

Original Research Article

Retrospective Assessment of Low Birth Weight in Nigeria using Life Table

Abstract

This study focuses on low birth weight in Nigeria. The main objective is to obtain the probability of delivering a Low Birth Weight (LBW) baby given a schedule of age-specific LBW that may be relevant in assessing the progress of Sustainable Development Goals in Nigeria. Descriptive and Life table methods were used to analysis the dataset on low birth weight from Nigeria Demographic and Health Surveys (NDHS), 1990 to 2013. The result shows that the probability of giving a LBW baby in Nigeria was high at age groups, 25-29 through 30-34 but dropped rapidly in the older ages. The average national rate of LBW was below 8% from 1990 to 2013. The result further showed that the reported low birth weights in Nigeria were predominantly 2.0kg. The consequences of low birth weight among mothers are increasing neonatal and infant mortality rates, which may hinder the achievement of SDGs in Nigeria. Thus, we recommend the use of life table in the study of health and socio-economic indicators among others.

Key words: Descriptive, Mother, life table, low birth weight, Survey.

1. Introduction

Babies weighing less than 2500 grams (or 5.5 pounds) at birth is termed low birth weights [18]. Low birth weight is a vital public health indicator although it is not a comprehensive measure of maternal or perinatal health outcomes. The incidence of LBW rate is the percentage of live births that weigh less than 2500 grams out of the total live births during the same period [7, 18].

Globally, 20 million LBW babies are born each year, of which 95.5% of them are in developing countries while the prevalence of LBW is about 15.5% [20]. In another study, the overall prevalence of LBW in developing countries was 15.9% [16]. It was observed that the overall incidence of LBW in the Ogun State, Nigeria from 1991 to 1999 was 16.8% [1]. This study was in agreement with the work in Ibadan, Nigeria that covered 1995 to 2005 which put the incidence rate of LBW at 16.8% [3]. The prevalence of LBW in Jos, Nigeria was 12.7% [21]. The rate was slightly higher in Enugu, Southeast, Nigeria, with an incidence of LBW of 14.2% [15]. The average incidence of LBW in the literature reviewed appears to be within the national rate.

Different studies in Nigeria have shown some factors associated with Low Birth Weight. According to the study by [4], they discovered that LBW infants are associated with gestational age at birth, exposure to malaria and recurrent apnoea. The factors associated with LBW include mother's educational status, height and health problems during pregnancy while determinants include tested positive for the human immune-deficiency virus, hypertension in pregnancy as well as prim parity [15]. Other factors include twin pregnancy, the maternal weight of less than 70 kg, delayed conception, inadequate antenatal care, low body mass index, and socioeconomic status [9, 16].

LBW contributes to a wide range of poor maternal and child health consequences. They include foetal and neonatal mortality, morbidity, infant mortality, inhibited growth and chronic diseases later in life [19]. By 2030, one of the objectives of Sustainable Development Goals (especially Goal 3) is to

reduce neonatal mortality to 12 per 1000 live births, under-5 mortality to 25 per 1000 live births and premature mortality from non-communicable diseases by one-third [17].

To this end, there is a need to estimate the expected year before a mother experiencing age-specific LBW delivers a low weight child in Nigeria using the life table, since LBW appears to be one of the barriers to the achievement of SDGs in Nigeria. The life table is applied to study different demographic parameters and health indicators in Nigeria such as labour force requirements, mortality, etc. [6, 8]. More recently, [2] used a life table to estimate the work-life expectancy in Kwara state, Nigeria. They observed that both the average work-life and average years lived followed the same pattern. The ultimate objective of this study is to obtain the average number of years a mother aged x year is expected to live before she delivers a low weight child which may be relevant in assessing the progress of SDGs in Nigeria. The specific objectives are: (i) to examine the trend of Low birth weight in Nigeria. (ii) to assess the descriptive properties of reported low birth weights in Nigeria. (iii) to determine the levels of low birth weight among mothers in Nigeria.

2. Method and Data Sources

The data for this study is a secondary data retrieved from the DHS program publications for different years in Nigeria (2013, 2008, 2003 and 1990). The reported birth weights by age of the Mother obtained with permission. The percentage of LBW babies was derived from data on children with reported birth weights. Thereafter, the mother's age-specific rate of low birth weight deduced from the percentages of LBW babies. To obtain the total number of live births (base population) for the computation of the LBW, we assumed that all the babies with reported birth weights were live births for convenience. Even at that, it may be very rare for a mother in Nigeria to keep a record of a child she lost seven years preceding the survey due to factors such as psychological effect, superstitions, trauma, etc. Section 3.1 presents the trends of Low Birth Weight in Nigeria while section 3.2 considers the descriptive characteristics of reported Low Birth Weights in Nigeria and section 3.3 is devoted to the life-table analysis of low birth weight in Nigeria.

