1. Introduction

The level of socio-economic development in a country and quality of life is depicted by the mortality trends of that particular country. Mortality indicators are useful in measuring the overall health status of populations. It provides an important evidence for planning of health services and the development of country specific health profiles as well as providing an insight into the disaggregated health situation of population sub groups. Mortality statistics of a country has a direct impact upon the developmental policies and service planning. These rates are also important for the monitoring of progress towards the United Nation Millennium Development Goals (MDGs) and for other such international comparisons.

Mortality statistics act as an indirect measure of morbidity in the absence of proper disease surveillance and data recording of morbidity. For instance, in the Maldives where there is no proper cancer registry, cancer mortality can be used as an indirect proxy to estimate the extent of the problem. One major advantage of mortality statistics in Maldives is the accuracy of reporting that has resulted from the establishment of a systematic vital registration system from 1998 onwards and the subsequent efforts to strengthen the vital registration system. These efforts have resulted in increased number of births and deaths being registered. The existing vital registration system have the potential of full coverage with consistency and accuracy particular to a small population such as the Maldives.

In the Maldives, mortality statistics are routinely collected and reported to the Ministry of Health through the Vital Registration System (VRS). In addition, every five years, The Population and Housing Census conducted by the Ministry of Planning and National Development determine the mortality estimates. These two methods of assessment provide opportunity for comparison and also address any issues of discrepancy that may exist between the two methods.

Irrespective of the method of assessment, the Maldives have gained considerable achievements in reducing mortality and increasing life expectancy. Furthermore, the difference between the mortality data through the Vital Registration System and the Census has narrowed down indicating the accuracy of both systems of measurement and improved level of reporting and capturing of vital events.

Based on the Census 2006, this chapter will describe the levels, patterns and differentials of mortality in the Maldives. Mortality levels and patterns will be considered based on the Crude Death Rates Age Specific Mortality Rates. Estimates will be made using the census data to obtain the Life Expectancy at Birth and Infant Mortality Rates. In addition, mortality differentials will be considered by locality and age.

2. Reported mortality levels

The data for mortality estimates for the Census 2006 were collected in the birth history section of the Maldives Housing & Population Census 2006 questionnaire. In the Census 2006, females aged 15 and over were asked for details of history of births including the number of live births and number of children living at the time of Census. It has to be noted that this method of collecting information retrospectively from birth histories is very much dependent upon the accuracy of reporting and recording. Estimated levels of mortality by employing retrospective methods have the tendency to have sampling and non sampling errors. In the case of Census, non sampling errors such as under reporting of early childhood deaths may lead to under estimates of mortality. Moreover, incorrect reporting of the age at death or date of birth may distort the age specific mortality

2.1: Crude death rate

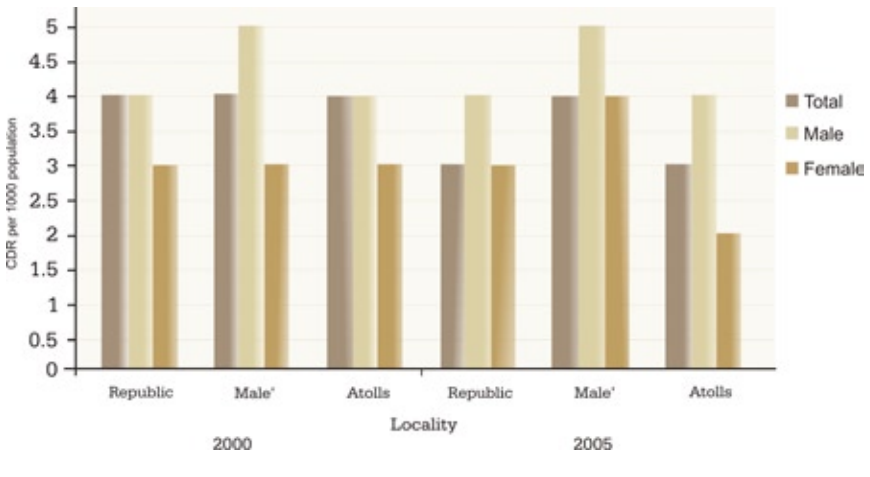
The Crude Death Rate can be defined as the number of deaths during a specified period per resident population during the midpoint of the time period. The Crude Death Rates for the year 2000 and 2005 are presented in Tables 1. The data for these are taken from the Vital Registration System (Ministry of Health) as the relevant data is unavailable from Census.

