

# 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 a mother aged  $x$  years giving a low-birth-weight child before reaching age  $x + n$  years which may be relevant in assessing the progress of Sustainable Development Goals in Nigeria. Descriptive Statistics and Life table methods were used to analyze the dataset on birth weights from the Nigeria Demographic and Health Surveys (NDHS), 1990 to 2013. The result shows that the probability of giving LBW baby was highest among 25-29 age group (12.8 LBWs per 1000 live births) followed by 30-34 age group (10.6 LBWs per 1000 live births) but dropped rapidly in the older ages. The prevalence of LBW obtained for the period studied was slightly below 8% (7.9). The incidence rate increased from 7.0% in 1990 to 10.2% in 2003 and declined to 7.3% in 2013. The consequences of low birth weight among mothers are increasing neonatal and infant mortality rates, which may hinder the achievement of SDGs in Nigeria. We recommend that the health professionals encourage balanced maternal nutrition and embark on regular vigorous campaigns in collaboration with traditional rulers, traditional birth attendants, village heads, and parents in the communities to encourage mothers to deliver their babies in the approved health care facilities to ensure that babies are weighed at birth.

**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% Rashidul et al. [16]. It was observed that the overall incidence of LBW in the Ogun State, Nigeria from 1991 to 1999 was 16.8% Ademola et al. [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% Amosu et al.[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 WHO[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 UN [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, Adewara et al. [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 rationale for this present study is to reveal the lapses in the previous surveys in terms of weight measurement at birth so that the Nigerian government will address them before the next round of survey. This study aims to carry out a retrospective assessment of low-birth-weight in Nigeria using Life Table. The ultimate objective of this study is to obtain life table probability of a mother aged  $x$  years giving a low birth weight child before reaching age  $x + n$  years which may be relevant in assessing the progress of SDGs in Nigeria. The specific objectives are: (i) to examine the trends and levels of low-birth-weight in Nigeria; (ii) to assess the descriptive properties of reported low birth weights in Nigeria; (iii) to obtain the prevalence of low-birth-weight in Nigeria within the period under study, and (iv) to obtain life table probability of a mother aged  $x$  years giving a low birth weight child before reaching age  $x + n$  years in Nigeria.

## 2. Method and Data Source

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. Firstly, the descriptive properties of the low-birth-weight derived from data on children with reported birth weights. UNICEF and WHO [18] gave a measure of the incidence of low-birth-weight as

$$\frac{\text{Number of live born babies with birthweight less than 2,500g}}{\text{Number of live births}} \times 100 \quad (1)$$

However, the denominator (number of live births) in (1) for most developing countries is not reliable or incomplete when available. For this study, the incidence of low-birth-weight expressed as

$$\frac{\text{Number of live born babies with birthweight less than 2,500g}}{\text{Total number of births with reported weight}} \times 100 \quad (2)$$

on the assumption that any birth with weight record is a live birth because it is rare for a mother in most developing countries to keep a record of a baby, she lost five or six years preceding the survey due to many factors such as psychological effect, superstitions, trauma, delivery of other babies, etc. Furthermore, the prevalence rate in this study is derived as

$$\frac{\text{Sum total of all live born babies with birthweight less than 2,500g}}{\text{Total number of births with reported weight}} \times 100 \quad (3)$$

The age-specific percentages of low birth weight are converted into life table functions. 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 the age-specific rate of low birth weight, then the life table probability that a mother aged  $x$  years gives a low birth weight child before reaching age  $x + n$  years is given by

$${}_nq_x = \frac{2n({}_nm_x)}{2 + n({}_nm_x)} \quad (4)$$

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

$$l_{x+n} = l_x (1 - {}_nq_x) \quad (5)$$

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

$${}_nL_x = \frac{n}{2} (l_x + l_{x+n}) \quad (6)$$

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

$$T_x = \sum_{i=x}^{\infty} {}_nL_i \quad (7)$$

And the average number of years ( $e_x$ ) a mother aged  $x$ -years expects to live before having a low birth child is given by