The methods of analysis adopted in this study are descriptive and life table approach. The life table was used to study the life history of mothers aged 15-19 through 45-49 who are experiencing age-specific low birth weight, as their numbers are depleted by force of low birth weight. A mother x -years experiencing schedule of age-specific rate of low birth weight, ${}_n m_x$, then the life table probability that a mother aged x years gives a low birth weight child before reaching age $x + n$ years (${}_n q_x$) is given by

$${}_n q_x = \frac{2n({}_n m_x)}{2 + n({}_n m_x)} \quad (1)$$

Consequently, given the total number of mothers without low birth weight child at the exact age x years (l_x), the total number of mothers reaching exact age $x + n$ years (l_{x+n}) without low birth weight is given as

$$l_{x+n} = l_x (1 - {}_n q_x) \quad (2)$$

Thus, the total person-years lived without giving low birth weight child between exact ages x and $x + n$ is given as

$${}_nL_x = \frac{n}{2}(1_x + 1_{x+n}) \quad (3)$$

The total person-years lived without giving low birth weight child beyond age x is

$$T_x = \sum_{i=x}^{\infty} {}_nL_i \quad (4)$$

And the average number of years (${}_ne_x$) a mother aged x -years expects to live before having a low birth child (life expectancy at age x , ${}_ne_x$) is given by

$${}_ne_x = \frac{T_x}{1_x} \quad (5)$$

When $n = 1$, then

$$e_x = \frac{T_x}{1_x} \quad (6)$$

Assumptions

In constructing the life table functions the following assumptions were made

- only women of child bearing age (15 – 49 years) are involved
- the population consists of a cohort of 10,000 mothers aged 15 - 49 years (i.e. a radix of $1_{15} = 10000$)
- low birth weight are the only source of decrement and all mothers aged 15 years are assumed to have survived throughout the age interval 15 – 49
- the cohort is closed to migration (in or out)
- low birth weight is uniformly distributed within the age interval $x - x+n$
- low birth weight is according to a pre-determined schedule of age-specific low birth weight rates
- the age –specific rates of low birth weight are relatively stable.

3. Results

Methods outlined in Section 2 are applied to data on LBW in Nigeria. Section 3.1 was devoted to examining the trend of Low birth weight in Nigeria; Section 3.2 assesses the descriptive properties of reported low birth weights in Nigeria while Section 3.3 deals with life table analysis of low birth weight in Nigeria.

3.1 Trends of Low Birthweight in Nigeria

The percentage of LBW has increased over the years. Figure 1 shows that North-West had the highest percentage of reported LBW from 0.3% in 1999 to 27.2% in 2013 followed by North-East (0.4% to 13.6%) respectively. The zones with the least average percentage of LBW over the years were South West (4.0%) and South East (4.4%) respectively.

