Meghalaya and Manipur. In contrast, states like Kerala, Tamil Nadu, Andhra Pradesh, Telengana, Madhya Pradesh, Odisha and

Nagaland experience a lower rate of elderly people who co-reside with adult children (figure 7a).

Figure 7b shows the distribution of the elderly population living with spouse/ others. States like Kerala, Tamil Nadu, Andhra Pradesh, Telengana, Madhya Pradesh, Rajasthan, Uttarakhand and Bihar have a higher rate of elderly people living with spouse/ others. Elderly people with spouses are lower in Delhi, Haryana, Punjab, Maharashtra, Mizoram, Meghalaya, and Manipur.

Figure 7c shows the distribution of elderly living in empty nest households, i.e., living alone. States like Tamil Nadu, Andhra Pradesh, Telengana, Madhya Pradesh, Chhattisgarh, Odisha and Nagaland have higher rates of empty nest households. Whereas states like Punjab, Haryana, Himachal Pradesh, Delhi, Manipur, Meghalaya, and Mizoram have a lower rate of elderly people living in empty nests.

METHODOLOGY

The study aims to find the impact of co-residence with adult children on the mental health of the elderly parents. The equation of interest to establish this relationship is presented in equation 7.

$$MH_i = \beta_0 + \beta_1 LA_i + \beta_2 FH_i + \beta_3 X_i + \varepsilon_i \quad (7)$$

Where, MH_i is the mental health of the elderly parent, which is a binary variable, takes the value 1 if the elderly parent is experiencing depressive symptoms and 0 otherwise. The main explanatory variable is living arrangement (LA_i), which is also a binary variable, takes 1 if elderly parents are living with their adult children and 0 if they are not living with their children. Functional health (limitation in doing daily activities) also has an impact on mental health; hence, it is controlled in the analysis. Socio-economic and demographic variables like MPCE, working status,

education, place of residence, age, and gender are also controlled and $\varepsilon_i$is the non-stochastic term.

The primary interest of this study is finding the coefficient of the explanatory variable, living arrangement. While elderly individuals' decision to co-reside with adult children is not random. Dependent elderly parents prefer to live with family members (Pezzin & Schone, 1999) and poor mental health may increase the likelihood of receiving both formal and informal care (Barnay & Juin, 2016). Using ordinary regression (simple probit model) may overestimate the results even after controlling for covariates affecting the outcome variable (Heckman et al. 1996). In order to control the endogeneity issue, Propensity Score Matching (PSM) is used to estimate the effect of outcome (mental health) as caused by treatment (living with children) and also the IV method (extended ordered probit) is used as an alternative identification strategy.

In non-randomized experiments, direct comparison of treated and control groups is misleading thus using propensity score helps to compare the groups directly. Propensity score is defined as the function of the observed covariates (x) such that the covariates are independent of treatment (Rosenbaum & Rubin, 1983). In this study, propensity score is defined as the probability of elderly parents to live with their adult children, and it is estimated using a logit model with age, education, marital status and so on as confounders. Individuals with similar propensity scores share similar characteristics and they are matched using the nearest neighbourhood matching technique.

In the presence of reverse causality, i.e., poor mental health among elderly parents motivates the adult children to co-reside with them, the regressor and error term will be correlated; Cov (X, U) ≠0. Results estimated by a simple ordered probit model will be biased and inconsistent. Extended regression models (ERM) effectively address the endogeneity issue. Since the dependent variable is ordinal, extended oprobit (eoprobit) model is used in this study. The variable "non-resident"

(state-level percentage of non-resident family members taken from IHDS 2011-12) is used as an instrumental variable (IV). The IV should be correlated with the endogenous regressor; Cov (X, Z)≠ 0, but should not be correlated with the error term; Cov (Z, U)= 0 (Wooldridge, 2009).

RESULTS

We start with a simple OLS model, where the dependent variable is the mental health of the elderly parent (measured using the CES-D scale[1]) and living arrangement is the important explanatory variable.

In Table 3, we report the estimated coefficients associated with the variable living arrangement. The regression result with the full set of control variables is discussed in Table A1 in the Appendix.

In the simple OLS model (Panel A), the variable depressive symptom is considered continuous and endogeneity in the relationship is ignored. Since the estimated coefficients will be inconsistent and biased, PSM (Panel B) is performed, which will take care of the issue of endogeneity. For a better representation of the dependent variable, we have categorized the variable depressive symptoms into three categories: no depression, moderately experiencing depression and high depression, and the ordered probit model (Panel C) is used. In ordered probit, also endogeneity is not addressed, hence the eoprobit model (Panel D) is used, and the IV used is percentage of non-resident family members at the state level from IHDS-2 data.

