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# Economics of Healthy Aging in India: A Multidimensional Perspective

## Abstract

Aging is the foremost challenge in recent times, given the demographic shift in populations across the world. It implies the costs of healthcare burden and involves economic and social security challenges through shortage of labor supply, consumption–saving paradox, increase in expenditure on healthcare, and most importantly, social capital among the developing countries. Furthermore, there is a likely challenge of old age security in terms of income and expenditure due to increasing healthcare costs and low earning incentives at older ages. India currently has the second largest population globally, with >9% of its population accounting for aging. Based on the multidimensional aging index (AI) using the latest longitudinal survey data of older adults in India, we examined the possible challenges of the economics of aging in India while examining the economic health and social outcomes of the elderly. Our results found that the elderly in India are highly exposed to negative impacts due to vulnerability in socio-economic and health spheres of life. Low labor force participation, lack of skills, and low literacy are the prevalent challenges faced by the elderly Indian population, particularly women. Similarly, the fiscal challenges include increased income tax and insurance coverage for the elderly, while health challenges imply a greater proportion of the disabled and multi-morbid, leading to more burden on the health and welfare system of India. Thus, given the possible short- and long-term effects of aging on the path of economic growth in India, policy incentives are required to minimize the impact and avert the burden of population aging in the country.

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# 1 Introduction

Population aging is one of the notable challenges in the upcoming times across the globe. With the demographic shift in the age structure, there are unprecedented challenges in terms of healthcare burden due to epidemiological transition (Dandona et al., 2017), and economic and social security burdens due to shortage of labor supply, consumption–saving paradox, increase in expenditure on healthcare, and poor social capital among the elderly (Gaag and Beer, 2015; Marešová et al., 2015). Furthermore, old age security is a possible challenge due to the trade-off between income and expenditure through increasing healthcare costs and low earning incentives at older ages (Bloom et al., 2010). Population aging through these challenges implies a specific burden on economic growth of countries, which are yet to surpass the threshold level of the economic prosperity (Thomas, 2014). Population aging will also hamper the growth process through prolonged post-retirement and decreasing saving capabilities, especially in the third world (Bloom et al., 2015). Similarly, there is a significant challenge of social security and addressing the needs for social cohesion and familial care for the elderly with the increase in the population aging in developing countries like India. Health and cognitive challenges have been already explored in detail, but focusing on economics and social security aspects is important and needs special attention in these countries. All these factors are key to healthy aging and need to be addressed in detail from a multidimensional perspective. Therefore, considering these challenges it is important to make a detailed account of all these aspects together, which will be the key focus of this study.

India has already reached the threshold level of population aging and will likely be the country with the world's largest aging population by the year 2050 (Subaiya and Bansod, 2011). The challenges of aging will be manifold in terms of health, social security, and economic well-being. Therefore, to understand future challenges of population aging in India, this study makes a comprehensive analysis of various dimensions of population aging in India. This study will be the first of its kind in India, where a detailed account of aging will be provided while computing the healthy aging index (HAI). Earlier studies have provided a detailed account of healthy aging indices across the countries, but in India, hardly any study so far has been conducted to analyze various dimensions of aging. Moreover, we applied the multidimensional methodology since we also included the economic aspect, which has been less focused by earlier studies while examining the healthy aging indices in. Therefore, this study contributes to the current literature in several ways. First, it provides the overall aging scenario of India, followed by a comprehensive analysis of various dimensions of aging. The study also provides a detailed account of the aging scenario in India based on the computed index and makes a state-level comparison, which is important since demographic transition in India has various phases across the states in India. Therefore, the computed aging index (AI) will give the state-level comparison of the aging scenario in India. Lastly, the study will provide the basis for understanding the multiple dimensions of aging in the policy context, given the considerable increase in the aging proportion and also vulnerability in terms of physical, mental, and socio-economic well-being of the elderly.

## 1.1 Population aging in India

India is currently the second populous country globally, with >9% of its population accounting for the aged population. As per the latest estimates, >130 million people aged ≥60 years live

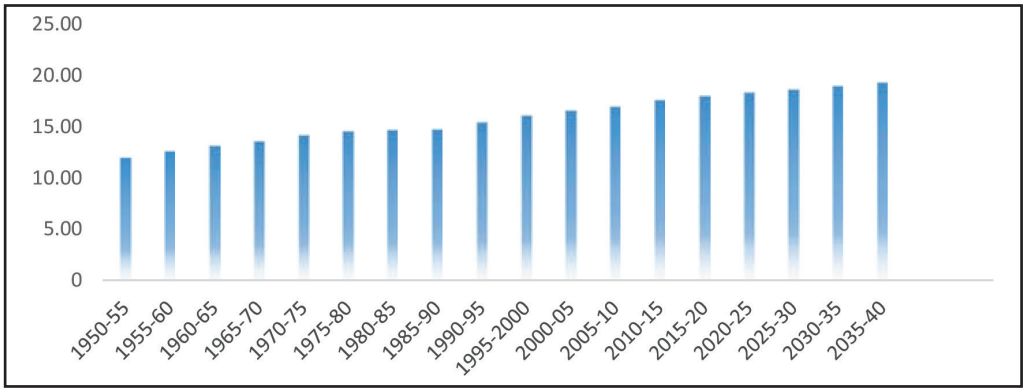
in India (Bloom et al., 2015). According to United Nations (UN) projections, these numbers will likely double and reach 20% by 2050 (WHO, 2020a). The older population will constitute a large population in India, and it will be the second largest population, with >200 million elderly people in the coming decades (Rajan and Aliyar, 2008). Similarly, an increase in life expectancy, which has almost improved by 20 points since 1950, will likely add up a large chunk of the population in the coming ages. Figure 1 shows a dramatic shift in life expectancy at age 60 years from 1950 to 2040 in India.

The population aged ≥70 years has almost doubled since 1950 in India. The oldest-old population is expected to increase by 6% by 2050, given the rise in life expectancy at age ≥60 years (Agarwal et al., 2016). Apart from the rise in life expectancy, the decline in the total fertility rate (TFR) has almost achieved a replacement level in India (IIPS and MOFHW, 2016). This decline is mainly due to various socio-economic and health policy interventions. On the other hand, India's advancement in healthcare has significantly brought down the mortality rates, thus contributing significantly to the growth of the elderly population.

Population aging is on the rise in India. There is a shift in the dependent population from children to older adults, which has increased the AI. The AI currently stands at 38 for every 100 children, but this will reach 75 by the year 2040 (Subaiya and Bansod, 2011). Figure 2 mirrors the rapid rise of India's elderly population in the next few decades.

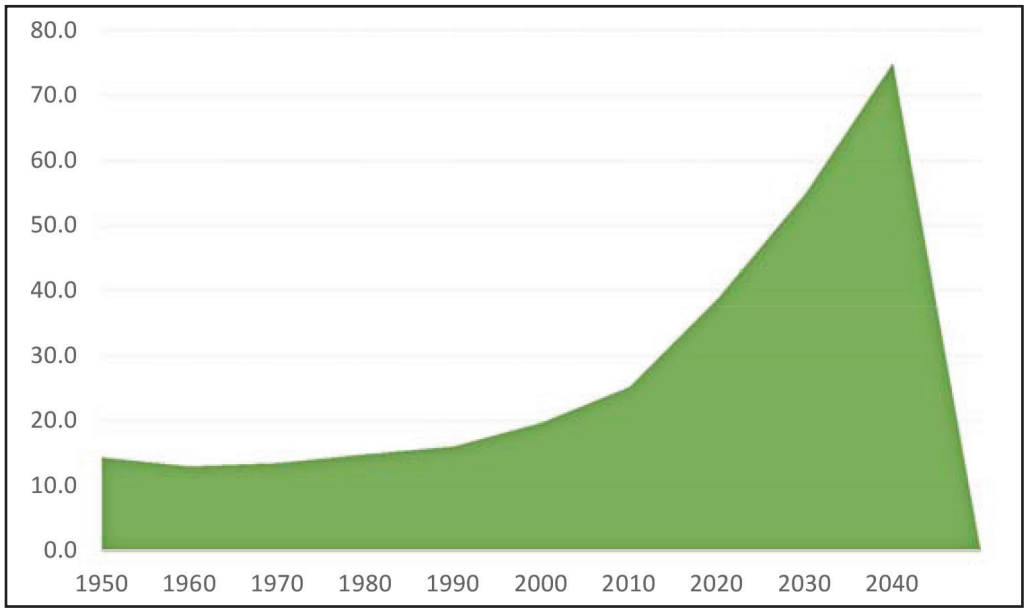
Demographic changes are attributed to increasing welfare and progress in human conditions. These changes are then reflected by factors like mortality, fertility, and life expectancy. But once the demographic transition occurs, these changes will imply a significant challenge on economic outcomes due to the greater concentration of the elderly population. Although there are some positive changes associated with this demographic shift, it also necessitates some important implications for countries and their path to economic development. Population aging involves these challenges through healthcare, economic burden, and social well-being. It also increases the vulnerability of the elderly population, especially women (Prakash, 1997; Gopal, 2006; Jones and Powell, 2006). Similarly, many other key challenges also arise due to the small portion of the elderly in the formal sector and their greater concentration in the unorganized sector, imbalanced with no social security or social provisions. Finally, poor accessibility and lack of awareness result in greater inequalities due to the underutilization of social and healthcare security measures at older ages. While the low level of labor force participation, lack of skills, and low literacy are the prevalent challenges that are faced by the elderly