Table 1: Crude Death Rate per 1000 population by gender and locality 2000-2005

Locality	CDR/ '000 population-YEAR 2000			CDR/ '000 population-YEAR 2005		
	Total	Male	Female	Total	Male	Female
Republic	4	4	3	3	4	3
Male'	4	5	3	4	5	4
Atolls	4	4	3	3	4	2

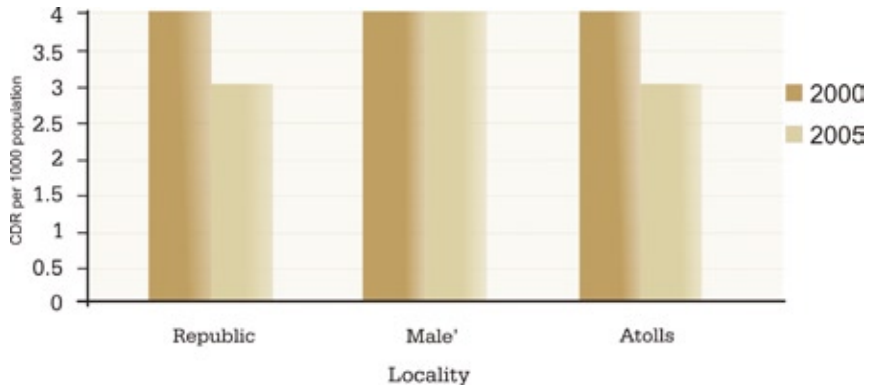
Source: Vital Registration System, Ministry of Health 2007

Figure 1: Crude Death Rate per 1000 population by gender and locality 2000-2005



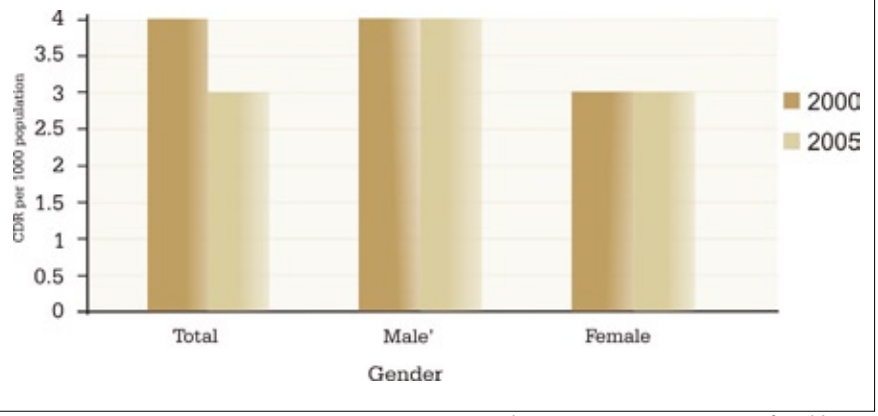
Source: Vital Registration System, Ministry of Health 2007

Figure 2: Comparison of crude death rate per 1000 population by locality 2000-2005



Source: Vital Registration System, Ministry of Health 2007

Figure 3: Comparison of crude death rate per 1000 population by gender 2000-2005



Source: Vital Registration System, Ministry of Health 2007

As illustrated from the above graphs, there is a decline in the overall crude death rate from the year 2000 to 2005. In the year 2005 the CDR for the atolls is lower (CDR=3) than in the year 2000 (CDR=4). The decline in the mortality rates could be due the improved access of health care across the Maldives and better diagnostic facilities. When comparing the male and female death rates, it is observed that CDR of females is lower in both the year 2000 and 2005.

