

Healthy Literate Working Dynamic Life Expectancy for India and Some of its Major States

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Abstract

The absence of disease or disability, good level of education and active involvement in society are considered as essential dimensions for a long and fulfilling life. To assess these concepts, we propose a new indicator the Healthy Literate Working Dynamic Life Expectancy that associates health, literacy level and employment status along with the changing mortality scenario in India and some of its major states for the census year 2011 based on the rates of change of probabilities of death over the previous 10 years i.e.2001. Since dynamic life table considers the mortality changes prevailing in a population, therefore it might provide a more realistic and accurate picture of the healthy, literate and working population under consideration. The analysis reveals higher values of healthy literate working dynamic life expectancy at birth for India and all the major states as compared under usual consideration. Further, different inequalities and a number of particular cases are obtained from the above proposed index.

Keywords: Dynamic life expectancy, Health, India, Literacy, Mortality, Working.

Introduction

Over the last Century, India has witnessed a drastic improvement in the overall life expectancy (LE). Several studies in the recent years have pointed out that declining death rates among adults and elders in India have contributed significantly towards improved LE¹. However, a question that could be raised in this context is that whether this increased life expectancy has really improved the quality of life in India. During second half of twentieth century, WHO noted that the fundamental objective of human activity should include both long life as well as good health². Additionally, the scientific literature on health inequalities has repeatedly demonstrated a strong association between lower levels of education and poorer health outcomes³. Further, in terms of employment, those with low literacy skills often have difficulty finding jobs that pay more than a living wage and thus they face difficulties supporting their

families and are more likely to depend on additional means such as social assistance or food stamps⁴. As such, to get proper medical facilities and for acquiring a healthy life, people should be well paid for their work.

Research during the past several studies have shown that literacy, employment and health condition of a person in a society are demographically measured by literate life expectancy⁵, working life expectancy⁶ and disability-free or healthy life expectancy⁷ respectively. Moreover, various previous demographic studies carried out in the areas of health, literacy and working life expectancy⁸⁻¹⁰ are mostly conducted by using the period life table method which assumes that the mortality experience of a population will remain constant. However, Denton and Spencer¹¹ showed an alternative approach of period life table, named as 'dynamic' extension, that contradicts the assumption of constant mortality of period life table

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and unambiguously allow for the likelihood of further changes in mortality rates. Although the requirement of dynamic life table is particularly important for analyzing the changes in mortality rates for India¹²⁻¹³, one can also have a thought to measure the life expectancy under dynamic scenario with addition to the three most important socio demographic factors viz health, literacy and working.

Empirical evidences suggests that health, literacy and working play a significant role in reducing mortality rates, which in turn is associated with an increase in life expectancy¹⁴⁻¹⁷. Hence, if we compute dynamic literate working life expectancy by considering simultaneous changes in mortality, morbidity, literacy and working, then the resultant indicator would expect to give an absurd value, which might not be acceptable in real situation. Consequently, to compute dynamic literate working life expectancy one can consider only the changing mortality scenario prevailing in a population and the current level of health, literacy and working. With this, the paper mainly concentrates on the dynamic extension of period life table and attempts to develop a new indicator viz. healthy literate working dynamic life expectancy (HLWDLE) in order to portray the affects of health, literacy and working on mortality in India.

Objectives

The main objectives as outlined in the present study are:

To develop the formula for Healthy Literate Working Life Expectancy (HLWLE) under dynamic set up of life table and to derive different inequalities and a number of particular cases from the above index.

To apply these indices in India and some of its major states for the census year 2011 based on the rates of change of the probabilities of death over the previous ten years i.e., 2001.

Methods and Materials

Development of a proposed indicator-Healthy Literate Working Dynamic Life Expectancy (HLWDLE):

Let ${}_n P_{hlwx}$ denote the age-specific proportions of healthy, literate as well as working persons simultaneously at age group $[x, x+n)$ respectively

then the expression for healthy literate working life expectancy (HLWLE) as developed by Thakuria¹⁸, which represents the expected number of years remaining healthy as well as literate and working life simultaneously of an individual at age x is given by

$$hlwe_x^0 = \frac{1}{l_x} \sum_x^{\omega} [{}_n P_{hlwx} * {}_n L_x] \tag{3.1}$$

Where ${}_n L_x$ denotes the total number of years lived by a cohort in the age group $[x, x+n)$ and ω represents the highest age category i.e., 80+.