$$e_x = \frac{T_x}{l_x} \quad (8)$$

### Assumptions

In constructing the life table functions the following assumptions were made

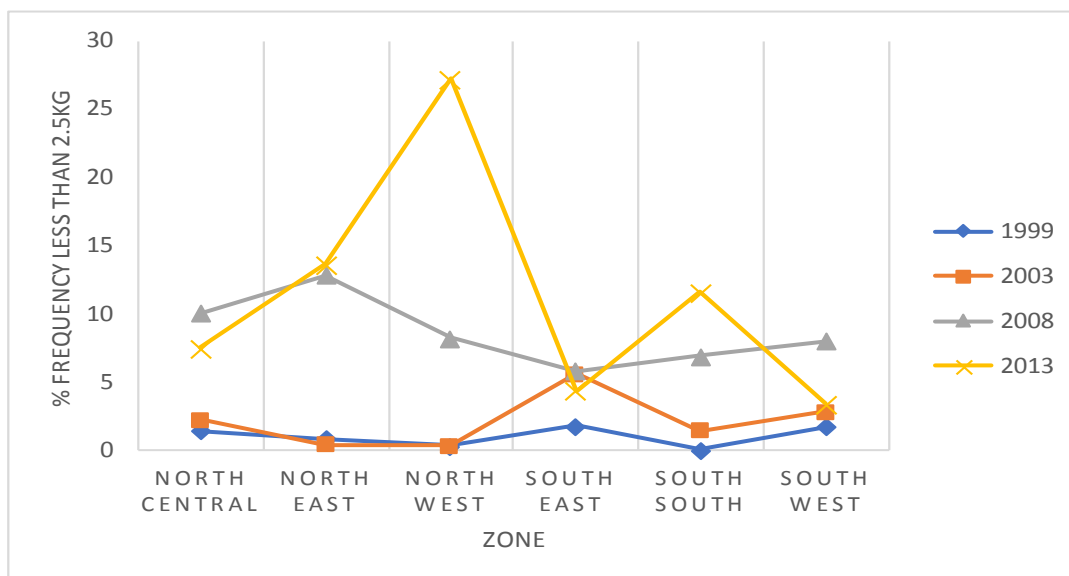
- only women of child bearing age (15 – 49 years) are involved
- the population consists of a cohort of 10,000 mothers aged 15 - 49 years (i.e. a radix of  $l_{15} = 10000$ )
- low-birth-weight are the only source of decrement and all mothers aged 15 years are assumed to have survived throughout the 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

The methods outlined in section 2 were applied to data on LBW in Nigeria. Section 3.1 presents the trends of low-birth-weight in Nigeria while section 3.2 considers the descriptive properties of reported low-birth weights in Nigeria and section 3.3 is devoted to the life-table analysis of low birth weight in Nigeria.

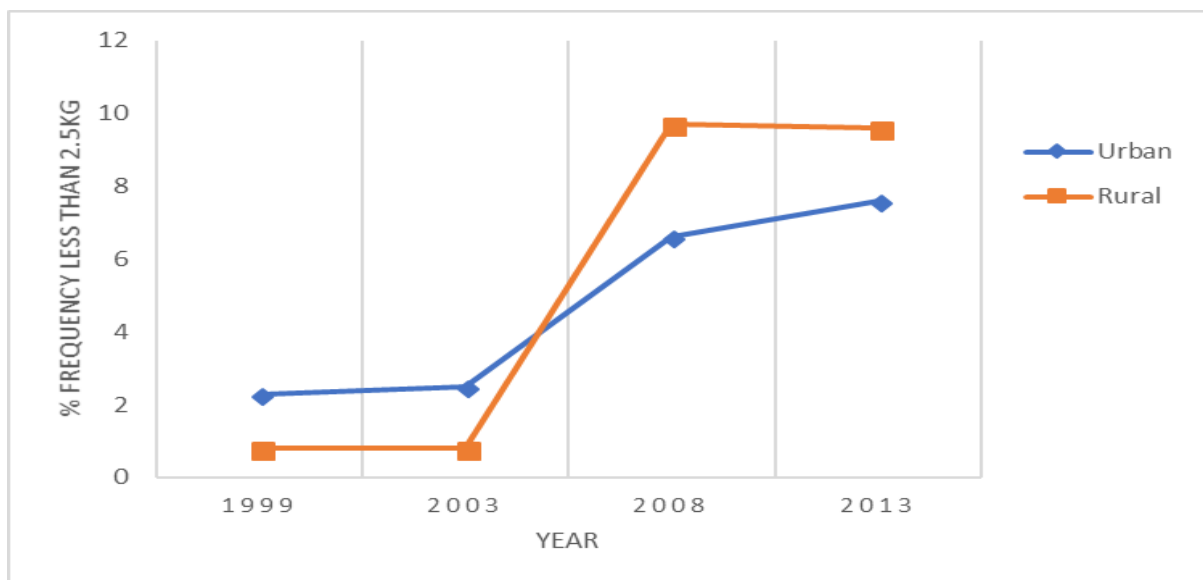
### 3.1 Trends of Low Birthweight in Nigeria