**Figure 1** Life expectancy in India by age ≥60 years (1950–2040).




*Notes*: Authors' own computation from the United Nations Population Division (UNPD).

**Figure 2** AI in India (1950–2040).




AI, aging index; UNPD, United Nations Population Division.
*Notes*: Authors' own computation from the UNPD.

Indian population, the productivity of the elderly population is also a challenge, given the low levels of physical and human capital (Raju, 2011; Bhagat, 2015).

Aging is a natural process, but it multiplies the challenges of physical and mental health as the individual grows older. These challenges then create a circular impact, affecting other aspects of individuals' health and well-being. Increasing age therefore not only effects the health of populations but also results in increasing burden through healthcare costs, work opportunities, and social security net. Therefore, understanding and examining these challenges are pivotal for policy-making in India, given the rapid rise of the aging population and its implication on human development.

## 2 Data and Methodology

### 2.1 Data

Longitudinal Ageing Survey of India (LASI) is a nationally representative survey of over 72,000 older adults aged ≥45 years across all the states and union territories in India, except Sikkim, conducted in 2018–19. It is a longitudinal survey to be conducted after every 2 years for the next 25 years. LASI covers a broad range of issues involving health, economic, and social determinants of the aging population in India. We used the latest estimates from UN population projections to compute the AI. By contrast, the recent projections of the population census are also used to reveal the overall scenario of aging in India.

### 2.2 Methodology

Bivariate analysis was used to depict the overall aging scenario in India. At the same time, a multidimensional AI was computed to mirror the aging scenario across the states in India.

There are different methods through which healthy aging is computed (Peel et al., 2004). These methods include the HAI, active aging index (AAI), and scale measures of the AI (Zaidi et al., 2013, 2017; Zaidi, 2015). Although these measures compute the healthy and active aging indicators, they hardly measure the economic aspects that are key to age-related challenges (De São José et al., 2017). Therefore, to measure the economic aspect of aging, we adopted a disintegrated method to formulate the different indices and make the results comparable at the national level. The advantage of this method over the other methods is it includes any dimension so that multiple factors can be included in the study (Kulkarni and Doke, 2015; Kwatra et al., 2020). We examine the health aspect of aging and the factors such as economic and social security outcomes, which affect aging outcomes (Neumayer, 2001). Thus, a set of indices are computed using the UN methodology, and then the indices are compared across Indian states. The description of the variables and their computation are given in the supplementary table.

We used a two-step procedure to compute the composite indices of economic, health, and social outcomes. First, the percentages are computed and converted into scores based on the following formula:

$$X_i \text{ score} = [(x - \min(x)) / (\max(x) - \min(x))]$$

Equal weights are assigned to all the indicators considered for the derivation of all the composited indices. Then, the scores are averaged to compute a composite index based on the following formula:

$\text{CI} = \text{Average}(X_{i-j})$ where CI means the composite index and $X$ is the number of indicators from $i$ to $j$.

The composite index score ranges from 0 to 100, with 0 representing the lowest score and 100 representing the highest score for each state.

# 3 Results

## 3.1 Economic dimensions of aging in India

Aging and economic challenges go hand in hand. With unprecedented changes in the population age structure, population aging is evolving as a challenge in restructuring the labor market and its impact through the rise in healthcare costs and social security risks. These factors can slow the progress of economic growth, despite some positive externalities of aging, like increasing saving behavior, experienced workforce, and increase in unpaid working population associated with aging (Guest, 2006; Orlická, 2015).

Population aging is strongly associated with an increase in healthcare costs. It implies a significant impact on economic growth due to the increasing demand for budget spending on the elderly (Alemayehu and Warner, 2004). Aging further enhances a significant impact on fiscal and social financing, raising a country's economic burden (Colin and Brys, 2019; Rouzet et al., 2019). With >9% of the aging population, India will face unprecedented challenges both in terms of health and socio-economic outcomes.

Table 1 presents the data on labor market conditions of the elderly in India. Only 35% of the total elderly population currently working is >60 years, whereas 46.18% is at age ≥50 years. Around 51% of male individuals are currently working at age ≥60 years as compared to 22%

of female individuals. It reflects the inequality in work among the older adults in India. Looking from the type of work, it is clear from the results that more than half of the elderly are involved in work related to agriculture, 21% of male individuals aged ≥50 years are involved in non-agriculture activities as compared to 10% women. Similarly, there is an asymmetry in wage and salary class, but the resulting difference between male and female individuals is very low. Looking at the nature of work, 46% population >50 years is working at their own farms or dwelling units.

The results provide a holistic view of the economic aspects of the population in India. Given the unprecedented socio-economic development over the past 50 years, economic progress has achieved an upward trend in India, encompassed by demographic dividend. But there will be a shift in the population age structure in the coming ages, resulting in the population aging and reduction in the likelihood of entering into the labor market (Petrou et al., 2001). Similarly, governed by changing demographics and technological advancement, India's future economic market needs challenging issues to address healthcare, social security, and other fiscal policies. Therefore, the unskilled workforce can be challenging and needs to be addressed through policy interventions (Fehr et al., 2010).

Older people may not simply produce as much as they consume since there are associated costs involved due to increasing disease burden, loss of saving proportion due to covering of healthcare costs, increasing proportion of tax to GDP, and cost associated with public health spending. There is a risk of fall in labor supply due to an increase in the risk for informal caregiving with a greater proportion of the aging population. Similarly, engagement in other informal work of the elderly may enhance the value through volunteering and social capital, but it may result in serious implications on the structure of the labor market. There is also an impact of saving behavior on the economic outcomes, like a fall in capital investment (Marešová et al., 2015). Moreover, the increasing consumption pattern also enhances the risk for the elderly to get more engaged in work, which later has the potential health and social consequences like work discrimination, ageism, and marginalization at the workplace.

Older people may contribute through greater consumption, which can generate the economic boom. Healthy people at older ages can live long and healthy lives and be self-sufficient and pay more taxes to support healthcare costs and the social security system.

A healthy workforce at higher ages can be significant, but the trend has not been sufficient, despite increased life expectancy. Similarly, the workers' higher ages fall in high-income groups only (Rice and Fineman, 2004). Furthermore, the education level and employment experience can reduce the aging burden through work and self-sufficiency in healthcare expenditure.

