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Research Article

Literate Life Expectancy of India and Some States Based on the 2011 Census

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ABSTRACT

This study aimed to analyze and compare the Literate Life Expectancy (LLE) of males and females in India and selected states based on 2011 census data. Six major states representing different regions of India were chosen: Assam for the North East, Gujarat for the West, Kerala for the South, Punjab for the North, Uttar Pradesh for the Central region and West Bengal for the East. SRS Abridged life tables for India and the selected states for 2011 were collected from official sources. LLE was estimated using a life table approach. Age-specific proportion of literacy were calculated based on 2011 census data. Extended Literate Life Expectancy was also calculated, considering both literacy and healthy life expectancy. Kerala consistently had the highest LLE, while Uttar Pradesh had the lowest. Line graphs illustrate LLE for males and females, showing a decline with increasing age. Kerala had a relatively higher LLE for both genders. Estimates of Literate Health Life Expectancy for both genders were provided, showing lower values for females than for males. Comparison tables and graphs showed that LHLE values were lower than LLE values, indicating a decrease in expectancy among individuals with health factors. LLE varied across zones and states, with higher values in the southern regions. Males generally had higher LLE than females.

Key words: Age-specific proportions of literacy, Census 2011, Extended Literate Life Expectancy, LHLE, LLE, SRS Abridged life table.

1. INTRODUCTION

Wolfgang Lutz first presented the Literate Life Expectancy (LLE) in 1995 at the International Institutes for Applied System Analysis (IIASA). This measure is mostly a demographic measure that sums life expectancy and literacy, the two main components, into a single figure.

The capacity to read and write is known as literacy. A person is literate if they can read and write brief, straightforward statements about their daily lives with comprehension. It is more common for those with strong reading skills to be happier, healthier, employed in better occupations, and to pay more for their education.

Life expectancy is the average lifespan of a given population or cohort (actual or hypothetical, more commonly when cross-sectional mortality risk is utilized).

The length of an individual's life and educational attainment are two fundamental components of social development that are combined in the methodical LLE approach [1]. Age-specific mortality rates and age-specific percentages of literate people were assessed using the LLE indicator. The overall average of a person's condition of literacy. This indicator's goal is to examine a person's years of existence while they are illiterate [2]. For direct cross-national comparisons, LLE provides a better fit than multidimensional human capital data.

There are numerous advantages to being literate in the political, social, economic, and environmental spheres of life [2]. When comparing subgroups within a population, such as regions, men, and women, or residents of rural and urban areas, one may use the Literate Life Expectancy measure. It is presumed that these are more uniform than the sum. There is no limit to the number of breakdowns if the data are available [2]. It is possible to use particular inequality indicators, such as the ratio of the lowest to greatest LLE values among subpopulations [2].

For a long time, social indicators [3] have been used informally to evaluate the state of a country and its progress toward national goals, especially in the field of economics. When assessing an individual's quality of life, attention should be paid to human welfare, specifically to concerns regarding gender, equity, and poverty [4]. Literate Life Expectancy (LLE), the most recent measure of social progress, is used in this context. We have attempted to emphasize the significance of utilizing a pure social indicator, which is primarily a demographically based indicator and purposefully does not utilize any economic measurement, instead combining life expectancy and literacy into a single statistic.

The Literate Life Expectancy (LLE) in India and the Seven States in 2011 was a crucial indicator of social and economic development. Research has indicated a positive correlation between life expectancy and literacy rates, highlighting the importance of education in improving overall well-being [5, 7, 8]. The analysis of healthy literacy working life expectancy reveals disparities between genders, with males generally experiencing better conditions than females due to factors like employment and literacy improvements [6, 8]. In specific states like Odisha and Punjab, variations in LLE are observed, with literacy improvements playing a significant role in enhancing life expectancy, especially for females [6, 8]. This study emphasizes the impact of literacy, working conditions, and mortality rates on the overall quality of life. Notably, females in India have shown an increase in healthy literateness and working life years, with improvements attributed to various factors, such as literacy, working conditions, and mortality rates [6, 8]. Overall, the analysis underscores the importance of education, working conditions, and health in determining quality and length of life. This highlights the need for targeted interventions to improve literacy rates, enhance working conditions and reduce mortality rates to ensure a healthier and more literate population in India and its selected states [6, 8].

At the urban or rural level of geographic aggregation, the Literate Life Expectancy Index is an extremely straightforward and comprehensive measure of social development. Significantly, by using various mortality and educational scenarios that can be linked to particular policy assumptions, this index can be used to estimate future social progress. In our nation, the number of literate individuals and the number of years an individual has survived are the only metrics used to assess basic health and education, respectively.

Issues with abstract indices on a relative scale are avoided by this LLE because it is an absolute number with an obvious interpretation. When measured across time, it permits claims regarding the pace of change rather than merely constant variations.

This new indicator allows for the prediction of future generations' educational and human potential in addition to displaying the state of social development as it stands at present. The results also show the literacy rate by age group. No maximum or minimum assumptions or modifications are required. This measure considers the fact that a person's years are not always filled with high productivity. Time and capabilities impact functional abilities. Therefore, the LLE index has a lower value in the oldest age groups. Age-specific literacy refers to the series of events that lead an individual from illiteracy to literacy.

By anticipating the social aspects of generational transitions, countries can gauge the nature and scope of their upcoming social needs in terms of public policy. Because the literacy level life expectancy statistic does not represent any economic income metric, the distribution of social benefits cannot be missed. The LLE indicator does not rely on national GDP accounting; rather, it is based solely based on individual attributes, such as mortality and literacy.

Because of the population's age-group distribution is systematic, the LLE indicator highlights years of life that are indicative of a real "literate state." Functional abilities were assigned a more realistic level by this social indicator.

Because of its adaptability, the LLE indicator makes it possible to compare patterns throughout time by revealing the current and most likely future trends for each age group. Therefore, there is much room for improvement in human development through a more equitable distribution of social services and precise budgetary restructuring.