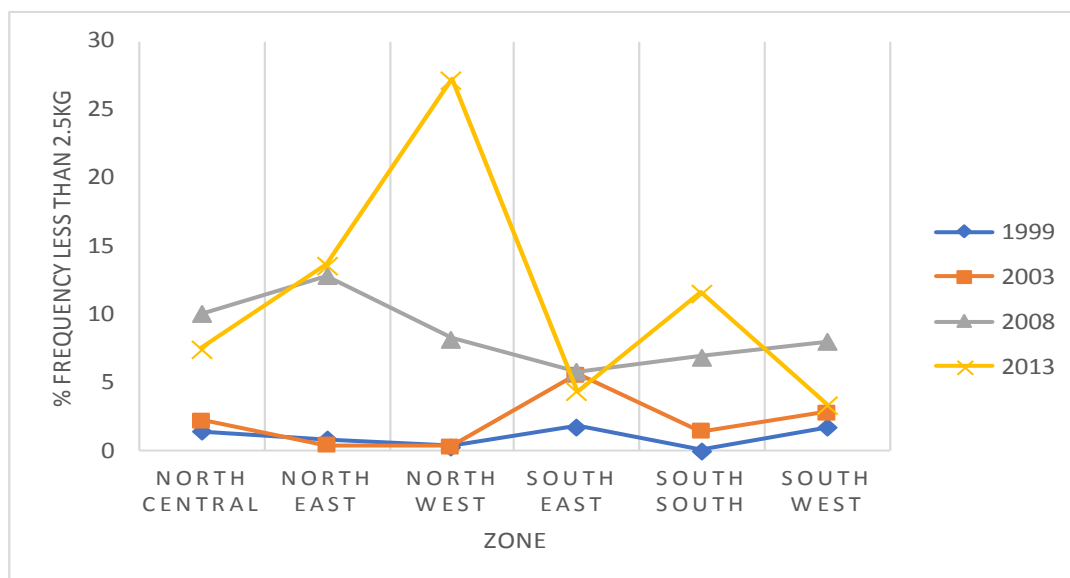


Figure 1: Trends of Low Birth Weight in Nigeria by Zone

The urban-rural comparison shows that the reported percentage of low birth weight was lower in a rural area in 1999 and 2003 (0.8% vs 0.8%) but increased significantly to 9.7% in 2008 and decreased slightly to 9.6% in 2013. Overall, low birth weight increased from 0.8% to 9.7% in rural areas while it increased from 2.3% to 7.6% in urban areas.

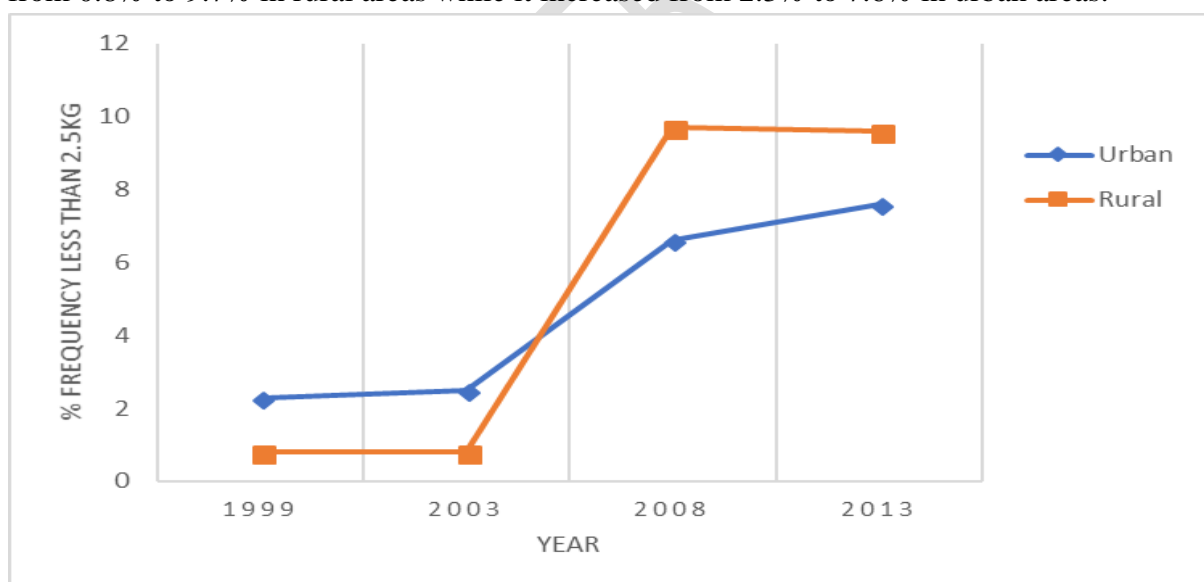


Figure 2: Trends of Low Birth Weight in Nigeria by Residence

The trends of the low birth weight by age of mother assessed to weigh the pattern of low birth weight as the force of low birth weight takes place. The age group with the highest average percentage of low birth weight from 1990 to 2013 was higher for 25-29 age groups with 2.6% followed by 30-34 age group with 2.1% while all other age groups had an average of less than 2.0%.