Panel A of Table 3 shows the result from OLS estimation. Compared to the reference category, elderly parents who live with adult children are expected to experience 6.8 units lower depressive symptoms, which is significant at 1% level. However, the OLS regression model is naïve, and to control the endogeneity, we have applied the PSM

[1] We have used an alternative measure of depressive symptom as a robustness check, which is measured using the CIDI scale and gives similar results

technique. Since the decision to co-reside is not random, we re-run equation (7) only on those elderly parents with similar covariates. The PSM results are reported in Panel B of Table 3. If elderly parents are living with their adult children, the probability of experiencing depressive symptoms falls by 5.8 percentage points, which is significant at 1% level, compared to those elderly parents living alone. This estimate is similar OLS estimate.

The ordered probit model (Panel C) shows that elderly parents who live with adult children are 5.3 percent (significant at 1% level) less vulnerable to higher depressive symptoms. Co-residence with adult children also increases the likelihood of no depression among elderly parents compared to the reference category. After controlling for the potential endogeneity issue, the results from extended ordered probit model are reported in Panel D of Table 3. Elderly people living with children are less vulnerable to higher depressive symptoms as compared elders who are not living with adult children. The probability of having higher depressive symptoms falls by 39 percent (significant at 1% level) among the elderly who are living with adult children. Whereas the probability of no depression and having moderate depression increases by 11 percent and 28 percent (significant at 1% level). For entire table refer to Appendix table A1.

Table 3: Regression Estimates

	Depressive symptoms		
Panel A: OLS regression			
Living arrangement (not living with children ®)			
Living with children	-0.068***		
	(.014)		
No. of observations	22,034		
Panel B: PSM			
Living arrangement (not living with children ®)			
Living with children	-0.058***		
	(0.005)		
No. of observations	29,846		
Panel C: Ordered probit	Margins		
	No depression	Moderate depression	High depression
Living arrangement (not living with children ®)			
Living with children	0.0151***	0.038***	-0.053***
	(0.002)	(0. 008)	(0.011)
No. of observations	22,034		
Panel D: eoprobit (IV method)			
Living arrangement (not living with children ®)			
Living with children	0.115***	0.277***	-0.393***
	(0.018)	(0.027)	(0.045)
No. of observations	20,058		

Source: Author's own calculation using LASI 2017-18 data.

Note: *** p<0.01, **p<0.05, *p<0.01. The control variables used in the regression: functional health (no assistance is needed, some assistance is needed, full assistance is needed), MPCE quintile (poorest, poorer, middle, richer and richest), health insurance (yes/no), age is categorized as 65-69 years, 70-74 years, 75 and above, gender (male/female), marital status (currently in union/ currently not in union), education (illiterate, less than 5 years, 5-9 years completed, 10 years and more), place of residence (rural/urban), religion, caste, state level percentage of elderly people, state level percentage of health care facility and region (north, south, east, west and north east).

Heterogeneity Analysis

To establish the role of informal and formal care in reducing depressive symptoms among elderly parents living with their adult children, we take recourse to subsample analysis. We model the informal care by the functional health variable, which signifies the requirement of assistance by ageing parents for daily activities. We hypothesize that the assistance is provided by the adult children in the comfort zone of the house. On the other hand, the formal care is modeled as the in-patient and out-patient services availed by the elderly in a hospital. It includes doctor visits and medical and nursing care received from professional experts, which may be technically more efficient but may lack some personal touch.

Role of Informal Care: Assistance needed for daily activities

Table 4.1: Marginal effect of living arrangement if elderly parents have limitations in doing daily activities.

Variable	Marginal effect		
	No depression	Moderate depression	Higher depression
Living arrangement (not living with children ®)			
Living with children	0.150***	0.356***	-0.506***
Region controls	(0.022)	(0.043)	(0.506)
	Yes	Yes	Yes
No. of observation	9,134		

Source: Author's own calculation from LASI 2017-18

Note: *** p<0.01, **p<0.05, *p<0.01

Results in table 4.1 show that the elderly people who need assistance for doing daily activities, the probability of experiencing higher depressive symptoms fall by 51% among those who co-reside with adult children. The likelihood of no depression increases by 15% among dependent elderly if they live with their children. While the analysis shows that co-residence increases the chance of moderate depression among the elderly living with children compared to the reference category. Thus, those who need assistance in daily activities are better off if they co-

reside with their children as the adult children can provide better care to their ageing parents at home.