Table 2: Comparison of Crude Death Rate per 1000 population for SAARC region - 2005

Country	Crude death rate (per 1'000)
Bangladesh	7.4
Bhutan	8.2
India	8.5
Maldives	5.7
Nepal	8.7
Pakistan	7.2
Sri Lanka	6.1

Source: United Nations, ESCAP 2006 Population Datasheet

When making a comparison betweeen the South Asian SAARC countries, as can be observed from the above table, Maldives has the lowest CDR. However, these results should be interpreted with caution as there is very little evidence to suggest that Maldives has a better health care system than the other SAARC countries. Moreover, the CDR calculated by the UN ESCAP 2006 population datasheet is 5.7 per 1000 population by using estimations, the accuracy of which will depend on the model applied for the estimation. It is imperative that the model used for such estimations fit the Maldivian context and take into account the unique socio-economic and geographical nature of Maldives.

2.2: Age specific mortality rate

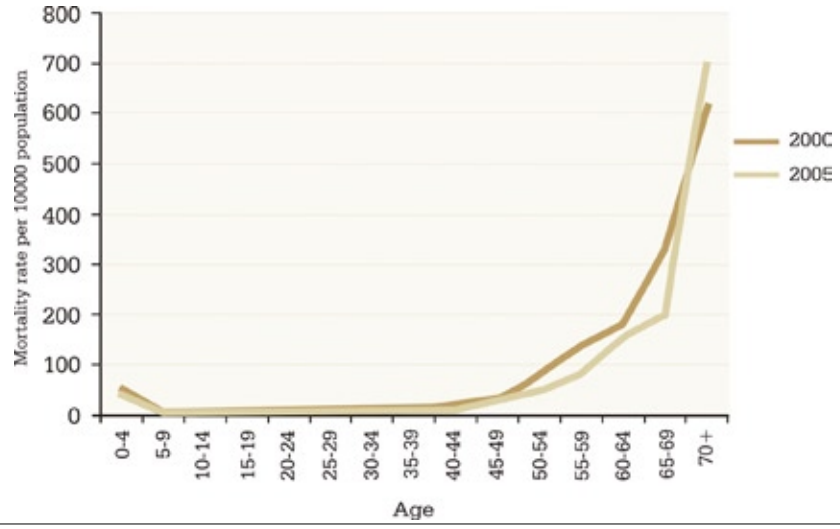
Age specific death rate is the number of deaths registered (or occurred) during a year at a specified age per 100,000 of the estimated resident population of the same age at mid-point of the year. The age specific mortality rates per 10,000 live births for the year 2000 and 2005 are presented in Table 3 and illustrated in the graphs below.

Table 3: Age specific mortality rate per 1000 population by gender 2000-2005

Age	ASMR per 10,000 population- YEAR 2000			ASMR per 10,000 population- YEAR 2005		
	Total	Male	Female	Total	Male	Female
0-4	51	54	49	39	45	33
5-9	4	4	4	5	6	3
10-14	4	4	3	4	4	4
15-19	3	3	3	4	4	4
20-24	6	8	4	6	10	2
25-29	6	7	5	6	9	3
30-34	6	9	2	6	8	4
35-39	11	11	11	5	8	3
40-44	19	14	24	10	15	5
45-49	31	43	17	32	35	29
50-54	80	72	89	50	59	41
55-59	140	166	112	83	88	77
60-64	182	172	194	154	176	131
65-69	327	374	265	200	221	177
70+	613	658	544	695	714	669