Economic consequences of aging are manifold. The shift in the age structure implies greater contributions from the elderly to avert the economic burden through greater participation in the formal and informal workforce, savings, and less tangible benefits (Van Der Gaag and De Beer, 2015). One of the challenges that aging implies is through the lack of social security coverage. Table 1 already shows the abysmal social security coverage of the elderly in India. More than 78% of the elderly population is uncovered in India, hinting toward the important challenge of population aging. Moreover, they are less likely covered by the other benefits since social security schemes do not cover the elderly population at large in informal

**Table 1** Economic conditions of the aging population in India (LASI-2017-18).

| Gender | Age groups (years) | Work status | | | Work type | | | Place of work | | | Work-related pension | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Working | Not working currently | Never worked | Agriculture | Non-agriculture | Wage and salary | Own farm or dwelling | Employers' place | Others | Pension | Insurance | None |
| **Male** | **50–59** | 90.21 | 7.57 | 2.22 | 46.26 | 22.34 | 31.4 | 39.94 | 16.23 | 43.83 | 5.05 | 4.72 | 89.06 |
| | **60–69** | 63.45 | 33.18 | 3.37 | 61.11 | 19.18 | 19.71 | 52.15 | 12.58 | 35.27 | 11.37 | 4.28 | 78 |
| | **≥70** | 33.62 | 61.93 | 4.46 | 65.44 | 20.53 | 14.03 | 59.42 | 11.24 | 29.34 | 13.18 | 3.18 | 64.14 |
| | **Total** | **65.46** | **31.3** | **3.23** | **54.08** | **20.98** | **24.94** | **46.88** | **14.27** | **38.85** | **9.45** | **4.16** | **80.63** |
| **Female** | **50–59** | 40.63 | 14.65 | 44.71 | 64.31 | 10.51 | 25.18 | 47.45 | 16.94 | 35.62 | 1.56 | 1.89 | 93.92 |
| | **60–69** | 28.63 | 27.25 | 44.12 | 69.67 | 10.43 | 19.9 | 47.21 | 15.45 | 37.33 | 2.74 | 1.53 | 90.97 |
| | **≥70** | 12.47 | 36.76 | 50.77 | 71.16 | 10.85 | 17.98 | 45.55 | 19.38 | 35.07 | 3.33 | 0.83 | 82.96 |
| | **Total** | **29.27** | **24.72** | **46.01** | **66.93** | **10.52** | **22.56** | **47.16** | **16.67** | **36.16** | **2.4** | **1.51** | **91.74** |
| **Total** | **50–59** | 63.19 | 11.43 | 25.38 | 52.58 | 18.2 | 29.22 | 42.57 | 16.48 | 40.95 | 3.64 | 3.58 | 90.84 |
| | **60–69** | 44.96 | 30.03 | 25.01 | 64 | 16.22 | 19.77 | 50.48 | 13.55 | 35.97 | 7.95 | 3.19 | 82.14 |
| | **≥70** | 22.67 | 48.9 | 28.43 | 67.08 | 17.77 | 15.16 | 55.47 | 13.55 | 30.97 | 9.62 | 2.33 | 68.38 |
| | **Total** | **46.18** | **27.79** | **26.03** | **58.42** | **17.45** | **24.13** | **46.98** | **15.08** | **37.94** | **6.7** | **3.13** | **84.28** |
| | ≥60 | 35.71 | 37.86 | 26.43 | 64.81 | 16.63 | 18.56 | 51.79 | 13.55 | 34.66 | 8.62 | 2.85 | 78.28 |

LASI, Longitudinal Ageing Survey of India.

*Notes*: Authors' own computation from LASI 2017-18.

Bold values indicate overall percentage which was mainly interpreted in the results.

sectors, reflecting their vulnerability. Thus, targeting the elderly for insurance coverage and other social security services can be critical for addressing the needs of the elderly, which can also help them in ensuring their well-being factors.

There is a scope for greater benefits of population aging in India, given the fall in replacement levels, as shown by the results. The shift in the market structure due to aging may also create new sectors of the economy. But there is a concern about the fall in wages that may decline the earnings of the young workforce (Weller, 2007; D'Addio et al., 2010).

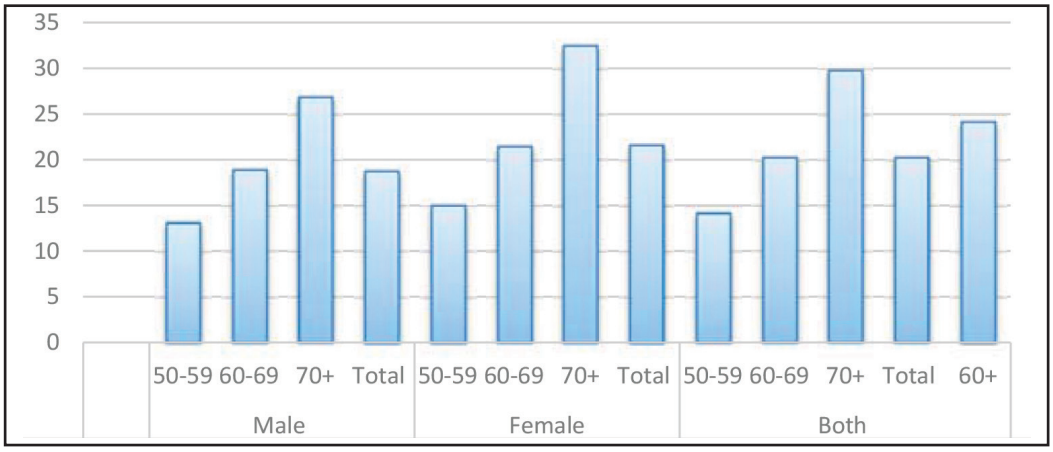
## 3.2 Health and well-being

### 3.2.1 Morbidity and behavioral risks

Good health is strongly associated with economic outcomes, particularly with the increase in age. People at older ages do not necessarily imply an economic burden if they perceive good health. However, they can also significantly contribute to economic and social benefits, given their active years of aging life (Clifton, 2009). Good health and well-being can significantly contribute to their work productivity if they are active at older ages (Skirbekk, 2008). They can work even after the post-retirement if they are physically active and healthy. Studies have already highlighted the fact that lowering health risks among the elderly can minimize the loss of productivity among the elderly (Cruwys et al., 2013; Kanabar, 2015). Furthermore, healthy aging increases opportunities and less burden of diseases due to good physical and functional health conditions. Figure 3 shows the self-rated health (SRH) among older adults in India.

More than 20% of older adults reported poor health in India, with 18% male individuals and 22% female individuals. Poor health is reported higher among female individuals than male individuals, indicating that women are at higher risk of poor health, which may be due to their living arrangements and financial constraints facing greater at older ages (Fleischmann et al., 2018). Moreover, poor health risks the loss of functional attributes, especially at older ages. SRH is assumed to increase over time; although this is presumed health, which cannot reflect the actual scenery, these trends have been shown even in diagnosed diseases with the increase in age (Puts et al., 2008). Table 2 provides a clear status of elderly health and their behavioral risks reflecting their vulnerability to multi-morbidities, hypertension, and smoking and drinking habits. About one-quarter of the elderly aged ≥60 years are at risk of multi-morbidities, whereas the risk associated with obesity is about 22%. Women have a higher risk of morbidity at upper ages as found by our study, which is in line with earlier studies where greater risk is among elderly women likely due to vulnerability of them to socio-economic and work status (Al-Modeer et al., 2013; George et al., 2017). Moreover, they are largely dependent for their needs; this also enhances their risk of greater morbidities (Woo et al., 2007). Results from Table 2 show that >36% elderly aged ≥60 years are at risk of hypertension. The table also shows the risk of behavioral factors like episodic drinking and smoking intake, which are 2 and 36%, respectively. The accumulating risks pose a severe threat to the elderly health and their well-being; therefore, significant interventions through policy changes are needed to address these challenges before they can incur economic costs of older adults in India and hamper the overall growth of the country.

**Figure 3** SRH by age and gender in India (LASI-2017-18).




LASI, Longitudinal Ageing Survey of India; SRH, self-rated health.
*Notes*: Authors' own computation from LASI 2017-18.

## 3.3 **Mental health**

Cognition health involves the mental functions of individuals and is key to work, happiness, and mental well-being (Erdtmann, 2015). Cognition is measured through multiple dimensions, and one such dimension is memory power (Dalgleish and Power, 2000). Cognition diminishes with age, affecting individuals' health and well-being, apart from increasing the risk for disability (Murman, 2015). Table 3 shows the percentage of poor memory among the elderly. Based on the last word recall test, the elderly population remembers more than half of the words, which implies a good memory functioning (Skirbekk et al., 2012).

Table 3 shows the results of depression and depressive symptoms based on two different scales among the elderly. The results show that around 26% male individuals suffer from depressive symptoms as compared to 31% female individuals aged ≥50 years, whereas looking at the depression prevalence based on the CIDI-SF scale, around 9% female individuals suffer from depression as compared to 7% male individuals aged ≥50 years in India. Depression is a common symptom among the elderly and likely impacts the physical and economic well-being of older adults. Although older adults are less vulnerable to depressive symptoms than younger adults, the greater prevalence among female individuals likely reflects their vulnerability to psychological and mental health states of the elderly.