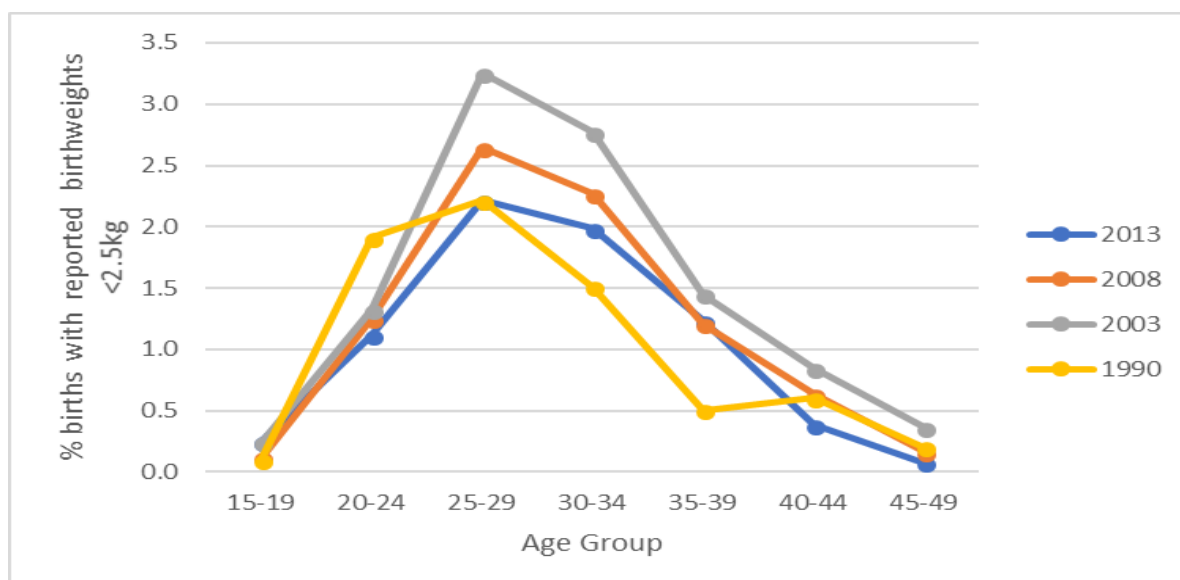


Figure 3: Trends of low birth weight in Nigeria by Age group

3.2 Descriptive characteristics of reported Low Birth Weights (< 2.5kg) in Nigeria

Table 1 shows, the mean ranges from 1.89kg to 2.02kg for both sexes in all the surveys while the standard deviation dropped to 0.30 in 2013 from 0.45 in 1990 for both sexes. The skewness is negative in all the surveys indicating that the distributions of the data have a tail to the left. Overall, the mode is predominantly 2.00kg in all the surveys except for males in 2003 NDHS.

Table 1 Estimate of Statistical Properties of reported Low Birthweights (< 2.5kg)

Parameter/Sex	1990			2003			2008			2013		
	Male	Female	Both	Male	Female	Both	Male	Female	Both	Male	Female	Both
Mean	1.92	1.87	1.89	1.92	2.05	2.00	2.04	2.03	2.03	2.02	2.02	2.02
Median	2.00	2.00	2.00	2.10	2.15	2.10	2.01	2.01	2.01	2.05	2.01	2.01
Mode	2.00	2.00	2.00	2.30	2.00	2.40	2.00	2.00	2.00	2.00	2.00	2.00
Std.	0.39	0.50	0.45	0.55	0.42	0.47	0.35	0.33	0.34	0.34	0.26	0.30
Kurtosis	1.15	-0.08	0.34	0.30	2.22	1.27	5.85	5.18	5.41	3.68	4.90	4.48
Skewness	-	-1.01	-1.06	-	-1.69	-1.48	-2.27	-1.98	-2.11	-1.89	-1.81	-1.91
Range	1.60	1.80	1.80	1.85	1.70	1.90	1.92	1.95	1.95	1.76	1.46	1.76
Minimum	0.80	0.60	0.60	0.55	0.75	0.55	0.50	0.50	0.50	0.70	1.00	0.70
Maximum	2.40	2.40	2.40	2.40	2.45	2.45	2.42	2.45	2.45	2.46	2.46	2.46

3.3 The life-table analysis of Low Birthweight in Nigeria

Based on the assumptions in section 2, equation (1) through (6) was applied to NDHS datasets on LBW. Table 2 shows, the trend of the probability of giving Low Birth Weight Babies in Nigeria. At age groups, 25-29 and 30-34 the probabilities were high but dropped rapidly in the older ages may be due to the decline in fertility rate (see Figure 4).