Now, for constructing dynamic life table as per the method given by Denton and Spencer, we need two period life tables for a particular region. The most recent period could be taken as the reference period.

Similarly, the required expression for healthy literate working dynamic life expectancy, denoted by, $hlwe_{xx}^0$ is then derived as follows:

$$hlwe_{xx}^0 = \frac{1}{l_{xx}} \sum_y^{\omega} [{}_n P_{hlwx} * {}_n L_{xy}] \tag{3.2}$$

Where ${}_n L_{xy}$ (the dynamic analogue of L_x column)

stands for the number of person years lived by survivors of the l_{xx} cohort in the interval y to $y+1$, ω

represents the highest age category i.e., 80+ and ${}_n P_{hlwx}$

represents the age-specific proportions of healthy, literate as well as working persons of the reference period. The healthy literate working dynamic life expectancy could then be used to represent the expected number of years lived on an average by a person in a healthy, literate as well as in working state when mortality changes over the years under consideration provided that the current situation of health, literacy and working remains same.

Particular Cases

The proposed indicator is a generalized one in the sense that from equation 3.2, numerous particular cases can be pursued. If the proportion of working persons are not considered in equation (3.2) then we get healthy-literate dynamic life expectancy (HLDLE) at various ages under current health and literacy state but under changing mortality pattern. Again

by ignoring the literate proportions in equation (3.2) gives healthy-working dynamic life expectancy (HWDLE) and by ignoring the healthy proportions we get the literate-working dynamic life expectancy (LWDLE). Likewise, ignoring the proportions of both literacy and working persons in the proposed index, we get healthy dynamic life expectancy (HDLE) at various ages under current health scenario but under changing mortality pattern. In a similar manner, we can obtain literate dynamic life expectancy (LDLE) and working dynamic life expectancy (WDLE). Moreover, if all the three factors health, literacy and working are ignored in equation (3.2), then we get dynamic life expectancy at various ages. Furthermore, if there is no continuation in the rates of change of probabilities of death, then all the above indicators will reduce to ordinary life expectancies. Thus, the above discussion clearly illustrates that the proposed index viz. healthy literate working dynamic life expectancy (HLWDLE) is seemed to be a more generalized one.

Inequalities

One can derive various inequalities as shown below:

$$hlwe_{xx}^0 \leq hle_{xx}^0 \leq he_{xx}^0 \leq e_{xx}^0$$

$$hlwe_{xx}^0 \leq hle_{xx}^0 \leq le_{xx}^0 \leq e_{xx}^0$$

$$hlwe_{xx}^0 \leq hle_{xx}^0 \leq we_{xx}^0 \leq e_{xx}^0$$

$$hlwe_{xx}^0 \leq lwe_{xx}^0 \leq le_{xx}^0 \leq e_{xx}^0$$

$$hlwe_{xx}^0 \leq lwe_{xx}^0 \leq we_{xx}^0 \leq e_{xx}^0$$

$$hlwe_{xx}^0 \leq lwe_{xx}^0 \leq he_{xx}^0 \leq e_{xx}^0$$

$$hlwe_{xx}^0 \leq hwe_{xx}^0 \leq he_{xx}^0 \leq e_{xx}^0$$

$$hlwe_{xx}^0 \leq hwe_{xx}^0 \leq we_{xx}^0 \leq e_{xx}^0$$

$$hlwe_{xx}^0 \leq hwe_{xx}^0 \leq le_{xx}^0 \leq e_{xx}^0$$

Where $he_{xx}^0, le_{xx}^0, we_{xx}^0, hl_{xx}^0, hw_{xx}^0$ and lwe_{xx}^0 represents healthy dynamic life expectancy, literate dynamic life expectancy, working dynamic life expectancy, healthy literate dynamic life expectancy, healthy working dynamic life expectancy and literate working dynamic life expectancy of an individual at age x respectively.

Similarly, if there is no continuation in the rates of change of probabilities of death, then all the above inequalities will reduce to ordinary life expectancies.

An important point to be noted here is that as the quantity of factors implicated in the life expectancy reduces, there is an increase in the corresponding value of the index which is quite obvious.