Raising educational attainment benefit society, the economy, and the environment. More educated people tend to produce and consume things more efficiently, and both trends generally improve the environment. Predicting the prospective growth of a generation and a country requires analyzing the replacement process of age groups according to educational attainment.

It would be interesting to know the number of years in a person's lifetime that they would have with both good health and literacy. The average number of years lived by a person in a literate and healthy state was determined using the life table technique to determine the answer.
This is a more generalized form of LLE that considers literacy and health. These LLE values give the idea of the expected number of years a person will live in a literate and healthy position.
Literacy and health, besides mortality, are two important aspects that determines the quality of life, therefore, by combining all these factors together, we can estimate the average number of years lived by a person in a literate and healthy state. i.e. life expectancy under a literate and healthy state, which may be termed Literate Health Expectancy. LHE denotes life expectancy under literate state and without diseases or free of diseases.
The LHE combines these factors into a single indicator, and it may be regarded as a better indicator to measure individual social empowerment, health status, and quality of life in a true sense of the term by a single measure in comparison to life expectancy, LLE, and health expectancy. LHE may also be regarded as a generalized measure of quality of life and the other three, life expectancy, health expectancy, and literacy as its components. LHE may be a better indicator to measure the human development index (HDI).
If we take literacy as a constant, we will have health values. If we take the values of health as constant then we will have the value literacy. Again, if we take both as constants, we have the expected life values.

2. OBJECTIVES

To calculate the literate life expectancy of males and females in India and some of its selected states based on the 2011 census, the selected states are Assam for the North East, Gujarat for the West, Kerala for the South, Punjab for the North, Uttar Pradesh for the Center, and West Bengal for the Eastern.

i. The selection of the states of India will give us a scope for estimating, comparing, and contrasting the Literate Life Expectancy (LLE) for Assam, Gujarat, Kerala, Punjab, Uttar Pradesh, and West Bengal.
ii. Comparison of Literate Life Expectancy for both Male and Female of the different states at different age interval.
iii. Further, we have calculated the extended literate life expectancy of India for both Males and Females. In this study, extended literate life expectancy was considered for both literacy and healthy life expectancy. This gives us a generalized view of how literacy and health impact life expectancy.

3. MATERIALS AND METHODS

3.1 Construction of Zones:

India is a nation in South Asia with a population of over 1.2 billion. It is the second-most populous country in the world, the most populous democracy, and the seventh-largest country in terms of area. The Bay of Bengal borders it to the southeast, the Arabian Sea to the southwest, and the Indian Ocean to the south. Its land boundaries are shared by Bangladesh and Myanmar (Burma) to the east, China, Nepal, and Bhutan to the northeast, and Pakistan to the west. In the Indian Ocean, India is situated close to Sri Lanka and the Maldives. The Andaman and Nicobar Islands of India form a shared marine border with Thailand and Indonesia. In terms of nominal GDP and purchasing power parity, the Indian economy ranked seventh and third globally in 2015.
We have considered of 6 states from different parts of the nation to calculate the Literate Life Expectancy at different age levels for both men and women.
To calculate the literate life expectancy of males and females in India and some of its selected states in 2011, the selected states assume Assam for the North East, Gujarat for the West, Kerala for the South, Punjab for the North, Uttar Pradesh for the Center and West Bengal for the Eastern.

3.2 Materials:

For the present study, SRS Abridged life tables for India and 6 major states for the 2011 period were collected from the “SAMPLE REGISTRATION SYSTEM BASED ABRIDGED LIFE TABLES 2009-2013” published by the Vital Statistics Division, Office of the Registrar General of India, Ministry of Home Affairs, New Delhi.
Again, the 2011 Census Report is also being used to calculate the population for different age groups from different states.

3.3 Methodology:

3.3.1 Calculating of Literate Life Expectancy:

In a life table used to summarize a population's experience with death, the LLE is estimated without the need for intricate mathematical operations. The weighted number of person-years at each age determined by the age-specific proportions of persons literate is the only new component.

i.e., $\mathbf{PL_x}$ = Age-specific proportions literate (for age group x)

The formula for calculating age-specific proportion literate ($\mathbf{PL_x}$) is

$$\mathbf{PL_x} = \frac{\text{Age–Specific Literate Population by Education Level}}{\text{Age–Specific Total Population}}$$

Here, $\mathbf{LL_x}$ = Literate person years lived for age group x
In the life table, the $\mathbf{L_x}$column is multiplied by $\mathbf{PL_x}$ to generate the $\mathbf{LL_x}$ column. The formula for the literate life expectancy indicator and notations in the model life table are as follows:

$$\mathbf{(L_x)\ (PL_x) = LL_x}$$

where, $\mathbf{L_x}$= Total number of person years living in age group x
Like a regular life table, literate life expectancy ($\mathbf{Le^o_x}$) is calculated by dividing the cumulative literate person years $\mathbf{LT_x}$ by the $\mathbf{l_x}$ column, i.e**.,**

$$\mathbf{Le^o_x} = \frac{\mathbf{LT_x}}{\mathbf{l_x}}$$

where**,** $\mathbf{LT_x = \Sigma LL_x}$
$\mathbf{Le^o_x}$ =Literate life expectancy at age x
$\mathbf{LT_x}$ = Cumulative literate person-years
$\mathbf{l_x}$= Number of survivors at age x

3.3.2 Calculation of Extended Literate Life Expectancy: Literate Healthy Life Expectancy

The formula for extended literate life expectancy indicator and notations in the model life table are as follows:

$$\mathbf{(L_x)\ (PL_x \times PH_x) = LL_x}$$

where, $\mathbf{PL_x}$ = Age-specific proportions literate (for age group x)

$$= \frac{\text{Age–Specific Literate Population by Education Level}}{\text{Age–Specific Total Population}}$$

$\mathbf{PH_x}$ = Age-specific proportions healthy (for age group x)

$$= \frac{\text{Age–Specific Healthy Population by Education Level}}{\text{Age–Specific Total Population}}$$