Table 2 Levels of probability of giving Low Birth Weight (${}_nq_x$) babies in Nigeria

Age	2013	2008	2003	1990
15-19	0.0013	0.0006	0.0012	0.0005
20-24	0.0056	0.0062	0.0066	0.0095
25-29	0.0110	0.0132	0.0161	0.0110
30-34	0.0099	0.0113	0.0138	0.0075
35-39	0.0061	0.0060	0.0072	0.0025
40-44	0.0019	0.0032	0.0042	0.0030
45-49	0.0004	0.0008	0.0018	0.0010

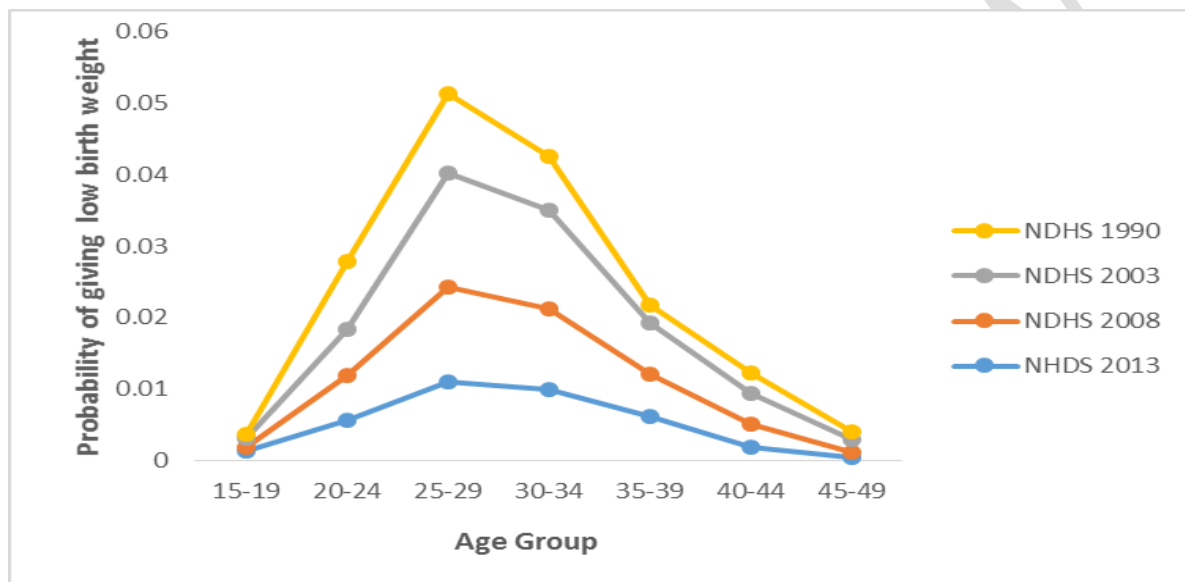


Figure 4. Plot of the Probability of giving Low Birth Weight baby (nq_x) against age: 1990-2013.

4. Discussion

This study discussed the Low Birth Weight in Nigeria. The descriptive method and life table were used to analysis data on LBW from NDHS. The result shows that the probability of giving LBW in Nigeria was very high at age groups, 25-29 through 30-34 but dropped rapidly in the older ages may be due to a decline in fertility. The percentage of Low Birth Weight increased from 0.7% in 1990 to 8.1% in 2013 [5, 14]. We observed that North-West had the highest percentage of reported LBW from 0.3% in 1999 to 27.2% in 2013 followed by Northeast (from 0.4% to 13.6%). The zones with the minimum average percentage of LBW over the years were South West (4.0%) and South East (4.4%). By states, the percentages of reported low birth weights were not the same according to the 2013 NDHS. The states that may have contributed significantly to the difference in percentage levels are Niger State (14.2%) in North Central, Adamawa State (20.0%) in the Northeast, Kaduna (36.1%) in the North-West while in the South-South, Bayelsa (11.5%), Cross River (12.7%) and Rivers (17.5%) respectively. Every other State across the zones had LBW below (10.0%) [14]. The zones with a high percentage of LBW are susceptible to violence do to militancy or insurgency. According to [14] only (16.0%) of babies were weighed at the birth of which less than (8.0%) are reported as low birth

weight. It is not surprising because a good number of births (63.0%) in 2013 NDHS did not take place in a health facility [14].

We observed that those with 'No Education (15.2%)' had the highest reported LBW percentage [14]. It appears there is an inverse relationship between LBW and the educational level of the mothers in all the surveys [5, 11, 12, and 13] because as wealth and educational level increases the percentage of low birth weight babies decreases [13]. Overall, from 1990 to 2013, LBW ranged from 0.50kg to 2.46kg. The mode was 2.0kg except for 2003 NDHS, indicating that the reported LBW in Nigeria from 1990 to 2013 were predominantly births weighing 2.0kg (see Table 1). For both sexes, the overall mean from the reported low birth weights was below 2.04kg in all the surveys while the standard deviation dropped to 0.30 in 2013 from 0.45 in 1990.