## 3.4 **Functional health**

One of the important health factors at old age is functional health. It is a significant contributor to healthy aging and involves the risk of health and social well-being of poorer elderly adults. Functional health involves the capacity of an individual to interact with others or to perform the activities of daily living (ADL; Whittle and Goldenberg, 1996). Although the functional health limitations increase with age, better functional health at higher ages is a good indicator of healthy aging and can reduce the cost associated with care (WHO, 2001). It can further enhance the involvement of people in the labor market for a longer time and also reflect their physical health status (Chirikos, 1993). Table 4 shows the physical and functional health activities of aging, including physical impairments. Around 8% of the aging population suffers

**Table 2** Morbidity and behavioral risk factors of the aging population in India (LASI-2017-18).

| Gender | Age groups (years) | Multi-morbidity | Obesity | Hypertension | Episodic drinking | Smoking |
|---|---|---|---|---|---|---|
| | | Any single morbidity | BMI >25 | Yes | Yes | Yes |
| **Male** | **50–59** | 15.66 | 25.55 | 30.13 | 6.94 | 52.08 |
| | **60–69** | 21.66 | 20.06 | 33.64 | 5.81 | 52.2 |
| | **≥70** | 23.56 | 14.06 | 34.23 | 3.68 | 47.64 |
| | **Total** | **19.92** | **20.57** | **32.49** | **5.68** | **50.98** |
| **Female** | **50–59** | 17.47 | 37.21 | 28.41 | 0.58 | 16.36 |
| | **60–69** | 23.87 | 30.41 | 36.87 | 0.69 | 19.18 |
| | **≥70** | 27.8 | 19.92 | 39.91 | 0.44 | 20.26 |
| | **Total** | **22.36** | **30.6** | **34.29** | **0.58** | **18.33** |
| **Both** | **50–59** | 16.65 | 31.95 | 29.19 | 3.45 | 32.49 |
| | **60–69** | 22.83 | 25.57 | 35.36 | 3.08 | 34.63 |
| | **≥70** | 25.78 | 17.08 | 37.16 | 2.01 | 33.51 |
| | **Total** | **21.22** | **25.94** | **33.45** | **2.95** | **33.53** |
| | **≥60** | **24.05** | **22.19** | **36.09** | **2.65** | **34.17** |

LASI, Longitudinal Ageing Survey of India.

*Notes*: Authors' own computation from LASI 2017-18.

Bold values indicate overall percentage which was mainly interpreted in the results.

**Table 3** Mental health conditions of the aging population in India (LASI-2017-18).

| Gender | Age groups (years) | Depression CIDI-SF | Depressive symptoms | Cognition score |
|---|---|---|---|---|
| | | Yes | Yes | Total word recall |
| **Male** | **50–59** | 7.42 | 24.46 | 34.12 |
| | **60–69** | 7.40 | 26.74 | 44.25 |
| | **≥70** | 7.17 | 28.71 | 56.52 |
| | **Total** | **7.35** | **26.39** | **43.56** |
| **Female** | **50–59** | 8.01 | 29.81 | 41.66 |
| | **60–69** | 8.78 | 30.71 | 51.54 |
| | **≥70** | 10.16 | 35.36 | 64.33 |
| | **Total** | **8.81** | **31.48** | **50.72** |
| **Both** | **50–59** | 7.74 | 27.41 | 38.23 |
| | **60–69** | 8.13 | 28.85 | 48.12 |
| | **70+** | 8.73 | 32.19 | 60.58 |
| | **Total** | 8.13 | 29.13 | 47.38 |
| | **≥60** | **8.37** | **30.2** | **53.16** |

LASI, Longitudinal Ageing Survey of India.

*Notes*: Authors' own computation from LASI 2017-18.

Bold values indicate overall percentage which was mainly interpreted in the results.

from an impairment, whereas the prevalence increases to 10% by age 60 years. Similarly, about 11% of the elderly aged ≥50 years face challenges in their ADL, while 41% face challenges in instrumental ADL.

Functional health is a challenge in terms of elderly productivity and healthy aging in India. Therefore, increasing functional health must be a priority since better functional health is also associated with greater wages and more working hours (WHO, 2020b). Furthermore, persons with good functional health can perform better traits than those with any limitations (David et al., 2001). Similarly, low physical impairment is also an important indicator of reducing disability and risk for well-being through greater participation in the labor market (Ferreira-Agreli et al., 2017). Functional inabilities can further stress aging as it is a lifecycle process. Functional abilities among the elderly enable well-being at an older age (Michel et al., 2016). Similarly, they result in the independence of the care functional limitations usually reflecting the onset of diseases among the elderly (Seals et al., 2016).

## 3.5 **Life satisfaction, living arrangements, and social activity**

Despite the sharp increase in life expectancy, the challenge of life satisfaction is foremost at upper ages. Therefore, better life satisfaction and living with dignity are the key elements at older ages (Griffin and McKenna, 1999). The elderly, like other population groups, deserve to live with peace since better life satisfaction is an important element of healthy aging (Gwozdz and Sousa-Poza, 2010). A U-shaped relationship is found in the literature on aging and life satisfaction, with a significant rise in the aging population. The relation changes with age, given the significant drop in health and rise of psychological and economic dependency (Beja, 2018). Table 5 shows the life satisfaction among the elderly in India.

**Table 4** Functional health of the aging population in India (LASI-2017-18).

| Gender | Age groups (years) | ADL | | IADL | | Impairments |
|---|---|---|---|---|---|---|
| | | 2+ ADL | Any ADL | 2+ IADL | Any IADL | Any impairment |
| **Male** | **50–59** | 4.33 | 9.82 | 11.31 | 19.65 | 7.50 |
| | **60–69** | 8.05 | 15.65 | 19.15 | 30.92 | 9.49 |
| | **≥70** | 16.78 | 28.16 | 38.62 | 49.91 | 11.65 |
| | **Total** | **8.95** | **16.75** | **21.32** | **31.69** | **9.33** |
| **Female** | **50–59** | 7.05 | 13.15 | 25.61 | 37.63 | 5.77 |
| | **60–69** | 10.29 | 19.57 | 37.5 | 49.61 | 8.31 |
| | **≥70** | 25.15 | 36.2 | 59.44 | 67.34 | 13.29 |
| | **Total** | **12.74** | **21.22** | **38.34** | **49.36** | **8.56** |
| **Both** | **50–59** | 5.81 | 11.64 | 19.11 | 29.46 | 6.55 |
| | **60–69** | 9.24 | 17.73 | 28.9 | 40.85 | 8.86 |
| | **≥70** | 21.16 | 32.36 | 49.51 | 59.03 | 12.5 |
| | **Total** | 10.97 | 19.14 | 30.42 | 41.14 | 8.92 |
| | **≥60** | **14.16** | **23.77** | **37.41** | **48.35** | **10.37** |

ADL, activities of daily living; IADL, instrumental activities of daily living; LASI, Longitudinal Ageing Survey of India.

*Notes*: Authors' own computation from LASI 2017-18.

Bold values indicate overall percentage which was mainly interpreted in the results.

Low life satisfaction is increasing with age, but it is higher among female than male individuals. Female individuals have low life satisfaction, but it is lower than among male individuals than the overall life satisfaction among the elderly. Our results from Table 5 reflect levels of low life satisfaction in India, which clearly increases with age. More than 33% elderly have reported low level of life ageing 60 and above in India. Table 5 also shows the social activity of older adults in India at ages 50 years and 60 years. Earlier studies have found a strong correlation of well-being with social interactions (Kemperman et al., 2019). Adults having fewer interactions are likely to face challenges of psychological health, whereas poor well-being is strongly associated with poor social networks, particularly at older ages. Examining the social activities of older adults, we found that more that more than half of the elderly population are not socially active in India (52.1%) at age 50 years and above, but the proportion is slightly lower at 50.21% at age ≥60 years. The results clearly show that female individuals are more socially inactive (56.79%) in India than their male counterparts (52.90%). This decrease is mainly due to the life cycle events that increase with aging, while there is also the role of other socio-economic factors which include loss of family members, friends, retirement, and low neighborhood networks among the elderly (Wrzus et al., 2013).