$\mathbf{LL_x}$ = Literate Healthy person-years lived for age group x
$\mathbf{L_x}$ = Total number of person-years living in age group x
Like in a regular life table, extended literate life expectancy is calculated by dividing the cumulative literate person years by the lx column, i.e.,

$$\mathbf{Le^o_x} = \frac{\mathbf{LT_x}}{\mathbf{l_x}}$$

where**,** $\mathbf{LT_x = \sum LL_x}$
$\mathbf{Le^o_x}$ = Literate life expectancy at age x
$\mathbf{LT_x}$ = Cumulative literate person-years
$\mathbf{l_x}$ = Number of survivors at age x

4. STATISTICAL ANALYSIS

4.1 Tabular representation:

Table I: Age-wise estimates of LLE in India and some of its selected states based on 2011 census for Males

Age / India and states	0-1	5-10	15-20	25-30	35-40	60+
India	44.71911	47.28481	40.5982	32.12865	24.45122	9.253474
Assam	41.32896	44.62514	38.03314	30.18695	23.11024	9.293297
Gujarat	48.06905	50.87839	43.82837	35.1309	26.99879	10.64438

Kerala	60.82435	61.54454	53.91348	44.45944	35.23335	14.74716
Punjab	45.68032	47.30418	40.282	31.78953	24.11801	8.547408
Uttar Pradesh	39.8816	43.22503	36.87475	28.74073	21.50314	7.631808
West Bengal	48.21313	50.08683	43.15863	34.65407	26.92533	11.09558

Observations (Table I):

i. The LLE value of India, which is 44.71 for males at age intervals 0-1 depicts that in a group of males (1,00,000) born together are expected to live 44.71 years on average as literate under the condition that present literacy and mortality condition prevail.
ii. The highest LLE value at birth occurs in Kerala, and the lowest value occurs in Uttar Pradesh.
iii. The highest LLE value for males occurs in Kerala at an age interval 5-10. The LLE value decreased as age increased.
iv. The LLE value of Assam and Uttar Pradesh is less than the national level, whereas the value of Kerala, Punjab, West Bengal, and Gujarat exceeds the national level.

Table II: Age-wise estimates of LLE in India and some of its selected states based on the 2011 census for women

Age / India and states	0-1	5-10	15-20	25-30	35-40	60+
India	34.24853	36.46748	29.83746	22.03419	15.70896	4.84769
Assam	32.96365	35.8742	29.4931	22.08193	15.74189	4.914642
Gujarat	38.46906	40.94224	33.95299	25.8361	18.82978	6.330654
Kerala	61.39882	62.27579	54.61534	44.94314	35.42012	13.8959
Punjab	40.30255	42.07451	35.05449	26.47429	18.98368	5.160258
Uttar Pradesh	26.19504	28.79029	22.52867	15.3458	10.5265	3.060962
West Bengal	39.90183	41.46828	34.45795	26.27463	19.15229	6.241613

Observations (Table II):

i. The LLE value of India, which is 34.24 for females at age intervals 0-1 depicts that in a group of males (1,00,000) born together are expected to live 34.24 years on average as literate under the condition that the present literacy condition prevails.
ii. The highest LLE value at Birth occurs in Kerala and the lowest value occurs in Uttar Pradesh.
iii. The highest LLE value for males occurs in Kerala at an age interval 5-10. The LLE value decreased as age increased.
iv. The LLE values of Assam and Uttar Pradesh are lower than the national level, and others are just above the LLE value of India.

4.2 Graphical representation:

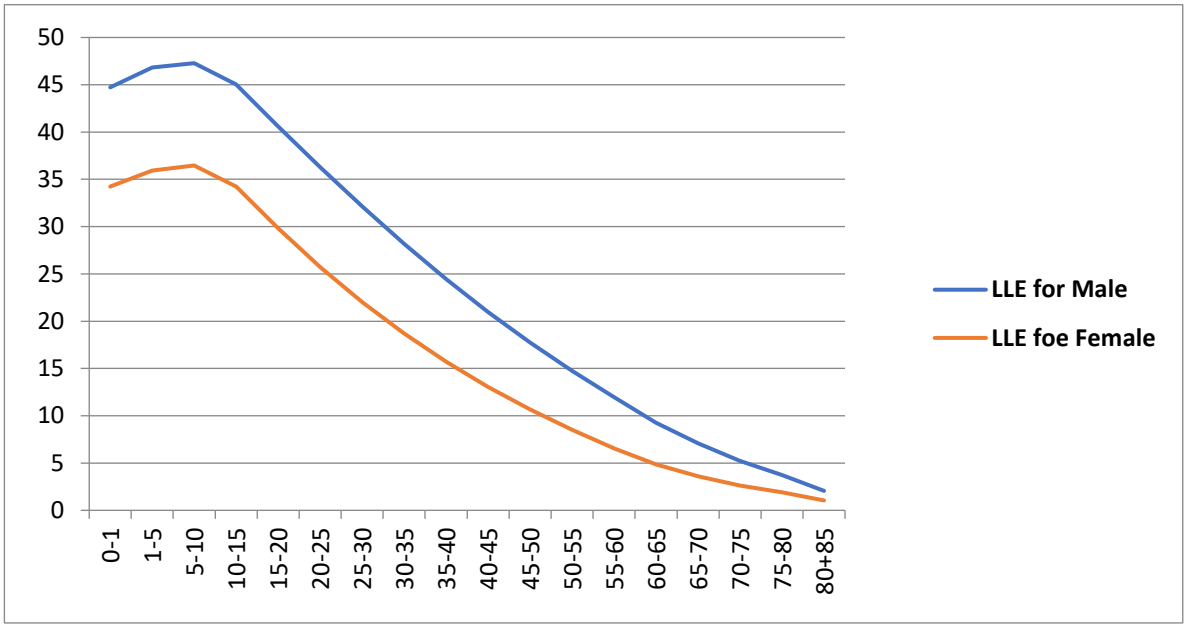

Fig. 1: Graphical representation of LLE in India for males and females

Observations (Fig. 1):

The line graph of LLE for males is above the line graph of females, which indicates that the Literate Life Expectancy of India for males is higher than that of females. Values are at their highest position at the age level 5-10 years and it gradually decreases with the increasing age.