Application

As stated in the objective, here we tried to estimate healthy literate working dynamic life expectancy (HLWDLE) for India and some of its major states for both sexes for the census year 2011. For this, the age specific proportions of healthy, literate as well as working persons together needs to be combined with the dynamic life table. The Sample Registration System (SRS) based abridged life tables of India and its selected states for the period 2009-2013 and 1999-2003 are considered for the purpose. The required information regarding the literate and working population by age and sex, for India and all the major states, are provided by the population census, which is the main source of demographic data in India. For the factor health, since we do not have morbidity data, as such for the present study, data on disability were taken from the table C20 of the 2011 Census of India. Using the above information, one can thus calculate the healthy proportions, literate proportions and working proportions by age and sex wise respectively. However, Census of India do not provide information on healthy, literate and working persons simultaneously. As such, we have attempted to find the values of the proposed indicator HLWLE by using the random number generation method. In the process, we have also generated very compact and user friendly R programs for calculating the values using the above technique. An interesting point to be noted here is that if we take the product of healthy, literate and working proportions simultaneously i.e by assuming all the three factors as independent, then the values obtained are very near to the values obtained by using the random number generation method¹⁸.

Finally, the age specific proportions of healthy, literate as well as working persons together are calculated for India and 17 of its major states and consequently, healthy literate working dynamic life expectancies are constructed and presented in Table 1 and 2 below for both the sexes for the period 2011 by taking the period 2009-13 (centered at 2011) as reference period and 1999-2003 (centered at 2001)

as the previous period. Various other social indicators, viz, healthy literate dynamic life expectancy, healthy working dynamic life expectancy, literate working dynamic life expectancy, healthy dynamic life expectancy, literate dynamic life expectancy and working dynamic life expectancy are also presented in the same tables. Looking into the constraints of time and space, the estimates are presented only at birth. Moreover, literate and healthy life expectancy is usually calculated at age zero while working life tables are generally constructed from age 15 onwards but in the present study to maintain the uniformity we have calculated all the indicators mentioned above from age zero onwards.

Table 1: Values of HLWDLE at birth and various other indicators along with period and dynamic life expectancy at birth (MALES)

STATES	Period	Dynamic	Dynamic							Period	Dynamic	Difference
	hlwe ₀ ⁰	hlwe ₀₀ ⁰	Difference	hle ₀ ⁰	hwe ₀ ⁰	lwe ₀ ⁰	he ₀ ⁰	le ₀ ⁰	we ₀ ⁰	e ₀ ⁰	e ₀₀ ⁰	
India	29.06	30.96	1.90	46.80	41.79	31.94	68.70	48.27	43.18	65.83	70.90	5.07
Jammu & Kashmir	25.88	26.77	0.89	42.31	40.33	27.89	68.66	44.01	42.27	70.56	71.74	1.18
Himachal Pradesh	35.34	35.36	0.02	51.46	41.62	36.46	67.35	53.04	43.04	68.96	69.57	0.61
Punjab	29.14	29.62	0.48	45.97	39.97	30.54	68.44	47.36	41.26	69.10	70.57	1.47
Haryana	28.36	27.79	-0.57	42.81	34.97	28.57	59.31	43.93	35.99	65.81	60.86	-4.95
Rajasthan	27.48	27.86	0.38	41.02	40.16	28.81	64.35	42.48	41.79	65.37	67.07	1.70
Uttar Pradesh	25.93	25.68	-0.25	38.63	36.79	26.40	59.60	39.65	37.86	62.54	61.17	-1.37
Bihar	25.69	26.97	1.28	40.13	43.50	27.87	68.43	41.40	45.0	67.34	70.58	3.24
Assam	27.49	29.20	1.71	42.37	40.15	29.84	63.25	43.26	41.06	61.94	64.56	2.62
West Bengal	30.7	32.29	1.59	50.47	41.89	33.26	70.95	52.04	43.19	68.46	73.10	4.64
Odisha	28.7	31.51	2.81	48.58	41.39	32.87	69.96	50.93	43.29	63.78	73.45	9.67
Madhya Pradesh	27.23	28.75	1.52	41.61	40.96	29.66	63.89	42.88	42.36	62.29	65.89	3.60
Gujarat	32.12	34.06	1.94	51.07	42.48	34.91	70.29	52.40	43.59	66.02	72.14	6.12
Maharashtra	33.84	37.15	3.31	57.28	44.57	38.53	75.77	59.41	46.28	69.37	78.58	9.21
Andhra Pradesh	24.96	26.49	1.53	42.25	41.01	27.46	69.26	43.79	42.64	65.50	71.96	6.46
Karnataka	30.41	31.78	1.37	47.25	41.95	32.65	67.70	48.53	40.96	66.37	69.53	3.16
Kerala	35.44	37.47	2.03	66.23	39.29	38.66	77.27	68.57	40.56	71.80	79.91	8.11
Tamil Nadu	32.88	34.96	2.08	54.32	43.22	35.72	73.29	55.48	44.19	68.16	74.84	6.68