5. Conclusion

Low birth weight remains high in Nigeria. Even at that, the reported number of babies weighed at birth is still poor. The zones in Nigeria that are prone to militancy, terrorism, and insurgency appear to be contributing significantly to the high rate of the LBW in the country. It is important to embark on vigorous campaigns to encourage health professionals and parents on the need to ensure that newborn babies are weighed at birth as a good number of babies reported in the surveys were not weighed at birth hence the reported/estimated rates of LBW maybe more. The entire sister agencies in Nigeria must continue to collaborate with their international counterparts to reduce LBW in Nigeria. There should be synergy among the local, state and federal agencies for effective data gathering, monitoring and estimation of incidence and prevalence of LBW among others.

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Appendix A: Distribution of reported babies (< 2.5kg) by age of mother and year of survey

Age	2013	2008	2003	1990
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15-19	13	5	2	1
20-24	58	53	11	19
25-29	115	112	27	22
30-34	103	96	23	15
35-39	64	51	12	5
40-44	20	27	7	6
45-49	4	7	3	2
Total (less than 2.5kg)	377	351	85	70
Total (weighed at birth)	5189	4232	830	993

Source: NDHS dataset.

Appendix B: Life table of Low Birth weight in Nigeria, 1990-2013.

NDHS 2013

Age group	nM_x	nq_x	np_x	l_x	nL_x	T_x	e_x
15-19	0.0003	0.0013	0.9987	10000.0	49968.7	343006.0	34.30
20-24	0.0011	0.0056	0.9944	9987.5	49798.3	293037.3	29.34
25-29	0.0022	0.0110	0.9890	9931.8	49385.5	243239.1	24.49
30-34	0.0020	0.0099	0.9901	9822.4	48869.3	193853.6	19.74
35-39	0.0012	0.0061	0.9939	9725.4	48477.4	144984.2	14.91
40-44	0.0004	0.0019	0.9981	9665.6	48281.4	96506.9	9.98
45-49	0.0001	0.0004	0.9996	9647.0	48225.5	48225.5	5.00
				9643.2			

NDHS 2008

Age group	nM_x	nq_x	np_x	l_x	nL_x	T_x	e_x
15-19	0.00012	0.00059	0.99941	10000.0	49985.2	342242.8	34.22
20-24	0.00125	0.00624	0.99376	9994.1	49814.5	292257.6	29.24
25-29	0.00265	0.01315	0.98685	9931.7	49332.1	242443.1	24.41
30-34	0.00227	0.01128	0.98872	9801.2	48729.4	193111.0	19.70
35-39	0.00121	0.00601	0.99399	9690.6	48307.5	144381.5	14.90
40-44	0.00064	0.00318	0.99682	9632.4	48085.3	96074.0	9.97
45-49	0.00017	0.00083	0.99917	9601.7	47988.7	47988.7	5.00
				9593.8			

NDHS 2003

Age group	nM_x	nq_x	np_x	l_x	nL_x	T_x	e_x
15-19	0.00024	0.00120	0.99880	10000.0	49969.9	340630.6	34.06
20-24	0.00133	0.00660	0.99340	9988.0	49774.9	290660.8	29.10
25-29	0.00325	0.01613	0.98387	9922.0	49209.8	240885.9	24.28
30-34	0.00277	0.01376	0.98624	9761.9	48473.7	191676.1	19.64
35-39	0.00145	0.00720	0.99280	9627.6	47964.6	143202.4	14.87
40-44	0.00084	0.00421	0.99579	9558.2	47690.7	95237.8	9.96
45-49	0.00036	0.00181	0.99819	9518.0	47547.1	47547.1	5.00
				9500.8			

NDHS 1990

Age group	nM_x	nq_x	np_x	l_x	nL_x	T_x	e_x
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15-19	0.00010	0.00050	0.99950	10000.0	49987.4	342927.2	34.29
20-24	0.00191	0.00952	0.99048	9995.0	49736.9	292939.8	29.31
25-29	0.00222	0.01102	0.98898	9899.8	49226.3	243202.9	24.57
30-34	0.00151	0.00752	0.99248	9790.7	48769.5	193976.5	19.81
35-39	0.00050	0.00251	0.99749	9717.1	48524.3	145207.0	14.94
40-44	0.00060	0.00302	0.99698	9692.6	48390.1	96682.7	9.97
45-49	0.00020	0.00101	0.99899	9663.4	48292.7	48292.7	5.00
				9653.7			

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