## 3.6 **Composite AI in India**

Aging is a complex and multidimensional phenomenon, given its socio-economic and health implications (David et al., 2001). Population aging implies multiple economic, social, hygienic, and behavioral challenges on the one hand. On the other hand, economic dimensions mean the

**Table 5** Life satisfaction and living arrangements of the aging population in India (LASI-2017-18).

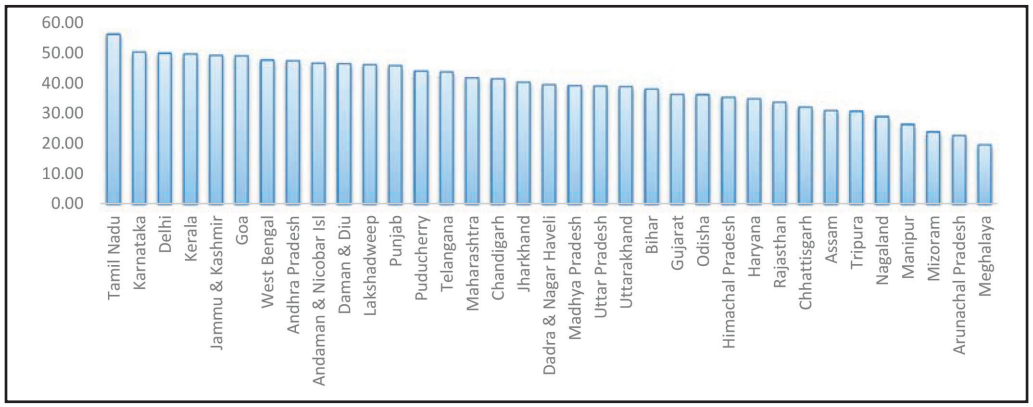
| Gender | Age groups (years) | Living arrangements | Low life satisfaction | Socially active |
|---|---|---|---|---|
| | | **Living alone** | **Low satisfaction** | **Not active** |
| **Male** | **50–59** | 1.01 | 30.61 | 64.20 |
| | **60–69** | 2.10 | 30.71 | 56.21 |
| | **≥70** | 3.11 | 29.85 | 47.21 |
| | **Total** | **1.96** | **30.45** | **56.79** |
| **Female** | **50–59** | 2.77 | 35.49 | 60.26 |
| | **60–69** | 6.64 | 32.51 | 51.44 |
| | **≥70** | 11.28 | 35.6 | 43.49 |
| | **Total** | **6.29** | **34.44** | **52.90** |
| **Both** | **50–59** | 1.97 | 33.30 | 62.03 |
| | **60–69** | 4.51 | 31.66 | 53.67 |
| | **≥70** | 7.33 | 32.86 | 45.27 |
| | **Total** | 4.27 | 32.59 | 54.71 |
| | **≥60** | **8.53** | **33.75** | **50.21** |

LASI, Longitudinal Ageing Survey of India.

*Notes*: Authors' own computation from LASI 2017-18.

Bold values indicate overall percentage which was mainly interpreted in the results.

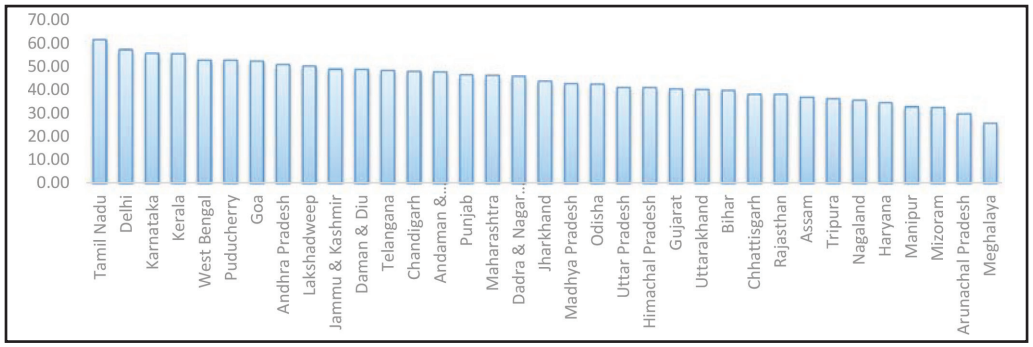
**Figure 4** AI by age ≥60 years in India (LASI-2017-18).




AI, aging index; LASI, Longitudinal Ageing Survey of India.

*Notes*: Authors' own computation from LASI 2017-18.

**Figure 5** AI by age ≥50 years in India (LASI-2017-18).




AI, aging index; LASI, Longitudinal Ageing Survey of India.

*Notes*: Authors' own computation from LASI 2017-18.

challenges of costs and social security concerns (Holzmann, 1988; Gopal, 2006; Chomik and Piggott, 2015). Therefore, evaluating the aging dimension is key before facing the challenges of population aging. Figure 4 shows India's composite AI, and the results indicate that economically weaker states are at higher risk of aging challenges, given their poorer score on the index. By contrast, states such as Tamil Nadu, Kerala, and West Bengal are better off on the aging composite index, given the higher score.

Figure 5 shows the AI for age ≥50 years. It shows similar results, given the context of aging challenge in India and across the states in India. Aging challenges need to be taken care of while evaluating the long-term health and social security challenges. Policy-makers must address aging issues, given their long- and short-term challenges and their implication on aging and health in India.

States performing poor on the AI must be targeted specifically to address future challenges of aging and their economic impact. Poor states like Bihar, Uttar Pradesh, and Madhya Pradesh need strong attention from policy-makers to address the needs of the elderly and avert the potential future challenges of population aging across these states. Similarly, there is also a need for an inclusive approach to address the social security coverage, which is abysmal throughout the country.

## 4 Discussion

Aging is not just a challenge of sustaining a higher concentration of population at older ages with good health but also indicates independent and secure participation of the elderly population in the labor market by ensuring their social security needs (Samorodov, 1999). There is already a focus on aging and labor market productivity, and researchers also emphasize on how the aging population can get involved with unpaid productive activities at older ages (Zaidi et al., 2013). Given India's rapid rise in the aging population and its socio-economic, political, and health challenges, we apply a multidimensional approach to evaluate the aging scenario in India and its socio-economic and health consequences. We study some of the key indicators of older adults aged ≥50 years in India based on their health, socio-economic, and living well-being conditions and attempted to understand the economic perspective of population aging in India. Mixed results were found across various indicators, which indicate a strong policy push for aging policies in India. Similarly, there seems to be greater inequality in socio-economic and health outcomes across gender, with women being more vulnerable to aging challenges. Thus, addressing the challenges of elderly women is pivotal as India is already moving toward the feminization of aging with a greater proportion of female elderly cohorts to that of men.

An increase in population aging has an important implication on individuals' communities and countries (Heslop, 1999). Given the subjective and objective well-being challenges, an increase in the proportion of older ages has a serious impact on the human development of the elderly (Rayner et al., 2005). Therefore, important challenges to the elderly will include health and social outcomes and how economically they will survive and overshadow the rising life expectancy. This study has made a comprehensive attempt to compute the composite AI. Although the AI seems to be higher among many states, there is a clear interstate disparity across the states. This clearly echoes the challenges of population aging in India. The results indicate that there are significant challenges associated with population aging. Some of the most populous states like Uttar Pradesh and Maharashtra fall under 50 in the index score, reflecting the challenges of poor socio-economic and well-being conditions. Similarly, northern and the northeastern states like Haryana, Rajasthan, Meghalaya, Mizoram, and Arunachal Pradesh are more vulnerable in terms of various aging indicators, resulting in the lower scores on the AI.

Economic factors are crucial for living and well-being. Better income levels are significantly associated with better life outcomes. Economic consequences of aging are mainly due to an increase in the workforce shortage, collapse of asset market, fiscal stress due to social security challenge, the burden of diseases, and growth slowdown due to labor and capital shortages, as witnessed in European countries (Carone et al., 2005). There is also a likely impact of the life cycle approach that enhances the consumption at older ages, with greater reliability of saving patterns (Bengtson et al., 2005). It is a challenge in the Indian setting, given the low saving proportions of the elderly and poorly managed social security market (pensions, old-age insurance, and social security) in the country. It will impact the economy as a whole and induce greater challenges to the growth of the Indian economy.

The labor force may not be a challenge in India for the next few decades, given its advantage in declining dependency rates for the next few decades. However, the burden is also due to healthcare costs, social security challenges, and elderly savings in India, as indicated by our

results. Therefore, the varying pattern of the AI may provide some space to policy-makers to be evenly prepared, but apparently, there are greater challenges of health and socio-economic well-being among the elderly.