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

Table 1 shows that the incidence rate increased from 7.0 in 1990 to 10.2 in 2003 dropped 8.3 in 2008 and declined further to 7.3 in 2013. The age group with the highest percentage of low birth weight from 1990 to 2013 was 25-29 age groups (2.6%) followed by 30-34 age group (2.1%) while the oldest age group recorded about 0.1%.

**Table 1:** Distribution of reported babies (less than 2.5kg) by age of mother and year of survey

Age/year	2013	2008	2003	1990
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
Incidence rate (%)	7.3	8.3	10.2	7.0
Prevalence rate (%) From 1990 to 2013			7.9	

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

Table 3.1 shows, the mean ranges from 1.9kg to 2.0kg for both sexes in all the surveys while the standard deviation dropped to 0.3 in 2013 from 0.5 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 approximately 2.0kg in all the surveys except for males in 2003 NDHS.

**Table 2:** Estimate of Statistical Properties of reported Low Birthweights (< 2.5kg)

Parameter/Sex	1990			2003			2008			2013		
	M	F	B	M	F	B	M	F	B	M	F	Both
Mean	1.9	1.9	1.9	1.9	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Median	2.0	2.0	2.0	2.1	2.2	2.1	2.0	2.0	2.0	2.1	2.0	2.0
Mode	2.0	2.0	2.0	2.3	2.0	2.4	2.0	2.0	2.0	2.0	2.0	2.0
Std.	0.4	0.5	0.5	0.6	0.4	0.5	0.4	0.3	0.3	0.3	0.3	0.3
Kurtosis	1.2	-0.1	0.3	0.3	2.2	1.3	5.9	5.2	5.4	3.7	4.9	4.5
Skewness	-1.1	-1.0	-1.1	-1.2	-1.7	-1.5	-2.3	-1.9	-2.1	-1.8	-1.8	-1.9
Range	1.6	1.8	1.8	1.9	1.7	1.9	1.9	1.9	1.9	1.8	1.5	1.8
Min	0.8	0.6	0.6	0.6	0.8	0.6	0.5	0.5	0.5	0.7	1.0	0.7
Max	2.4	2.4	2.4	2.4	2.6	2.5	2.4	2.5	2.4	2.5	2.5	2.5

**Note:** M=Male, F=Female, B = Both sexes

### 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, levels of probability that a mother aged x years gives a low birth weight ( ${}_nq_x$ ) 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.

**Table 3:** Levels of probability that a mother aged x years gives a low birth weight ( ${}_nq_x$ ) in Nigeria

Age	2013	2008	2003	1990	Average	Average LBW per 1000 live births
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15-19	0.0013	0.0006	0.0012	0.0005	0.0009	0.9
20-24	0.0056	0.0062	0.0066	0.0095	0.0070	7.0
25-29	0.0110	0.0132	0.0161	0.0110	0.0128	12.8
30-34	0.0099	0.0113	0.0138	0.0075	0.0106	10.6
35-39	0.0061	0.0060	0.0072	0.0025	0.0055	5.5
40-44	0.0019	0.0032	0.0042	0.0030	0.0031	3.1
45-49	0.0004	0.0008	0.0018	0.0010	0.0010	1.0

#### 4. Discussion

This study discussed the low-birth-weight (LBW) in Nigeria. The descriptive method and life table were used to analyze data on LBW from NDHS. The result shows that the probability of giving LBW baby was highest among 25-29 age group (12.8 LBWs per 1000 live births) followed by 30-34 age group (10.6 LBWs per 1000 live births) but dropped rapidly in the older ages may be due to decline fertility. The percentage of low-birth-weight increased from 7% in 1990 NDHS to 10.2% in 2003 NDHS and dropped to 7.2% in 2013 NDHS. We observed that North-West had the highest percentage of reported LBW increased from 0.3% in 1999 NDHS to 27.2% in 2013 NDHS 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 the 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 the state include 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 due 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].