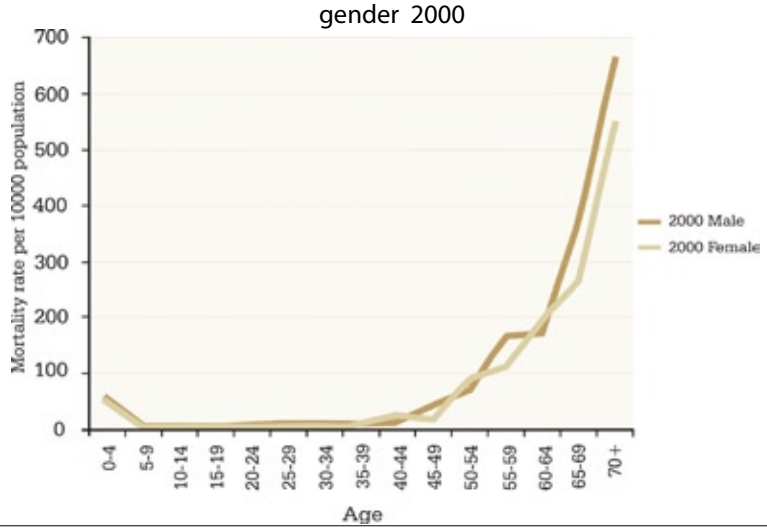
Source: Maldives Health Report 2001, & Vital Registration System, Ministry of Health 2007

Figure 4: Age specific mortality rate per 10,000 population 2000-2005



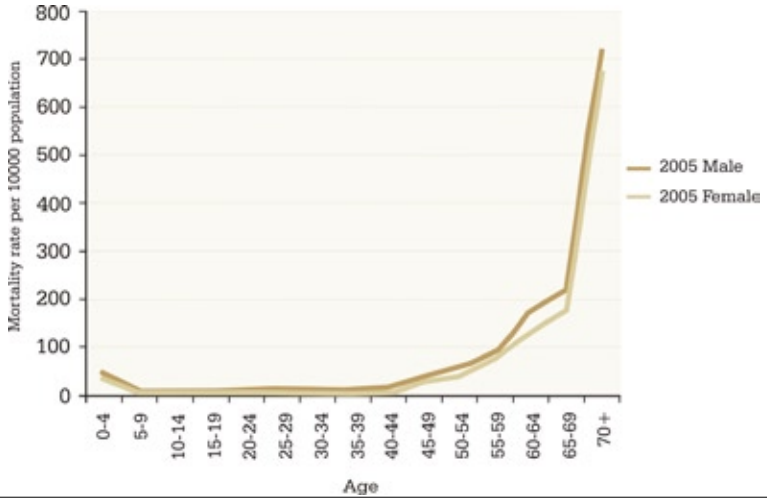
Source: Maldives Health Report 2001 & Vital Registration System, Ministry of Health 2007

Figure 5: Age specific mortality rate per 10,000 population by gender 2000



Source: Maldives Health Report 2001 & Vital Registration System, Ministry of Health 2007

Figure 6: Age specific mortality rate per 10,000 population by gender 2005



Source: Maldives Health Report 2001 & Vital Registration System, Ministry of Health 2007

As evident from the above figures, the characteristic U-shape mortality pattern is shown for the Maldives, similar to the pattern of other countries. Mortality rates are high during infancy up to the age of five. It then stabilises and again increases very steeply after the age of 50. Infant mortality contributes highest to under five mortality. Detailed breakdown of infant mortality to Early Neonatal Deaths, Late Neonatal Deaths and Post neonatal Deaths is useful and presented in the table below.

Table 4: Neonatal Death Rate per 1000 live births 1992-2006

Year	Early Neonatal Death Rate (0-6 days)			Late Neonatal Death Rate (7-27 days)			Post Neonatal Death Rate (28-364 days)		
	Total	Male'	Atolls	Total	Male'	Atolls	Total	Male'	Atolls
2000	12	13	12	2	1	3	7	3	8
2005	7	8	7	1	0.4	2	4	4	4

Source: Vital Registration System, Ministry of Health 2007

It can be seen that early neonatal death rate is highest. The first week of life presents itself with risks which maybe associated with deaths. For example a newborn may need stabilization after a traumatic delivery or may not be adjusting well to the new environment.

Another important consideration is that, unlike years ago there is an increased number of premature babies being born, who will have higher risk of dying than the full term babies. Decades ago there were a lesser number of premature babies and a higher number of stillborns due to the limitation of health facilities and resources. It can be said that better advancements in health including diagnostic facilities allow early detection of a distressed foetus which may lead to surgical delivery before term hence contributing to increased number of premature babies.