Demographic outcomes are less likely to have an externality effect in aging phenomena since the challenges at older ages are entirely different from those witnessed in fertility and mortality transition (Van Der Gaag and De Beer, 2015). There is a possible impact of population aging on the macro-economic balance of the country, which must be considered since population aging has consequences on savings, investment, real interest rates, and capital flow (Orlická, 2015). Furthermore, aging will shift the cross-country distribution of economic performance in India and enhance the fiscal challenges that include an increase in income tax and insurance coverage for the elderly (Chomik and Piggott, 2015). These challenges may enhance the burden, given the greater proportion of disabled and morbid persons, leading to a greater burden on the health and welfare system.

Aging faces multiple challenges, but healthy aging can lower the significant burden (Baltes and Carstensen, 1996). While health and cognitive functions are key to successful participation in daily life, they are also essential for successful aging at the later stages of life. Similarly, these factors can reduce the risk of comorbidities and work-related challenges. Economic security is also key to ensure better outcomes of older adults in India. Securing their needs through labor market outcomes and social security coverage can be determinantal in ensuring the economic needs of the elderly and an attempt toward successful aging. Given the sharp rise in the aging proportion, a diversified approach is therefore needed to address their socio-economic and healthcare challenges. From an economic perspective, a macro approach is needed to understand the economic challenges, given the gap in the current understanding of economic implications of population aging in India and those across the globe.

## 5 Policy Recommendations

Given the scope of the economic and socio-physical paradigm of active aging, better cohorts of older people can avert the challenges and lower the economic impacts through healthy aging. Similarly, there is a higher risk of age-related disability, but there is a scope for active and independent aging with better policies and programs. Thus, the aim of the policy-making should be to extend the benefits of the increase in life expectancy. Moreover, the priority should also be on building such initiatives that can minimize the challenges of productivity and social security of aging.

The aging process is modifiable, and older adults can live longer with good health (Christensen et al., 2009). Behavioral changes and timely policy interventions can mitigate the economic challenges of aging (Angeloni and Borgonovi, 2016). Therefore, the focus should be on age–setting priorities that can minimize the aging challenges through independence and increasing autonomy. While there is already a focus on health and social security, policies must prioritize economic settings that can minimize the aging burden in India.

With the increasing share of the aging population in India, health challenges may be less severe than the challenges of social security and economic well-being. Policies must prioritize such pushes only, which can lower the aging burden in the Indian context. Policy-making for the elderly in India is pivotal since a large chunk of the population is falling into older

age groups, given the large increase in population aging. Therefore, the intervention for aging populations are required to be widened to focus not only on health and social security but also on the economic challenges of labor market composition and sustainable economic outcomes.

While the broad focus of active aging is on health outcomes, initiatives must be taken to study the economic and social dimensions. Hardly economic dimensions are covered through the active aging research, which is a serious concern, given the different natures of aging market in poorer countries. Hence, fostering the challenges of the economic dimension needs special attention to aging measures.

To sum up, it is essential to identify the potential of the older population not only in social aspects but also in economic aspects of how the elderly can sustain to maintain the long-term growth of populations. Since the idea was to identify the challenges of aging in India, policy aims must be set for vulnerable groups to identify the problems in active aging in India.

## 6 Limitations

- A separate analysis by gender can provide a more thorough approach toward the socio-economic dimension of aging in India.
- More thorough measures of poverty can provide a significant approach as well as thorough analysis of aging dimensions, which can be addressed in future studies.
- Since the survey does not include a broad dimension of economic aspects, economic dimensions may not be that reliable.
- A better methodology can be significant as adopted by the recent studies involving multiple approaches.

## 7 Conclusion

The present study examined the socio-economic and health challenges of healthy aging in India, given that socio-economic and health challenges are more concerned and can be addressed through policy settings. With the aging population likely achieving a significant pace in India, averting the economic impact should be critical for policy-makers to address in the healthy aging context. Therefore, investments in health and labor market incentives should be a priority in the early stages to achieve the optimal level of healthy aging outcomes in India. Moreover, investment-generating resources are required to address the challenges of healthy aging to overcome the future economic adversities in India.

**Abbreviations**

AI, aging index; BKPAI, Building Knowledge on Population Ageing of India; LASI, Longitudinal Ageing Survey of India; MDPI, multidimensional poverty index; UN, United Nations; UNPD, United Nations Population Division; WHO, World Health Organization.

**Declarations**

**Availability of data and materials**

LASI data will be available on request from the IIPS India. The request form is available at: https://iipsindia.ac.in

**Competing interest**
The authors declare that they have no competing interests.

**Funding**
No funding was received to carry out this work.

**Authors' contributions**
We declare that all authors made significant and equal contributions to carry out this work.

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**References**

Agarwal, A.; A. Lubet; E. Mitgang; S.K. Mohanty; Bloom, D.E. (2016): Population Aging in India: Facts, Issues, and Options, in: Program on the Global Demography of Aging. PGDA Working Papers 13216.

Alemayehu, B.; K.E. Warner (2004): The Lifetime Distribution of Health Care Costs. Health Services Research 39, 627-642. doi:10.1111/j.1475-6773.2004.00248.x

Al-Modeer, M.A.; N.S. Hassanien; C.M. Jabloun (2013): Profile of Morbidity Among Elderly at Home Health Care Service in Southern Saudi Arabia. Journal of Family and Community Medicine 20, 53-57. doi:10.4103/2230-8229.108187

Angeloni, S.; E. Borgonovi (2016): An Ageing World and the Challenges for A Model of Sustainable Social Change. Journal of Management Development 34.

Baltes, M.M.; L.L. Carstensen (1996): The Process of Successful Ageing. Ageing and Society 16, 397-422.

Beja, E.L. (2018): The U-Shaped Relationship Between Happiness and Age: Evidence Using World Values Survey Data. Quality and Quantity 52, 1817-1829.

Bengtson, V.L.; G.H. Jr. Elder; N.M. Putney (2005): The life course perspective on ageing, in: M. Johnson Ed. The Cambridge handbook of age and ageing. Cambridge, UK: Cambridge University Press, pp. 493-509.

Bhagat, R.B. (2015): Ageing in India: The Class Demographics and Policy Issues. in: Lancy Lobo and Jayesh Shah Eds. The Trajectory of India's Middle Class: Economy, Ethics and Etiquette. Cambridge Scholar Publication, UK, pp. 248-263.

Bloom, D.E.; D. Canning; G. Fink (2010): Implications of Population Ageing for Economic Growth. Oxford Review of Economic Policy 26, 583-612.

Bloom, D.E.; D. Canning; A. Lubet (2015): Global Population Aging: Facts, Challenges, Solutions & Perspectives. Daedalus 144, 80-92.

Carone, G.; D. Costello; N. Diez Guardia; G. Mourre; B. Przywara; A Salomäki (2005): The Economic Impact of Ageing Populations in the EU25 Member States. Dir Gen Econ Financ Aff Eur Econ Work Pap.

Chirikos, T.N. (1993): The Relationship Between Health and Labor Market Status. Annual Review of Public Health 14, 293-312.

Chomik, R.; J. Piggott (2015): Population Ageing and Social Security in Asia. Asian Economic Policy Review 10, 199-222.

Christensen, K.; G. Doblhammer; R. Rau; J.W. Vaupel (2009): Ageing Populations: the Challenges Ahead. Lancet 374, 1196-1208. doi:10.1016/S0140-6736(09)61460-4

Clifton, J. (2009): Ageing and Well-Being in an International Context. Institute for Public Policy Research, London.

Colin, C.; B. Brys (2019): Population Ageing and Sub-Central Governments: Long-Term Fiscal Challenges and Tax Policy Reform Options. OECD Work Pap Fisc Fed (30), 0_1-29.

Cruwys, T., G.A. Dingle; C. Haslam, et al (2013): Social Group Memberships Protect Against Future Depression, Alleviate Depression Symptoms and Prevent Depression Relapse. Social Science & Medicine 98, 179-186. doi:10.1016/j.socscimed.2013.09.013

D'Addio, A.C.; M. Keese; E. Whitehouse (2010): Population Ageing and Labour Markets. Oxford Review of Economic Policy 26, 613-635.

Dalgleish, T.; M. Power (Eds.) (2000): Handbook of Cognition and Emotion. John Wiley & Sons.