It was 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 0.5kg to 2.5kg. The mode was 2.0kg except for 2003 NDHS, indicating that the reported LBW in Nigeria from 1990 to 2013 was predominantly birthed weighing 2.0kg (see Table 3.1). 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 0.3kg in 2013 from 0.5kg in 1990.

The prevalence rate of LBW (7.9%) obtained in this study is below the global estimate of 15.5% as of 2018 ([www.who.int/maternal\\_child](http://www.who.int/maternal_child)) [28]. There is still a wide difference in the incidence rate of low-birth-weight between advanced and emerging countries. In developing countries, the rate of LBW on the average is about 15% while their counterparts (developed countries) is about 7% Ramakrishnan [22]. The prevalence of LBW differs among countries in sub-Saharan Africa. In Ethiopia, the prevalence of LBW was about 28.3% Assefa et al. [23] while in Nigeria low-birth-weight affects about five to six million children every year Olu Dunant et al. [24]. In Zimbabwe, according to Feresu et al. [25], there were 199 low-birth-weight infants per 1,000 live births. Furthermore, the study by Hannah Blencowe et al. [26] observed that out of 148 countries of 195 UN member countries, the prevalence of LBW was estimated to be 14.6% which shows improvement compared to 17.5% recorded in 2000. The results further show that estimate of LBW is about 24% in sub-Saharan Africa, 91% for developing countries while southern Asia (48%) recorded the highest rate in 2015. Again, these rates are higher than (7.9%) observed in Nigeria between 1990 and 2013.

For Nigeria to reduce LBW more efforts are needed to address the determinants of LBW identified which include mothers' education, living alone during pregnancy, malnutrition, pre-natal, and health care services Adam et al.[27] and the consequences such as foetal and neonatal mortality, morbidity, infant mortality, inhibited growth, and chronic diseases later in life, etc. [19].

## 5. Conclusion and Recommendations

The prevalence of low-birth-weight (7.9%) obtained in this study for Nigeria between 1990 and 2013 using data from different rounds of Demographic and Health Surveys is below the global estimate of 15.5% as of 2018 by World Health Organization. The LBWs per 1000 live births obtain the study is within the 2030 of target 25 or fewer deaths per 1000 live births for under-five mortality by United Nations. Even at that, the reported number of babies weighed at birth is still poor in Nigeria, which means that the estimate for that country may have been under-reported or underestimated due to insufficient data. The zones in Nigeria that are prone to high poverty, militancy, terrorism, and insurgency appear to be contributing to the rate of the LBW in that country. Unless Nigeria Government improves the standard of living, girl child education, stamp out rising level of militancy/terrorism, etc. the rate of LBW may not drop drastically.

We recommend that government should strengthen her collaboration with traditional rulers and traditional birth attendants. This will create more awareness for the need to capture the weights of babies at birth. It is also important that the health professionals embark on regular vigorous campaigns in collaboration with village heads and parents in the communities to encourage child delivery in the health care facilities as 63% of child deliveries in 2013 Demographic and Health Survey took place at home thereby making it difficult to weigh them at birth. 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: Life table of Low Birth weight in Nigeria, 1990-2013.**  
**NDHS 2013**

Age group	${}_nM_x$	${}_nq_x$	$l_x$	${}_nL_x$	$T_x$	$e_x$
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<b>15-19</b>	0.0003	0.0013	10000.0	49968.7	343006.0	34.30
<b>20-24</b>	0.0011	0.0056	9987.5	49798.3	293037.3	29.34
<b>25-29</b>	0.0022	0.0110	9931.8	49385.5	243239.1	24.49
<b>30-34</b>	0.0020	0.0099	9822.4	48869.3	193853.6	19.74
<b>35-39</b>	0.0012	0.0061	9725.4	48477.4	144984.2	14.91
<b>40-44</b>	0.0004	0.0019	9665.6	48281.4	96506.9	9.98
<b>45-49</b>	0.0001	0.0004	9647.0	48225.5	48225.5	5.00

9643.2

**NDHS 2008**

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

9593.8

**NDHS 2003**

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

9500.8

**NDHS 1990**

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

9653.7