Estimating old-age thresholds using quantity and quality of remaining life years: Application to India and selected states

Introduction

India is in the latter part of the third stage in demographic transition with declining fertility and mortality. This marked decline in death rates is driven by improvements in health conditions due to medical progress and better living conditions. Such mortality decline has caused a steady increase in the average life span over time, reaching very high levels in recent years. Life expectancy has been increasing and is quite likely to grow in the near future as well. The increased burden of pension and social security for the aged has led to an expected increase in the number of retirees. Therefore, understanding the implications of longevity improvements on quality (health, work, skills) of extended years of life need to assess (Dhillon & Ladusingh, 2013).

An important limitation of the conventional measures of ageing, such as the proportion of people aged 65 or 80 years and above, or the old-age dependency ratio (Lutz, Sanderson, & Scherbov, 2008), is that they do not take into account the variations in life expectancy that have been observed in most of the world over the past five decades (Spijker, 2015). The old-age population living today are healthier and have less severe disabilities than their earlier counterparts in most parts of the world (Christensen, Doblhammer, Rau, & Vaupel, 2009). Ageing is a multidimensional process and chronological age is only one characteristic of people. The conventional measures of ageing do not account for the major improvements in health and life expectancy, thus leading to a tendency to overestimate the impact of population ageing when these indicators are used (Spijker & MacInnes, 2013). There have been many alternative approaches to measure ageing (Chu, 1997; d'Albis& Collard, 2013; Ryder, 1975; Skirbekk, Loichinger, & Weber, 2012), and the prospective age approach has been significant among all in measuring population ageing (Sanderson & Scherbov, 2005, 2007, 2008, 2010). The prospective age approach was later on modified and generalised into the "characteristic approach" (Sanderson & Scherbov, 2013, 2015, 2017). Instead of working with a constant 15 years of RLE, other characteristics that have direct implications for ageing like mortality rate, grip strength, chair rise speed, or equitable pension age (defined by life course ratio) can also be used to redefine ageing. Balachandran et al. (2017) further modified the RLE-15 measure for better cross-country comparison by arguing that the selection of fixed value of RLE-15 was based on the conditions in the developed countries and for the case of developed and developing countries it needs to be adjusted. It prescribed that all countries be compared against a standard population for a better cross-regional comparison. The method was known as the comparative prospective old-age threshold.

While the prospective age concept given by Sanderson and Scherbov, can be seen as a breakthrough in the research to define old age thresholds, we think that this indicator could be further enhanced to define old age thresholds in the Indian context by incorporating information on the population's health status and other dimensions that accounts for the quality of the extra years of life gained through longevity improvements. The old-age dependency ratio adjusted for the new old age thresholds will have economic and policy implications in terms of retirement age and pension policies. So, this paper aims to estimate the old-age threshold using the multidimensional approach by adding two more dimensions as proposed by Balachandran & James (2019), which is based on the famous Characteristic Approach given by Sanderson & Scherbov (2013) in India and its select states. Further, this paper estimates the multidimensional old-age dependency ratio (MOADR) and compare it with the conventional old-age dependency ratio (OADR).

Data and Methods

The study compiled data from the Sample Registration System (SRS), Census of India 2011, and Study on Global Ageing and Adult Health (SAGE), Wave 1 conducted in 2007-10. The information on health and human capital was obtained from SAGE, wave-1 which represented a national representative sample of 7150 persons aged 50+, covering major Indian states that includes Assam, Karnataka, West Bengal, Maharashtra, Uttar Pradesh, and Rajasthan Therefore, the analysis of the paper was restricted to these major states of India. Further, the life expectancies for age groups ranging from 50 to 85+, time for both sexes were retrieved from the SRS based abridged life tables for 2007-11 (RGI, 2013).