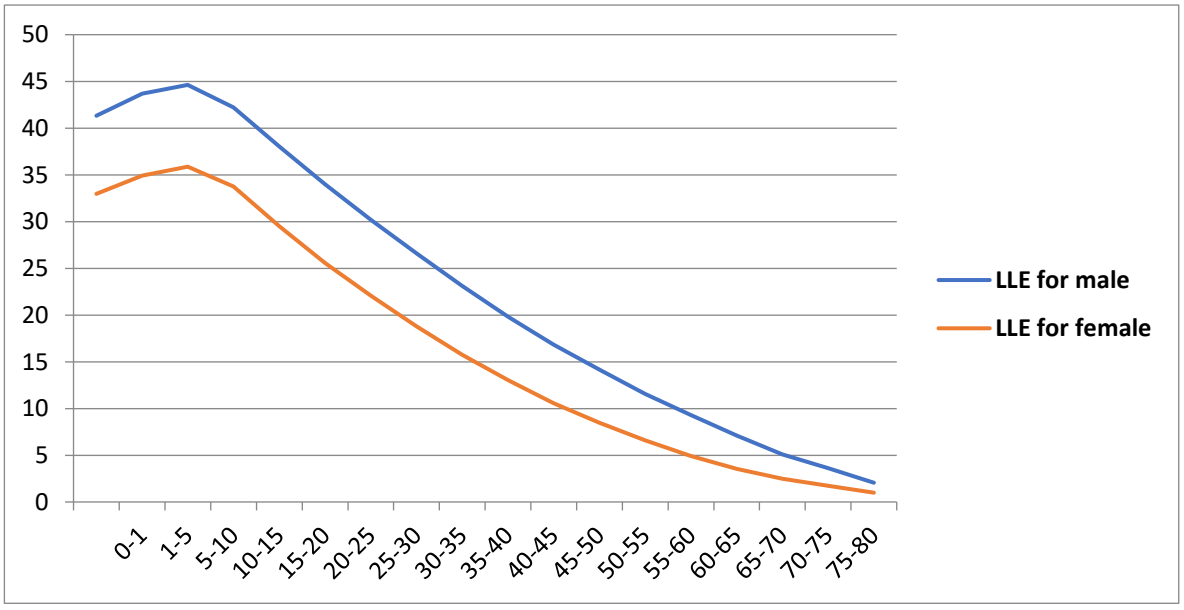

Fig. 2: Graphical representation of the LLE of Assam for males and females

Observations (Fig. 2):

Here also, the line graph of LLE for males is above the line graph of females, which indicates that the LLE value for males in Assam is higher than that for females. The highest value occurs at the age interval 5-10 years and it continues to decline at the growing age level.

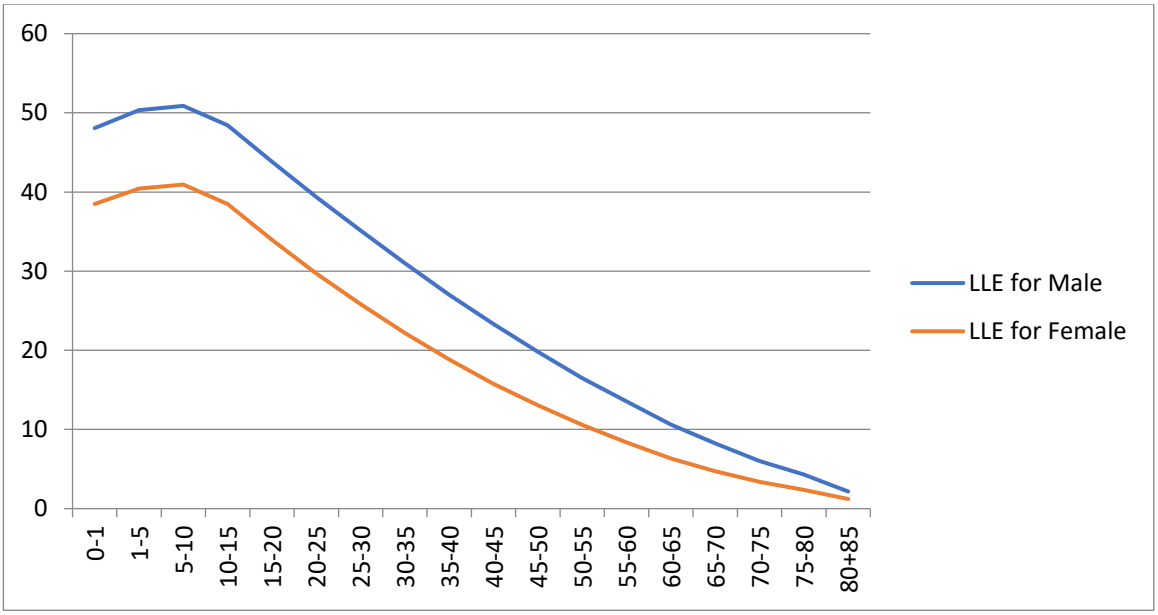

Fig. 3: Graphical representation of LLE in Gujarat for males and females

Observations (Fig. 3):

Here also, the line graph of LLE for males is above that of females, which indicates that LLE for males in Gujarat is higher than that for females. The highest value occurs at an age interval 5-10 years and gradually declines.