Role of Informal Care: Assistance is not needed for daily activities

Table 4.2: Marginal effect of living arrangement if elderly parents do not have limitations in doing daily activities

Variable	Marginal effect		
	No	Moderate	Higher
Living arrangement (not living with children ®)			
Living with children	0.024***	0.042***	-0.066***
	(0.0005)	(0.001)	(0.001)
Region controls	Yes	Yes	Yes
No. of observation	10,924		

Source: Author's own calculation from LASI 2017-18

Note: *** p<0.01, **p<0.05, *p<0.01

Table 4.2 shows the effect of living arrangement if elderly parents do not have any limitations in doing daily activities. Elderly parents who have better functional health, their probability of experiencing higher depressive symptoms falls by 6.6 percent if they co-reside with their adult children. The probability of experiencing no depressive symptoms increases by 2.4 percent among elderly parents who live with their adult children compared to the reference category. Thus, for parents who don't need assistance in daily living, for them co-residence with adult children is less effective.

Role of Formal Care: Access for Hospital/Doctor Visits

Table 4.3: Marginal effect of living arrangement if elderly parents have access to formal health care

Variable	Marginal effect		
	No	Moderate	Higher
Living arrangement (not living with children ®)			
Living with children	0.097***	0.219***	-0.317***
	(0.0002)	(0.0005)	(0.0007)
Region controls	Yes	Yes	Yes
No. of observation	12,267		

Source: Author's own calculation from LASI 2017-18

Note: *** p<0.01, **p<0.05, *p<0.01

Table 4.3 suggests that, compared to the reference category, those who live with children are 31% less likely to experience higher depressive symptoms if they receive formal care from hospitals. The likelihood of no depression (11%) and moderate depression increases (26%). Thus, formal care provides less comfort to ageing parents than informal care.

Role of Formal Care: Have No Access to Hospital/Doctor Visits

Table 4.4: Marginal effect of living arrangement if elderly parents do not have access to formal health care

Variable	Marginal effect		
	No	Moderate	Higher
Living arrangement (not living with children ®)			
Living with children	0.133***	0.358***	-0.491***
	(0.0002)	(0.0005)	(0.0004)
Region controls	Yes	Yes	Yes
No. of observation	2,866		

Source: Author's own calculation from LASI 2017-18

Note *** p<0.01, **p<0.05, *p<0.01

Table 4.4 reports the effect of co-residence on elderly parents if they do not have access to formal healthcare. Compared to the reference category, if elderly parents do not have formal care and live with their children, the probability of experiencing higher depression falls by 49 percent. The probability of experiencing no depression increases by 13 percent. Thus, those who don't need formal care for them co-residence is more effective in controlling mental health issues.

CONCLUSION

This study tries to examine the association between the mental health of elderly parents and their co-residence with adult children. The results show that if elderly parents are living with their adult children, it significantly reduces the likelihood of depressive symptoms among elderly people. Previous studies show that dependent elderly parents have a preference for informal care over formal care, and this study also corroborates with existing studies. The sub-sample analysis shows that informal care is more effective in reducing higher depressive symptoms among elderly parents than formal care. In the absence of a well-functioning public support system, informal care from adult children improves the mental health of elderly parents.

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APPENDIX

Table A1: OLS regression

Variables	coefficient
Living arrangement (not living with children ®)	
Living with children	-0. 069***
	(0.014)
Functional health (no health is needed ®)	
Some assistance is needed	0.081***
	(0.014)
Full assistance is needed	0.274***
	(0.019)
MPCE quintile (poorest ®)	
Poorer	-0.041**
	(0.018)
Middle	-0.044**
	(0.02)
Richer	-0.041**
	(0.02)
Richest	-0.043**
	(0.022)
Health insurance (no ®)	
Yes	-0.03*
	(0.016)
Work status (Currently working®)	
Ever worked but not working currently	0.039**
	(0.016)
Never Worked	0.02
	(0.021)
Age (60-64 ®)	
65-69 years	-0.019
	(0.016)
70-74 years	-0.041**