Table 2: Values of HLWDLE at birth and various other indicators along with period and dynamic life expectancy at birth (FEMALES)

STATES	Period	Dynamic	Difference	Dynamic							Period	Dynamic	Difference
	hlwe ₀ ⁰	hlwe ₀₀ ⁰		hle ₀ ⁰	hwe ₀ ⁰	lwe ₀ ⁰	he ₀ ⁰	le ₀ ⁰	we ₀ ⁰	e ₀ ⁰	e ₀₀ ⁰		
India	9.84	10.36	0.52	35.80	19.97	10.60	73.55	36.68	20.50	69.28	75.74	6.47	
Jammu & Kashmir	6.06	6.12	0.06	27.51	14.87	6.29	71.30	28.34	15.45	73.96	74.52	0.56	
Himachal Pradesh	20.94	21.33	0.39	42.44	33.62	21.77	73.95	43.33	34.61	73.06	76.34	3.28	
Punjab	7.15	7.35	0.20	40.81	12.16	7.51	74.29	41.73	12.46	73.43	76.22	2.79	
Haryana	5.75	5.81	0.06	33.41	10.64	5.93	66.42	34.08	10.88	70.91	68.12	-2.79	
Rajasthan	9.46	9.71	0.25	24.49	27.21	9.92	70.08	25.14	28.15	69.99	73.67	3.68	
Uttar Pradesh	5.10	5.43	0.33	27.29	14.38	5.55	69.40	27.88	14.75	65.25	71.18	5.93	
Bihar	5.69	5.97	0.28	25.20	17.34	6.11	70.71	25.77	17.78	68.02	72.50	4.48	
Assam	8.68	9.29	0.61	35.11	17.31	9.46	70.75	35.84	17.72	65.08	72.67	7.58	
West Bengal	7.80	8.09	0.29	41.63	13.18	8.27	75.17	42.65	13.50	71.56	77.25	5.69	
Odisha	9.81	10.25	0.44	33.75	18.94	10.54	69.43	34.85	19.60	65.88	72.45	6.58	
Madhya Pradesh	10.38	10.92	0.54	29.03	25.61	11.14	69.05	29.66	26.27	65.52	71.02	5.50	

STATES	Period	Dynamic	Difference	Dynamic						Period	Dynamic	Difference
	hlwe ₀ ^d	hlwe ₀₀ ^d		hle ₀₀ ^d	hwe ₀₀ ^d	lwe ₀₀ ^d	he ₀₀ ^d	le ₀₀ ^d	we ₀₀ ^d	e ₀ ^d	e ₀₀ ^d	
Gujarat	9.87	10.09	0.22	39.06	16.75	10.31	71.26	39.92	17.14	70.49	73.02	2.53
Maharashtra	15.31	16.16	0.85	47.12	24.79	16.58	79.84	48.42	25.49	73.42	82.28	8.86
Andhra Pradesh	11.39	11.69	0.30	31.93	25.35	11.99	71.96	32.81	26.12	70.42	74.41	3.99
Karnataka	12.70	12.89	0.19	37.05	22.32	13.15	68.16	37.82	22.80	70.78	69.66	-1.12
Kerala	11.66	12.0	0.34	65.99	13.20	12.29	83.32	68.03	13.53	77.79	86.06	8.27
Tamil Nadu	13.99	14.77	0.78	45.62	24.06	15.01	80.43	46.36	24.47	72.33	81.86	9.53