Methodology:

The study applied the multidimensional approach proposed by Balachandran and James (2019), for computing the Multidimensional Old-age Threshold (MOAT). This method is based on the Characteristic Approach that was formulated by Sanderson and Scherbov (2013) which implements different characteristics or dimensions. In addition to the three dimensions (RLE, Cognition, ADL) used by Balachandran and James (2019), this study included the five dimensions (RLE, Self-rated health, Handgrip strength, ADL, Cognition). The age-groups (50-55, 55-60, 60-65, 65-70, 70-75, 75-80, 80-85, 85+) were considered for computing the MOAT. The multidimensional approach- firstly we computed a standard population which gave an optimal value by averaging out the standard population values for each dimension over age-groups. Secondly- we derived the dimension based old-age thresholds (OAT) for each dimension by choosing age at which each dimension reached the optimal value and finally combining these dimension-specific oats, we obtained the MOAT. Here the equal weight assumption was made for all the dimensions. The mathematical derivation of the method is provided in detail by Balachandran and James(2019).

Further, to assess the implications of MOATs on old age dependencies, the study computed the Old-Age Dependency Ratio(OADR) adjusted for MOAT and call the Multidimensional old-age dependency ratio (MOADR). The Conventional OADR was defined as the ratio of the number of people 60 years or older to the number of people ages 15 through 59

$$OADR = \frac{Number\ of people\ 60\ years\ or\ older}{Number of peopleages\ 15\ to\ 59}$$

The MOADR was defined as the ratio of the number of people above the MOAT to the number from age 20 to MOAT

$$MOADR = \frac{Number\ of\ people\ older\ than\ MOAT}{Number\ of\ people\ aged\ 20\ to\ MOAT}$$

The computation and comparisons of both the conventional OADR and MOADR were made using the data from census 2011 for India and selected states.

Major findings

The overall MOAT for India was 67 years, where only one state observed below 65 years. It was the highest in Maharashtra (68.6 years) and Rajasthan (67.5 years) and the lowest in Assam (63.9 years). The MOAT value implied that at the age of 67 years, Indians have 13.3 years of remaining life expectancy, 23 percentage stated good health, having 19.6 kgs mean grip strength, 31% were able to perform all of the ADL and on an average they could recall around 5 words (4.8) (Table-1).

The state of Maharashtra had the highest MOAT for males (67.7 years), while West Bengal had the highest MOAT for females (66.6 years). Assam had the lowest MOAT for both males (65.2) and females (63.4). Karnataka was the only state having a higher MOAT for females than that of males. The OATs based on RLE, are quite similar in both the genders and across the states.

Table 1: Estimates of old-age thresholds (years) for different dimensions and MOAT

State	*Remaining life expectancy*	*Self-rated Health*	*Handgrip*	*Ability to do ADL*	*Cognition*	*MOAT*
Assam	63.1	54.9	68.2	76.8	56.4	63.9
Karnataka	66.1	70.9	66.0	55.8	71.0	66.0
West Bengal	66.1	56.7	77.2	68.3	64.5	66.5
Maharashtra	67.1	66.2	68.8	71.4	69.3	68.6
Uttar Pradesh	64.3	72.0	55.6	63.3	73.8	65.8
Rajasthan	67.4	53.9	77.5	58.0	77.9	65.5
INDIA	**65.9**	**66.1**	**67.4**	**64.5**	**71.1**	**67.0**

Though the overall RLE based OAT was higher for females (67.3 years) than males (64.5 years). Karnataka also had a higher OAT based on self-rated health for both males (71.4 years) and females (73.1 years). Females in West Bengal had the highest handgrip strength-based old age threshold (78.3 years) and which was higher than that of males in West Bengal. Abilities to perform ADL based OAT is the highest for both males (79.2 year) and females (64.9 years) in Assam. Karnataka observed a higher OAT based on cognition for females than that of males (Table-2).