	(0.02)
75 and above	-0.038**
	(0.019)
Gender (female ®)	
Male	0.004
	(0.017)
Marital status (currently not in union ®)	
Currently in union	-0.061***
	(0.015)
Education (illiterate ®)	
Less than 5 years	-0.017
	(0.02)
5-9 years completed	-0.041
	(0.018)
10 years or more	-0.106***
	(0.026)
Residence (urban ®)	
Rural	0.006
	(0.016)
Religion (hindu ®)	
Muslim	0.009
	(0.02)
Christian	-0.045
	(0.029)
Other	-0.147***
	(0.027)
Caste (ST ®)	
SC	0.024
	(0.025)
OBC	-0.011
	(0.024)
Others	-0.022
	(0.026)

State level percentage of elderly people	0.038*** (0.011)
State level percentage of health care facility	-0.009*** (0.002)
Region (north ®)	
Central	-0.184*** (0.021)
East	-0.059*** (0.021)
North east	-0.103 (0.02)
West	-0.208*** (0.023)
South	-0.03** (0.02)

Source: Author's own calculation from LASI 2017-18

Note: *** p<0.01, **p<0.05, *p<0.01

Table A2: Extended ordered probit model (eoprobit)

Variables	Marginal effects		
	No	Moderate	High
Living arrangement (not living with children ®)			
Living with children	0.122*** (0.023)	0.296*** (0.029)	-0.418*** (0.052)
Functional health (no health is needed ®)			
Some assistance is needed	-0.034*** (0.003)	0.102*** (0.013)	0.137*** (0.016)
Full assistance is needed	-0.052*** (0.003)	-0.249*** (0.021)	0.301*** (0.023

MPCE quintile (poorest ®)			
Poorer	0.006	0.016	-0.022
	(0.004)	(0.011)	(0.015)
Middle	0.014***	0.036***	-0.051***
	(0.005)	(0.012)	(0.017)
Richer	0.016***	0.040***	-0.056***
	(0.005)	(0.013)	(0.018)
Richest	0.032***	0.064***	-0.096***
	(0.008)	(0.014)	(0.022)
Health insurance (no ®)			
Yes	0.007*	0.014*	-0.021*
	(0.004)	(0.007)	(0.011)
Age (60-64 ®)			
65-69 years	0.011***	0.027***	-0.038***
	(0.004)	(0.010)	(0.014)
70-74 years	0.018***	0.040***	-0.058***
	(0.005)	(0.011)	(0.016)
75 and above	0.018***	0.039***	-0.057***
	(0.005)	(0.011)	(0.016)
Gender (female ®)			
Male	-0.005	-0.011	0.016
	(0.005)	(0.010)	(0.015)
Marital status (currently not in union ®)			
Currently in union	0.020***	0.048***	-0.068***
	(0.004)	(0.010)	(0.013)

Education (illiterate ®)			
Less than 5 years	0.001	0.002	-0.003
	(0.005)	(0.012)	(0.017)
5-9 years completed	0.005	0.011	-0.015
	(0.004)	(0.010)	(0.014
10 years or more	0.018**	0.033***	-0.051**
	(0.007)	(0.013)	(0.020)
Residence (urban ®)			
Rural	0.003	0.008	-0.011
	(0.004)	(0.009)	(0.013)
Religion (hindu ®)			
Muslim	-0.007	-0.018	0.025
	(0.005)	(0.013)	(0.018)
Christian	0.004	0.008	-0.011
	(0.008)	(0.016)	(0.024)
Other	0.020**	0.033***	-0.053***
	(0.009)	(0.011)	(0.020)
Caste (ST ®)			
SC	-0.012**	-0.027**	0.039**
	(0.007)	(0.013)	(0.020)
OBC	-0.006	-0.011	0.016
	(0.007)	(0.012)	(0.019)
Others	-0.006	-0.012	0.018
	(0.007)	(0.013)	(0.020)
State level percentage of elderly people	-0.024***	-0.053***	0.077***
	(0.003)	(0.007)	(0.011)

State level percentage of health care facility	0.002***	0.005***	-0.008***
	(0.000)	(0.001)	(0.001)
Region (north ®)			
Central	-0.010**	-0.025**	0.035*
	(0.005)	(0.014)	(0.018)
East	-0.012***	-0.032***	0.044***
	(0.003)	(0.009)	(0.013)
North east	0.023***	0.036***	-0.059***
	(0.006)	(0.009)	(0.015)
West	-0.017***	-0.049***	0.065***
	(0.005)	(0.017)	(0.023)
South	0.013**	0.024***	-0.038***
	(0.005)	(0.009)	(0.014)

Source: Author's own calculation from LASI 2017-18

Note: *** p<0.01, **p<0.05, *p<0.01

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