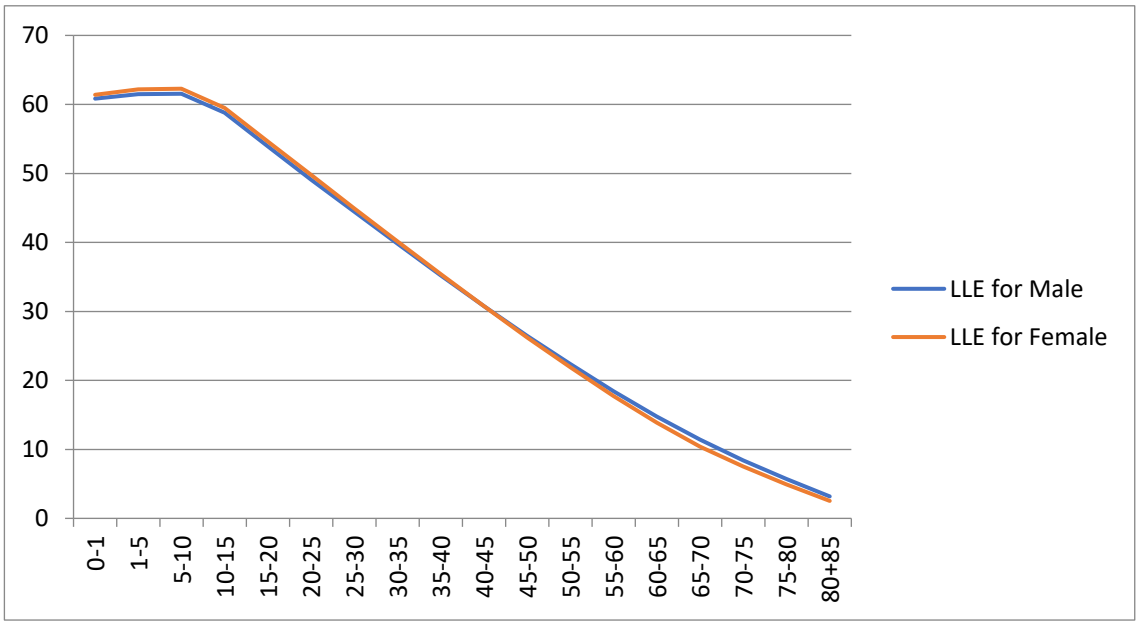

Fig. 4: Graphical representation of LLE in Kerala for males and females

Observations (Fig. 4):

The line graph of LLE for males almost coincides with the line graph of females, which indicates that the Literate Life Expectancy of Kerala for males is almost equal to that of females. Values are at their highest position at the age level 5-10 years and it gradually decreases with increasing age intervals.

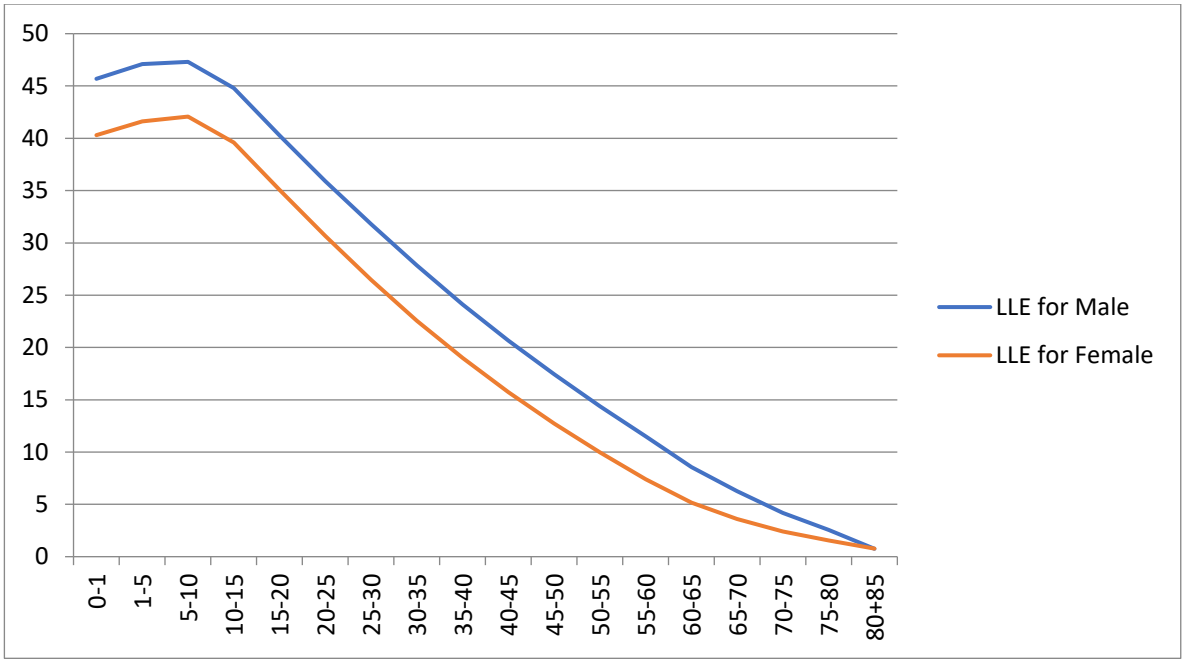

Fig. 5: Graphical representation of LLE in Punjab for males and females

Observations (Fig. 5):

The line graph of LLE for males is above the line graph of females which indicates that the Literate Life Expectancy of Punjab for males is higher than that of females. Values are at their highest position at the age level 5-10 years and it gradually decreases with the increasing age.