Table 2: Gender differentials in OAT based on different dimensions and MOAT

	Remaining life expectancy		*Self-rated Health*		*Handgrip strength*	
	Male	Female	Male	Female	Male	Female
Assam	63.3	62.9	54.3	51.3	67.8	69.6
Karnataka	65.8	65.8	71.4	73.1	68.9	65.2
West Bengal	65.9	65.9	58.4	52.3	68.8	78.3
Maharashtra	67.4	66.4	57.7	67.2	69.7	62.8
Uttar Pradesh	64.0	64.2	72.7	64.1	55.7	54.3
Rajasthan	66.4	67.6	58.4	52.8	68.4	74.6
INDIA	**64.5**	**67.3**	**70.2**	**66.2**	**67.2**	**58.6**
	Ability to do activities of daily living		***Cognition***		***Multi-dimensional Old Age Threshold (MOAT)***	
	Male	Female	Male	Female	Male	Female
Assam	79.2	74.9	61.1	58.2	65.2	63.4
Karnataka	55.1	53.4	68.5	74.0	65.9	66.3
West Bengal	74.6	67.7	71.0	68.9	67.7	66.6
Maharashtra	70.3	63.7	71.0	62.7	67.2	64.5
Uttar Pradesh	60.4	63.2	74.1	73.2	65.4	63.8
Rajasthan	57.9	51.9	81.5	72.5	66.5	63.9
INDIA	**70.0**	**60.1**	**72.0**	**67.8**	**68.8**	**64.0**

The estimated MOATs in all states were higher than 60 in all states. Therefore, the shares of older persons (60+) to the total population were higher in all selected states as compared to the old aged share above MOAT of respective states. So, the burden of ageing decreases to a great extent if MOAT is considered rather than the conventional age 60 which is the age at the retirement of general employees of the central government of India and in all of the selected state Government employees (Table 4). The share of old-age reduced by half from 8% (60+) to 4% (MOAT:67+) in India. In Maharashtra, the percentage of elderly was the highest (9.3%) that reduced to 4.9% with revised old age (MOAT:68.6). The old-age dependency ratio decreased from 14.2% to 7.3% for India if the MOAT being considered instead of the age 60. Assam state which had the lowest burden of ageing (measured conventional age 60) among selected states, had the higher old age dependency measured with multidimensional approach. Further, gender gaps in old-age dependency increased sharply when measured with MOAT (females have doubled OADR than males) as compared to when it was measured with old age 60 (1

percentage point difference between females and males). However, rural-urban differentials in the burden of ageing narrowed down with multidimensional approach.

Table 4: Share of older persons to total population and old age dependency ratio according to conventional OAT (age 60) and MOAT in India and states, 2011

	Percentage of 60+					*OADR*				
	Total	***Males***	***Females***	***Rural***	***Urban***	***Total***	***Males***	***Females***	***Rural***	***Urban***
India	8.0	7.7	8.4	8.1	7.9	14.2	13.6	14.9	15.1	12.4
Assam	6.1	6.2	6.0	6.0	6.6	11	10.9	11.1	11	11
Karnataka	8.4	7.9	8.9	8.9	7.5	14.8	13.8	15.8	16.7	12
West Bengal	8.2	8.2	8.2	7.5	10.1	13.2	12.7	13.7	12.5	14.5
Maharashtra	9.3	8.8	9.7	10.3	7.9	15.7	14.2	17.2	18.8	12.2
Uttar Pradesh	6.8	6.6	7.1	6.9	6.5	13.9	13.9	13.8	14.8	10.9
Rajasthan	7.2	6.6	7.9	7.2	7.4	13	11.9	14.1	13.7	11.1
	Percentage of MOAT plus					***MOADR***				
	Total	***Males***	***Females***	***Rural***	***Urban***	***Total***	***Males***	***Females***	***Rural***	***Urban***
India	4.0	3.8	4.2	4.1	3.9	7.3	6.1	11.4	7.8	6.5
Assam	3.1	3.1	3.1	3.0	3.5	8.4	7.8	8.8	8.4	8.1
Karnataka	4.3	4.2	4.8	4.9	3.8	8.2	7.7	8.7	9.2	6.7
West Bengal	4.1	3.9	4.2	3.7	5.3	6.9	6.1	7.2	6.5	7.7
Maharashtra	4.9	4.6	5.2	5.6	4.0	8.5	7.9	12.7	8.6	5.4
Uttar Pradesh	3.6	3.5	3.6	3.7	3.1	5.9	7.7	7.8	8.0	6.7
Rajasthan	3.6	3.2	4.1	3.7	3.4	6.8	6.4	11.4	7.3	5.7

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