Dandona, L.; R. Dandona; G.A. Kumar; D.K. Shukla; V.K. Paul; K. Balakrishnan; D. Prabhakaran; N. Tandon; S. Salvi; A. P. Dash; A. Nandakumar (2017): Nations within a Nation: Variations in Epidemiological Transition Across the States of India, 1990–2016 in the Global Burden of Disease Study. The Lancet 390, 2437-2460.

David, H.; S. Volkoff; E. Cloutier; F. Derriennic (2001): Ageing, Work, Organizationand Health. Perspectives Interdisciplinaires Sur Le Travail et la Santé. doi:10.4000/pistes.3746

**De São José, J.M.; V. Timonen; C.A.F. Amado; S.P. Santos** (2017): A Critique of the Active Ageing Index. The Journal of Aging Studies 40, 49-56.

**Erdtmann, F.** (2015): Cognitive Aging: Progress in Understanding and Opportunities for Action. Military medicine 180.

**Fehr, H.; S. Jokisch; L.J. Kotlikoff** (2010): Global Growth, Ageing, and Inequality Across and Within Generations. Oxford Review of Economic Policy 26, 636-654. doi:10.1093/oxrep/grq033

**Ferreira-Agreli, B.; F.A. Dias; P.C. dos Santos-Ferreira; N.C. Gomes; D.M. dos Santos Tavares** (2017): Functional Disability and Morbidities Among the Elderly People, According to Socio-Demographic Conditions and Indicative of Depression. Investigacion y Educacion en Enfermeria 35, 48-58. doi:10.17533/udea.iee.v35n1a06

**Fleischmann, M.; E. Carr; B. Xue, et al.** (2018): Changes in Autonomy, Job Demands and Working Hours after Diagnosis of Chronic Disease: A Comparison of Employed and Self-Employed Older Persons Using the English Longitudinal Study of Ageing (ELSA). Journal of Epidemiology and Community Health 72, 951-957. doi:10.1136/jech-2017-210328

**Gaag, N.V.D.; J. de Beer** (2015): From Demographic Dividend to Demographic Burden: The Impact of Population Ageing on Economic Growth in Europe. Tijdschrift voor economische en sociale geografie 106, 94-109. doi:10.1111/tesg.12104

**George, L.S.; S. Deshpande; M.K. Krishna Kumar; R.S. Patil** (2017): Morbidity Pattern and its Sociodemographic Determinants Among Elderly Population of Raichur District, Karnataka, India. Journal of Family Medicine and Primary Care 6, 340-344. doi:10.4103/2249-4863.220025

**Gopal, M.** (2006): Gender, Ageing and Social Security. Economic and Political Weekly |4477-4486.

**Griffin, J.; K. McKenna** (1999): Influences on Leisure and Life Satisfaction of Elderly People. Physical & Occupational Therapy in Geriatrics 15, 1-16.

**Guest, R.S.** (2006): Population Ageing, Capital Mobility and Optimal Saving. Journal of Policy Modeling 28, 89-102.

**Gwozdz, W., A. Sousa-Poza** (2010): Ageing, Health and Life Satisfaction of the Oldest Old: An Analysis for Germany. Social Indicators Research 97, 397-417.

**Heslop, A.** (1999): Poverty and Livelihoods in an Ageing World, in: Randel, J., German, T. & Ewing, D. Eds. The ageing and development report: poverty, independence and the world's older people. London: Earthscan Publications, pp. 22-32.

**Holzmann, R.** (1988): Ageing and Social-Security Costs. European Journal of Population Démographie 3, 411-437.

**IIPS, MOFHW** (2016): National Family Household Survey (NFHS-4). Mumbai, India.

**Jones, H.; J.L. Powell** (2006): Old Age, Vulnerability and Sexual Violence: Implications for Knowledge and Practice. International Nursing Review 53, 211-216.

**Kanabar, R.** (2015): Post-Retirement Labour Supply in England. Journal of the Economics of Ageing 6, 123-132. doi:10.1016/j.jeoa.2015.05.002

**Kemperman, A.; P. van den Berg; M. Weijs-Perrée; K. Uijtdewillegen** (2019): Loneliness of Older Adults: Social Network and the Living Environment. International Journal of Environmental Research and Public Health 16406. doi:10.3390/ijerph16030406

**Kulkarni, A.P.; P.P. Doke** (2015): Exploring Computation of Modified Human Development Index by Using Proxy Indicators. Indian Journal of Public Health Research & Development 6, 139-144.

**Kwatra, S.; A. Kumar; P. Sharma** (2020): A Critical Review of Studies Related to Construction and Computation of Sustainable Development Indices. Ecological Indicators 112, 106061

**Marešová, P.; H. Mohelská; K. Kuča** (2015): Economics Aspects of Ageing Population. Procedia Economics and Finance 23, 534-538.

**Michel, J.-P.; C. Dreux; A. Vacheron** (2016): Healthy Ageing: Evidence that Improvement is Possible at Every Age. European Geriatric Medicine 7, 298-305. doi:10.1016/j.eurger.2016.04.014.

**Murman, D.L.** (2015): The Impact of Age on Cognition, in: Seminars in Hearing. Thieme Medical Publishers, 111-121.

**Neumayer, E.** (2001): The Human Development Index and Sustainability – A Constructive Proposal. Ecological Economics 39, 101-114.

**Orlická, E.** (2015): Impact of Population Ageing and Elderly Poverty on Macroeconomic Aggregates. Procedia Economics and Finance 30, 598-605.

**Peel, N.; H. Bartlett; R. McClure** (2004): Healthy Ageing: How is it Defined and Measured? Australasian Journal on Ageing 23, 115-119.

**Petrou, S.; J. Henderson; C. Glazener** (2001): Economic Aspects of Caesarean Section and Alternative Modes of Delivery. Best Practice & Research Clinical Obstetrics & Gynaecology 15, 145-163. doi:10.1053/beog.2000.0154

**Prakash, I.J.** (1997): Women & Ageing. Indian Journal of Medical Research 106, 396-408.

**Puts, M.T.E.; D.J.H. Deeg; N. Hoeymans; W.J. Nusselder; F.G. Schellevis** (2008): Changes in the Prevalence of Chronic Disease and the Association with Disability in the Older Dutch Population Between 1987 and 2001. Age and Ageing 37, 187-193.

**Rajan, I.S.; S. Aliyar** (2008): Population Ageing in India. in: S. Irudaya Rajan, Carla Risseeuw, and Myrtle Perera, Eds, Institutional Provisions and Care for the Aged: Perspectives from Asia and Europe. Delhi: Anthem Press 115-133.

**Raju, S.S.** (2011): Studies on Ageing in India: A Review. BKPAI Working Paper No. 2, United Nations Population Citation Advice: Fund (UNFPA), New Delhi.

**Rayner, E.; A. Joyce; J. Rose; M. Twyman; C. Clulow** (2005): Human Development: An Introduction to the Psychodynamics of Growth, Maturity and Ageing. Routledge.

**Rice, D.P.; N. Fineman** (2004): Economic Implications of Increased Longevity in the United States. Annual Review of Public Health 25, 457-473. doi:10.1146/annurev.publhealth.25.101802.123054

**Rouzet, D.; A.C. Sánchez; T. Renault; O. Roehn** (2019): Fiscal Challenges and Inclusive Growth in Ageing Societies. OECD economic policy papers, No. 27. OECD Publishing. https://doi.org/10. 1787/c553d8d2-en.

**Samorodov, A.** (1999): Ageing and Labour Markets for Older Workers. Employment and Training Department, International Labour Office, Geneva.

**Seals, D.R.; J.N. Justice; T.J. LaRocca** (2016): Physiological Geroscience: Targeting Function to Increase Healthspan and Achieve Optimal Longevity. The Journal of Physiology 594, 2001-2024.

**Skirbekk, V.** (2008): Age and Productivity Capacity: Descriptions, Causes and Policy Options. Ageing Horizons 8, 4-12.

**Skirbekk, V.; E. Loichinger; D. Weber** (2012): Variation in Cognitive Functioning as a Refined Approach to Comparing Aging Across Countries. Proceedings of the National Academy of Sciences of the USA 109, 770-774. doi:10.1073/pnas.1112173109

**Subaiya, L.; D.W. Bansod** (2011): Demographics of Population Ageing in India: Trends and Differentials, BKPAI Working Paper No. 1. New Delhi: United Nations Population Fund (UNFPA), pp. 4-7.