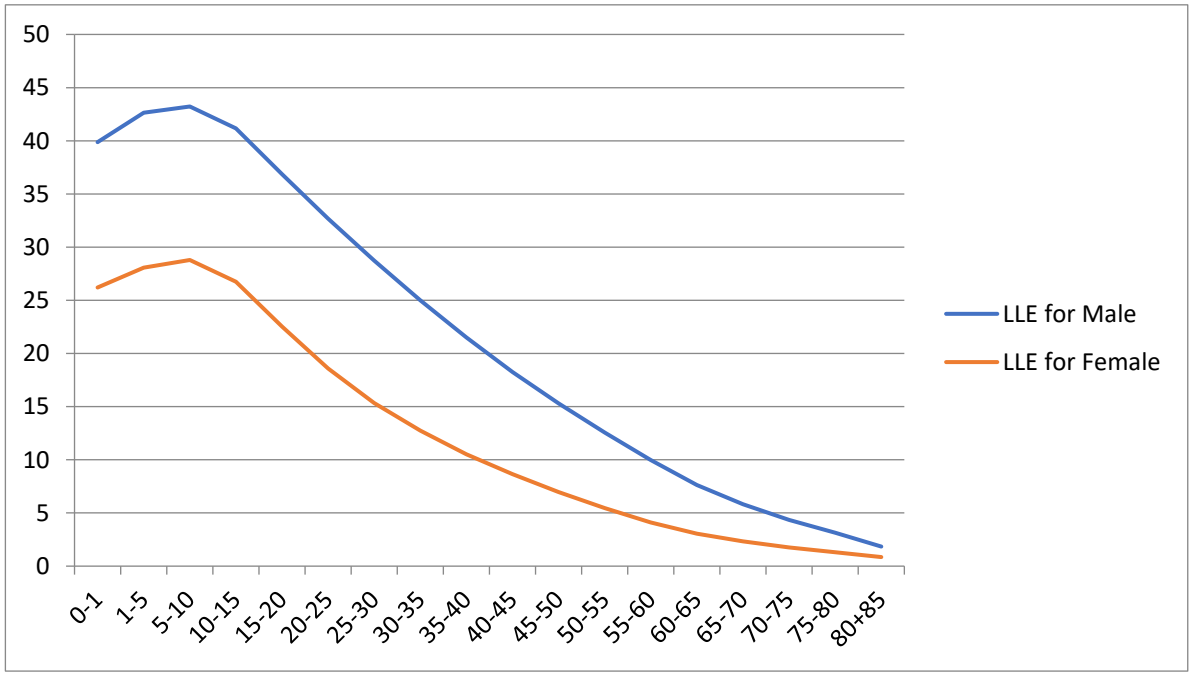

Fig. 6: Graphical representation of LLE in Uttar Pradesh for males and females

Observations (Fig. 6):

The line graph of LLE for males is above the line graph of females, which indicates that the Literate Life Expectancy of Uttar Pradesh for males is higher than that of females. The LLE values were very low for females. Values are at their highest position at the age level 5-10 years and it gradually decreases with the increasing age.

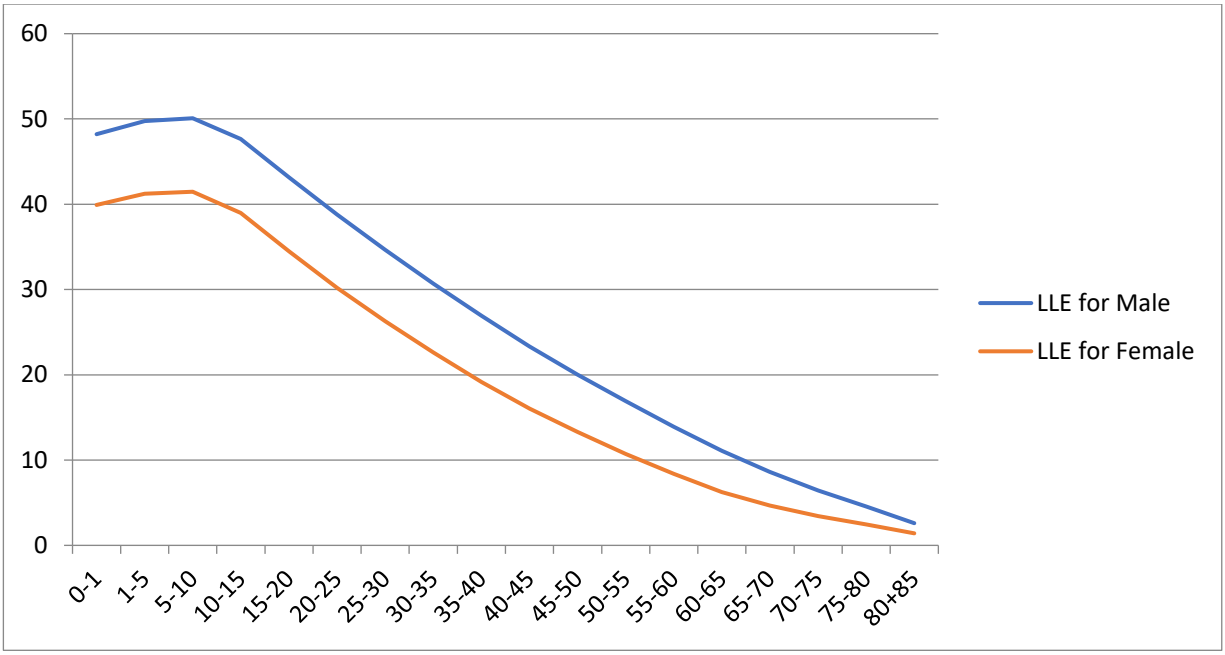

Fig. 7: Graphical representation of LLE in West Bengal for males and females

Observations (Fig. 7):

The line graph of LLE for males is above the line graph of females, which indicates that the Literate Life Expectancy of West Bengal for males is higher than that of females. Values are at their highest position at the age level 5-10 years and it gradually decreases with the increasing age.

4.3 Literate Health Life Expectancy

Table III: Age-wise Estimates of Literate Health Life Expectancy in India for Males and Females

Age group / Gender	India			
	0-1	15-20	25-30	60+
Male	41.8092	38.05658	30.25512	8.883778
Female	32.0428	27.9944	20.78003	4.616218

Observations (Table III):

Table III depicts that based on the 2011 census, an Indian male who survives 65.8 years is expected to live for 41.8 years in both literate and healthy states. Again, females who survive 69.3 years are expected to live for 32.04 years in both literate and healthy states. Life expectancy value has decreased with an increase in the number of factors.