In addition to this factor we do have to consider that the increased early neonatal death rate could also be due to lack of adequate health care being provided during the first week of life. However, much evidence needs to be gathered to actually find out the major contributing factors to neonatal death in order to arrive at a plausible explanation. Late neonatal death rate is lesser than the early neonatal death as the risk to life decreased as the infant grows. It can be seen that the neonatal death rates has significantly reduced from the year 2000 to 2005.

Mortality pattern of children below the age five has declined from 51 per 10,000 population to 39 per 10,000 population in 2000 and 2005 respectively. This decline in mortality pattern can be reflected to the improvements in health care delivery and accessibility to health services during the period.

As can be seen from the graphs, there is a general decline in the mortality from ages 5 to50 years from the year 2000 to 2005. The mortality rate for persons aged 65-69 has declined from 327 per 10, 000 population in 2000 to 200 per 10,000 population in 2005. However, the mortality rate for persons above 70 years have increased from 613 per 10, 000 population in 2000 to 695 per 10,000 population in 2005.

When comparing the mortality pattern of males and females, as can be seen from the graphs, the mortality rate for females are lower than that of males. This is more evident in the year 2000 than in the year 2005. It is also noted that in the year 2000, for females age between 60-64 years there is an elevation in mortality pattern. In order to analyze the age specific mortality trends comprehensively it is imperative that cause specific mortality is known for deriving plausible explanations.

3. Mortality estimates

3.1: Life expectancy at birth

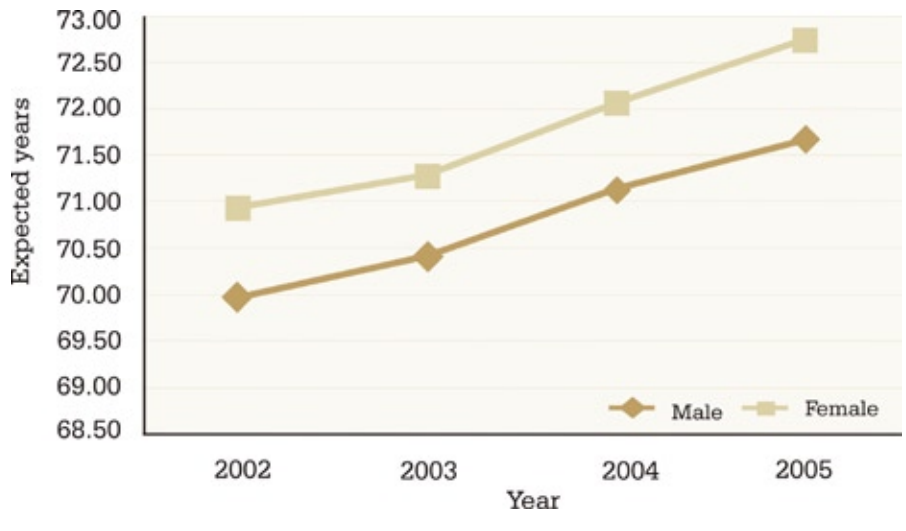
The average life span of a person from birth is a frequently used demographic measure to assess the overall health of a country. Better health and welfare increases life expectancy while incidences such as war, famine and deteriorating health situation can rapidly decrease the life expectancy. Fortunately in the Maldives, improvements in health and welfare as well as the unprecedented growth in the economy over the last few decades have lead to a rapid increase in life expectancy. Furthermore, decline in child mortality rates as reported in the proceeding parts of this chapter, has lead to increased child survival hence leading to higher longevity in life. The graph below shows the increase in life expectancy from 2002 to 2005.