Results and Discussion

Some Important Observations

1. The highest dynamic HLWLE at birth during a 10-year interval is observed in Kerala for males with 37.47 years and Himachal Pradesh for females with 21.33 years. The same is also true in case of usual consideration.
2. The lowest dynamic HLWLE at birth during a 10-year interval is in Uttar Pradesh for both the sexes with 25.68 years for males and 5.43 years for females.
3. Among all the indicators, the values of healthy literate life expectancy (HLE) at birth are found to be highest for India as well as for all the selected states under study whereas the values of working life are found to be much lower for both the sexes under both the procedures.
4. The working life of Keralian people are found to be much poor as compared to the other states. The gap between LE at birth and WLE at birth under dynamic scenario is found to be 39.35 years in Kerala, the highest gap in comparison to all other states.
5. Meanwhile, Bihar, the state which records quite low values in terms of HLE at birth (68.43 years) and extremely low values in terms of LLE at birth (41.4 years) as compared to Kerala, records second highest in the list after Maharashtra with regard to WLE at birth and HWLE at birth.
6. Further, in spite of low literacy and health status of the females of Rajasthan, Andhra Pradesh and Madhya Pradesh, their working status are found to be extremely good.

Sex Difference:

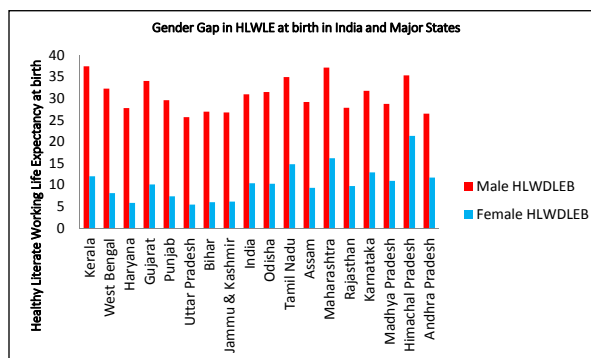


Figure 1: Gender disparity in Healthy Literate Working Dynamic Life Expectancy at birth for India and its major states, 2011.

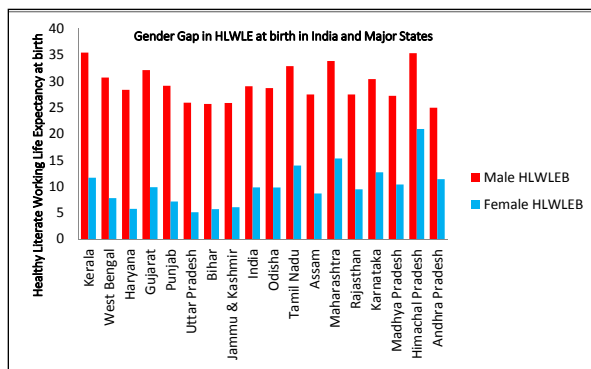


Figure 2: Gender disparity in Healthy Literate Working Life Expectancy at birth for India and its major states, 2011.

Some Important Observations:

1. Among the states under consideration, the highest gap in gender variation with regard to HLWLE at birth is found to be in Kerala under both dynamic and usual consideration with almost 25 years and 24 years respectively.

One of the possible reason for this might be the lower work participation of females compared to males.

2. Subsequently, after Kerala, all other states also exhibits high gender disparity in terms of dynamic HLWLE at birth. A closer inspection reveals that although the gender gap in LLE is found to be high in India as well as across all its major states except Kerala (0.54 years) however, this gap is found to be much more with regard to female work participation in the labour force.

Conclusion

The study puts forward a new and innovative indicator healthy literate working dynamic life expectancy by combining four essential dimensions of life: health, the literacy level and the employment status along with the mortality scenario in India and some of its major states, by incorporating the rates at which the probabilities of death have been changing over the previous years. Due to tremendous improvement in mortality rates during the last decade, the values of dynamic HLWLE at birth for all the major states are more or less higher as compared under usual consideration. The result of this indicator reveals that in most of the states, a higher value of healthy literate working life expectancy (HLWLE) is mainly correlated with longer health, higher literacy and with longer periods of working for both males and females under both dynamic and usual consideration. However, some states viz. Kerala, Bihar, Rajasthan, Andhra Pradesh and Madhya Pradesh are an exception. In spite of showing highest literacy levels in the nation as well as enjoying much more healthier lives, the Kerala state fails to engage its active population in labour force. Meanwhile, despite having very low literacy level and poor health condition, males of Bihar and females of Rajasthan, Andhra Pradesh and Madhya Pradesh showed active involvement in work participation.

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