**Thomas, J.J.** (2014): The Demographic Challenge and Employment Growth in India. Economic and Political Weekly 15-17.

**Van Der Gaag, N.; J. De Beer** (2015): From Demographic Dividend to Demographic Burden: The Impact of Population Ageing on Economic Growth in Europe. Tijdschrift voor economische en sociale geografie 106, 94-109.

**Weller, S.A.** (2007): Discrimination, Labour Markets and the Labour Market Prospects of Older Workers: What Can a Legal Case Teach Us? Work, Employment & Society 21, 417-437.

**Whittle, H.; D. Goldenberg** (1996): Functional Health Status and Instrumental Activities of Daily Living Performance in Noninstitutionalized Elderly People. Journal of Advanced Nursing 23, 220-227.

**WHO** (2020a) Ageing. https://www.who.int/health-topics/ageing#tab=tab_1. Accessed September 2021.

**WHO** (2020b) Ageing: Healthy ageing and functional ability. https://www.who.int/philippines/news/q-a-detail/healthy-ageing-and-functional-ability#:~:text=WHO%20defines%20healthy%20ageing%20as,they%20have%20reason%20to%20value. Accessed Oct 2021.

**WHO WH** (2001): Men, Ageing and Health: Achieving Health Across the Life Span. World Health Organization, Geneva.

**Woo, E.K.; C. Han; S.A. Jo; M.K. Park; S. Kim; E. Kim; M.H. Park; J. Lee; I. Jo** (2007): Morbidity and Related Factors Among Elderly People in South Korea: Results from the Ansan Geriatric (AGE) Cohort Study. BMC Public Health 7, 1-9. doi:10.1186/1471-2458-7-10.

**Wrzus, C.; M. Hänel; J. Wagner; F.J. Neyer** (2013): Social Network Changes and Life Events Across the Life Span: A Meta-Analysis. Psychological Bulletin 139, 53-80. doi:10.1037/a0028601

**Zaidi, A.** (2015): Creating and Using the Evidence Base: The Case of the Active Ageing Index. Contemporary Social Science 10, 148-159.

**Zaidi, A.; K. Gasior; M.M. Hofmarcher, et al.** (2013): Active Ageing Index 2012 Concept, Methodology and Final Results. http://www1.unece.org/stat/platform/display/AAI/Active+Ageing+Index+Home. Accessed Jan 2022.

**Zaidi, A.; K. Gasior; E. Zolyomi; A. Schmidt; R. Rodrigues; B. Marin** (2017): Measuring Active and Healthy Ageing in Europe. Journal of European Social Policy 27, 138-157.

# Supplementary File

## Variables in the study

## Data

This study used the data from the first round of the Longitudinal Ageing Survey of India (LASI) conducted in 2017–18. LASI is a survey on older adults, covering a broad range of issues varying from socio-economic to physical and mental health of older adults aged ≥45 years in India.

## Variables in the study

### Work status

Work status denotes the current work status of the older adults, which was computed based on the question "Are you currently working?" It also includes those working at the time of the survey or those who are temporarily laid off, sick, or in training. The variable was then made trichotomous with 0 = currently not working, 1 = currently working, and 2 = who has never worked. No response to the question was considered as never worked.

### Work type

Work type was based on the question asked to respondents about their main job, which is defined as the paid job at which they worked the longest hours. The response to this question was then classified into three categories: 0 = agriculture (farm/fishery/forestry/own/family and agricultural laborer), 1 = non-agriculture (non-agricultural worker and own account worker), and 3 = wage salary (wage salary and paid family worker).

### Place of work

Place of work was computed based on the following question asked to survey respondents "Can you describe the place where you mainly work?" The response to the question was recoded in three categories: 0 = own (own dwelling and own farm or business), 1 = employers (employer's dwelling and employer's workplace), and 3 = others (construction site, place with a fixed location, place without a fixed location, and others).

### Work-related pension

Work-related pension was computed based on the question "Whether you are covered with any pension or not?" asked to the respondents. The variable was then computed into work-related pension, insurance, and others.

### Self-rated health (SRH)

SRH was on a scale of 1–5 "from poor to excellent" and was categorized as 0 "good" (representing good, very good, and excellent) and 1 "poor" (representing poor or fair) in our study.

## Multi-morbidity

Multi-morbidity conditions refer to the presence of two or more chronic diseases, which include hypertension, chronic heart diseases, stroke, chronic lung disease, diabetes, cancer or malignant tumor, any bone/joint disease, any neurological/psychiatric disease, or high cholesterol. The variable in the study was computed using morbidity-related questions based on the binary response of yes and no to the questions. The variable was then categorized into three groups, with 0 = no morbidity, 1 = single morbidity, and 2 = more than one morbidity.

## Obesity

Obesity was computed based on the World Health Organization (WHO) classification of body mass index, with a BMI of ≥25.0 as obese in the study.

## Hypertension

The prevalence of measured hypertension refers to those measured with a systolic blood pressure of ≥140 mmHg or a diastolic blood pressure of ≥90 mmHg or both.

## Episodic drinking

Episodic drinking refers to those who reported consumption of at least 60 g or more of pure alcohol on at least one occasion in the past 30 days.

## Smoking

Currently smoking tobacco refers to smoking any tobacco product such as cigarette, bidi, cigar, hookah, and cheroot.

## CIDI-SF

**CIDI-SF** is based on the Composite International Diagnostic Interview, where respondents are asked to report about felt sad, blue, or depressed for two weeks period during last 12 months for all day long or most of the day. A score was generated from the set of these questions, then the CIDI-SF scale score ranges from 0 to 10, and a score of ≥3 is used to calculate the prevalence of probable major depression. The complete flowchart of the CIDI-SF scale is shown.

## Depressive symptoms

Depressive symptoms were measured based on the CES-D scale which included 10 items, with 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). Response options included rarely or never (<1 day), sometimes (1 day or 2 days), often (3 days or 4 days), and most or all of the time (5–7 days) in a week prior to the interview. For negative symptoms, rarely or never (<1 day) and sometimes (1 day or 2 days) were scored 0, and often (3 days or 4 days) and most or all of the time (5–7 days) categories were scored 1. Scoring was reversed for positive symptoms. The overall score ranges from 0 to 10, and a score of ≥4 is used to calculate the prevalence of depressive.

## Cognition score

The cognition score was measured by the number of words recalled. To measure this, a scale of 0–10 was prepared representing a higher score for better cognitive ability based on two and more words recalled, whereas poor was computed based on less than two words recalled.

## Activities of daily living (ADL)

ADL was computed based on a set of six questions which include dressing, putting on chapels or shoes, walking across a room, bathing, eating difficulties, and getting in or out of bed (any one or more). A combined score was generated based on the set of questions which was later categorized into none, single, and more than one activities, respectively.

## Instrumental activities of daily living (IADL)

This was based on a set of seven questions, with a binary response of yes or no. These questions include preparing a hot meal, shopping for groceries, making telephone calls, taking medications, doing work around the house or garden, managing money, and getting around or finding address in an unfamiliar place. The score was generated based on these questions and then categorized into three groups, no, single, and more than one, respectively.

## Impairments

These are problems in the body function or structure as a significant deviation or loss. LASI respondents were asked if they had any form of impairments, including physical (such as locomotor), hearing, visual, speech (such as speech production and language comprehension), and mental (such as intellectual, cognition, or learning) impairments. Any impairment was then considered as the respondents having anyone of the following impairments in the study.

## Living arrangements

Respondents in the survey were asked about living, and the variable was then combined into three categories, with those living alone as 0, with family as 1, and with others as 2. We used percentage of living alone in the final index computation in this study.

## Life satisfaction

Life satisfaction was computed based on a set of questions in which respondents were asked to agree or disagree with life events. Respondents were asked to respond strongly agree, somewhat agree, slightly agree, neither agree nor disagree, slightly disagree, somewhat disagree, or strongly disagree with the following set of questions that include ideal life, life conditions, life satisfaction, achievements, and the change that an elderly can bring. Based on the aforementioned set of responses, a score was generated 5–35, which was then categorized into three categories 5/20 = 0 “low,” 21/25 = 1 “medium,” and 26/35 = 2 “high.” Finally, low satisfaction was used in the index computation in this study.