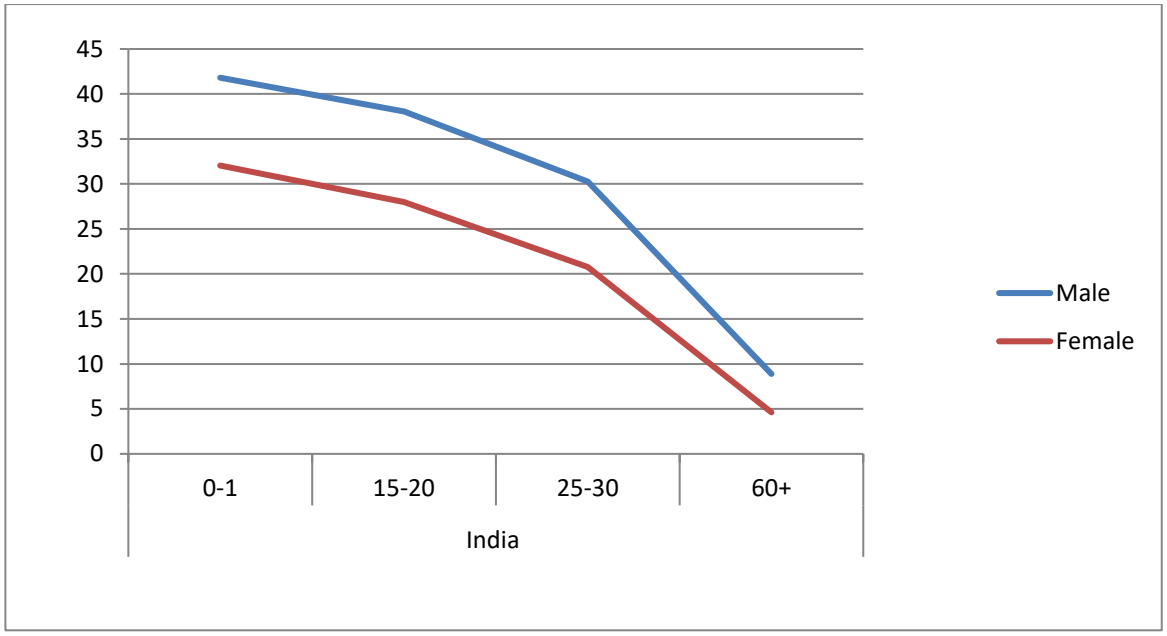

Fig. 8: Graphical representation of the age-wise estimates of Literate Health Life Expectancy

Observations (Fig. 8):

Fig. 8 depicts that there is a large difference between males and females and values are higher for males than for females.

4.4 Comparison of LHLE and LLE in India

Table IV: Comparison of LHLE and LLE in Males in India

Age intervals	LLE	LHLE
0-1	44.71911	41.8092
1-5	46.83169	43.78431
5-10	47.28481	44.20794
10-15	45.04945	42.1414
15-20	40.5982	38.05658
20-25	36.25863	34.07589
25-30	32.12865	30.25512
30-35	28.1901	26.61257
35-40	24.45122	23.13214
40-45	20.97711	19.9005
45-50	17.75175	16.88872
50-55	14.75027	14.0899
55-60	11.94766	11.43388
60-65	9.253474	8.883778
65-70	7.084354	6.825178
70-75	5.226269	5.070276
75-80	3.75486	3.654912
80-85	2.064136	2.034744

Observations (Table IV):

From the table, we can see that the values of LLE at different age levels are greater than the values of LHLE, which shows that when the numbers of factor go on increasing, the values gradually decrease. LHLE gives the value that considers both literacy and health as a component.

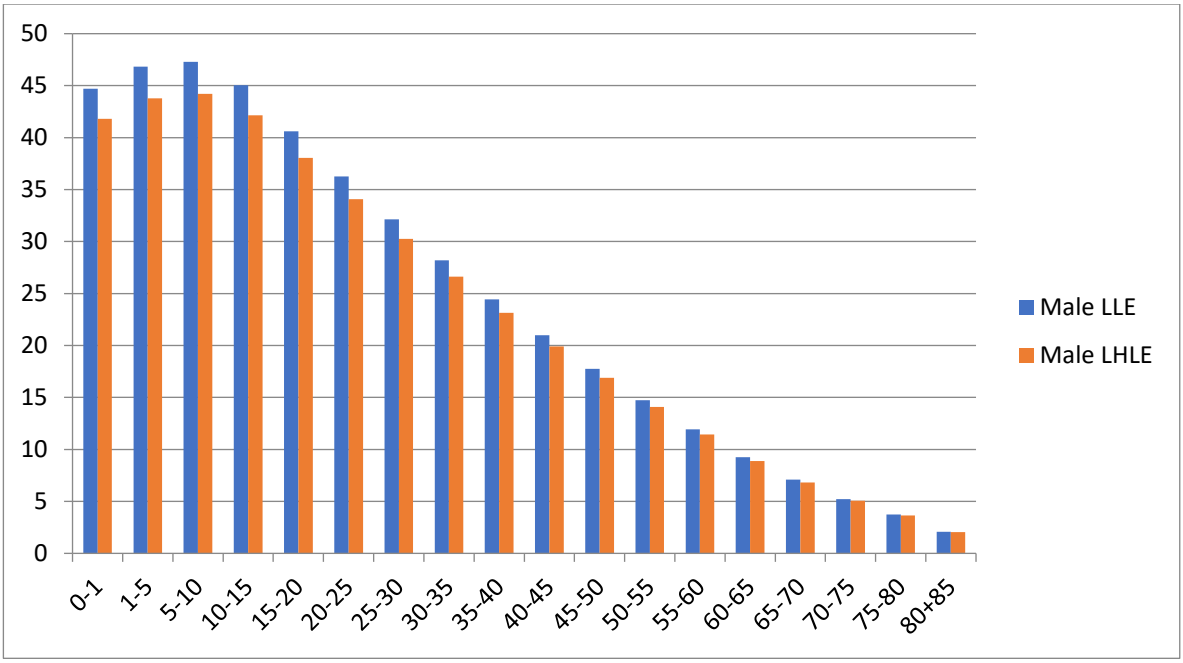

Fig. 9: Diagram of LLE and LHLE in males

Observations (Fig. 9):

It is obvious from the figure that the values of LLE are higher at the age level 5-10 and it gradually decreases with increasing age intervals. The values of LHLE are less than those of the LLE.

Table V: Comparison of LHLE and LLE of India for Female

Age intervals	LLE	LHLE
0-1	34.24853	32.0428
1-5	35.92995	33.61594
5-10	36.46748	34.11885
10-15	34.22157	32.03583
15-20	29.83746	27.9944
20-25	25.7046	24.18605
25-30	22.03419	20.78003
30-35	18.7063	17.69213
35-40	15.70896	14.88265
40-45	13.05173	12.3924
45-50	10.66704	10.14106
50-55	8.515195	8.110073
55-60	6.542975	6.231255
60-65	4.84769	4.616218
65-70	3.613879	3.454527
70-75	2.634229	2.53587
75-80	1.897739	1.834396
80-85	1.047348	1.027479

Observations (Table V):

From the table, we can see that the values of LLE at different age levels are greater than the values of LHLE, which shows that when the numbers of factors go on increasing, the values gradually decrease. LHLE gives values that consider both Literacy and Health as a component.

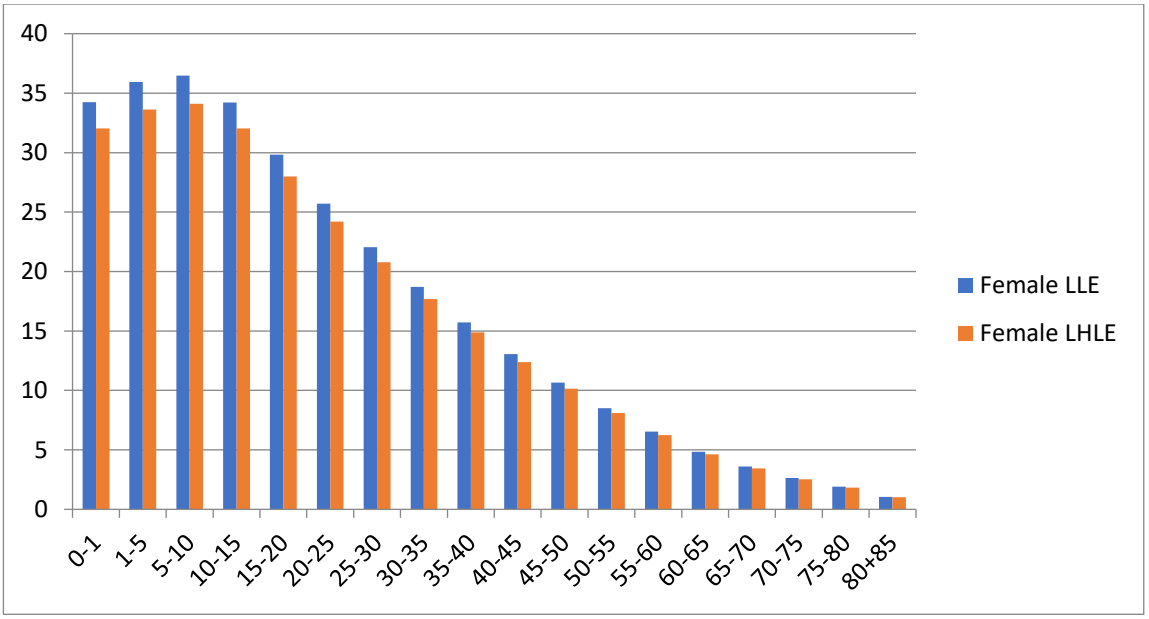

Fig. 10: Diagram of LLE and LHLE for females

Observation (Fig.10):

It is obvious from the figure that the values of LLE are higher at the age level 5-10 and it gradually decreases with time. The values of LHLE are less than those of LLE.

5. CONCLUSION AND DISCUSSION

In this study, our aim was to observe in the variation in the Literate Life Expectancy at various age intervals in different zones of India based on the 2011 census. For this purpose, life tables were constructed for both sexes. Substantial disparities in mortality and life expectation at birth were observed among the zones. In the zones, Literate Life Expectancy is high at an age interval 5-10. The South and East zones were found to fall in the category of high literate life expectancy. The situation is better for the West zone. However, the category patterns of the North East and Central zones are poor compared to the national level.

Literate life expectancy is maximum at the age group 5-10, the early stages of life, or childhood stage. The mortality rate continuously increases with the advancement of age. Regarding sex differentials, it was observed that the mortality pattern of males was worse than that of females. Literate life expectancy of females is substantially lower than that of males in different age groups. The difference in the LLE at birth between males and females was found to vary from 1-9 in the other zones except the South zone. LLE for females in the south zone is higher than for males.

Again, from the study of Literate Health Life Expectancy of India for males and females, we observed that based on the 2011 census, an Indian male who survived 65.8 years is expected to live for 41.8 years in both literate and healthy states.

Again, females who survive 69.3 years are expected to live for 32.04 years in both literate and healthy states.

Thus, the results of the present study can be applied in order to obtain new social and economic measures to remove the heterogeneity of different zones. Similar patterns of LLE in different zones will help in the comparative study of its different states, and accordingly, development processes may be applied to the different zones. Moreover, the Central and North East zones, being poor performing zones, need more attention from government policies. Lastly, it has to be concluded that the overall LLE scenario of in all the zones of India is lagging behind the standards of many neighboring country like China, Sri Lanka. Thus, there is an urgent need for corrective measures at both the state level and national levels.

To increase awareness of education in every home, neighborhood, village, town, and district, actions have been initiated. By providing free education, creating awareness about the importance of education, offering grants, subsidies, and scholarships, late-night classes, offering free books, creating digital platforms for reading and learning, and lowering educational cost, we can reduce illiteracy. To accomplish the various program phases, we need the cooperation of all agencies, educators, students, housewives, government workers, local groups, and the public. All educated people and students should work together in every way possible to solve this issue and bring about social, economic, and political reforms. There is room for more schools throughout the nation. The central and state budgets should include significant funding for the fight against illiteracy. The goal of the government should be to enroll every child in school. It is important to take decisive action to end child labor. Fundraising groups and both formal and informal educational establishments should assist underprivileged individuals in learning to read and write. They are essential in helping the illiterates become literate.

The government cannot accomplish the difficult goal of ending illiteracy on its own. Individuals should volunteer to fulfill this national obligation in order to elevate the literacy campaign into a large-scale movement.
In terms of socioeconomic advancement, India will undoubtedly lag behind other nations until its intellectual elite gives seriously considers to the deadly illness of illiteracy.

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