Table 5: Life expectancy at birth 2002-2005

	2002	2003	2004	2005
Male	69.96	70.40	71.13	71.66
Female	70.93	71.29	72.07	72.74

Source: Ministry of Planning and National Development 2007

Figure 7: Life expectancy at birth 2002-2005



Source: Ministry of Planning and National Development 2007

Similar to other countries, life expectancy at birth for females (72.74)is higher than for males (71.66). There is a marked improvement in life expectancy from the year 2002 to 2005. In the year 2005 the life expectancy at birth for males was 69.96 and for females, 70.93. This figure has increased in 2005 to 71.66 and 72.74 for males and females respectively. The socio economic changes including developments to health infrastructure and service delivery over the past decade can be concluded to contribute to the increase in life expectancy.

3.2: Infant mortality rate

Infant Mortality Rate (IMR) refers to number of deaths of children under one year occurring per 1000 live births in a given year.

The mortality indicators from the census can be derived through direct or indirect estimates. The indirect estimates of IMR using the census data can be derived based on the information on children surviving among children ever born.

This indirect method of estimation of Infant Mortality Rate was developed by Brass (1966) and modified later by Sullivan (1972) and Trussell (1975). This method involves calculating the proportion of dead children among children ever born by age group of women (ie: for age range 15-19, 20-24, 25-29, 30-34 etc) and converting the proportion of children dead (ie: D1, D2, D3, D4.. etc) into probabilities of dying between ages 1, 2, 3, 4, 5 etc… (ie q1, q2, q3, q4 …etc). This indirect method, with the application of United Nation's South Asian model Palloni-Heligman equations, has indicated overestimation of mortality levels which is not consistent with the other health indicators and life expectancy of the Maldivian population. The reliability of this indirect method of estimation is very much dependent on the quality of census data, particularly the number of children ever born, children surviving and age group of women.

Therefore for the analysis of Census 2006 data, a direct estimate of infant mortality has been made from the available data. The following table shows the Infant Mortality Rates per 1000 live births for the year preceding the census.

Table 6: Infant mortality rate per 1000 live birth - 2005

Locality and age of mother	Number of children		Number of infant deaths	Infant Mortality Rate per 1000 live births
	Born alive last year	Surviving among born alive last year		
Republic	**5,344**	**5,247**	**97**	**18.15**
15-19	149	145	4	26.85
20-24	1,685	1,655	30	17.80
25-29	1,619	1,588	31	19.15
30-34	1,081	1,064	17	15.73
35-39	580	573	7	12.07
40-44	202	196	6	29.70
45-49	28	26	2	71.43
Male'	**1,476**	**1,455**	**21**	**14.23**
15-19	19	19	0	0.00
20-24	449	445	4	8.91
25-29	486	477	9	18.52
30-34	355	350	5	14.08
35-39	135	134	1	7.41
40-44	28	26	2	71.43
45-49	4	4	0	0.00
Atolls	**3,868**	**3,792**	**76**	**19.65**
15-19	130	126	4	30.77
20-24	1,236	1,210	26	21.04
25-29	1,133	1,111	22	19.42
30-34	726	714	12	16.53
35-39	445	439	6	13.48
40-44	174	170	4	22.99
45-49	24	22	2	83.33

As mentioned previously, the data for mortality estimates for the Census 2006 were collected in the birth history section of the Maldives Housing & Population Census 2006 questionnaire. In the Census 2006, details of history of births including the number of live births and number of children living at the time of census were asked from females aged 15 and over. Based on this information the numbers of infant deaths were calculated. Infant Mortality Rates per 1000 live births were then calculated to arrive at the direct estimate of infant mortality levels in the Maldives as detailed in Table 6.

The Infant Mortality Rate for the year preceding the census stood at 18.15 per 1000 live births. The IMR for Male' is 14.23 per 1000 live births and for the atolls, IMR is 19.65 per 1000 live births. The IMR generated from the Census is relatively closer to the IMR generated by the Vital Registration System of the country which stands at 16 per 1000 live births.

4. Mortality differentials

There are several differentials that contribute to the variation in mortality levels, namely demographic, socio-economic, cultural and locality factors. In order to analyse these differentials information on these factors need to have been collected during the Census 2006. The data constraints of Census 2006 permit examination of limited number of mortality differentials, hence mortality levels has been considered by locality and age as discussed below.

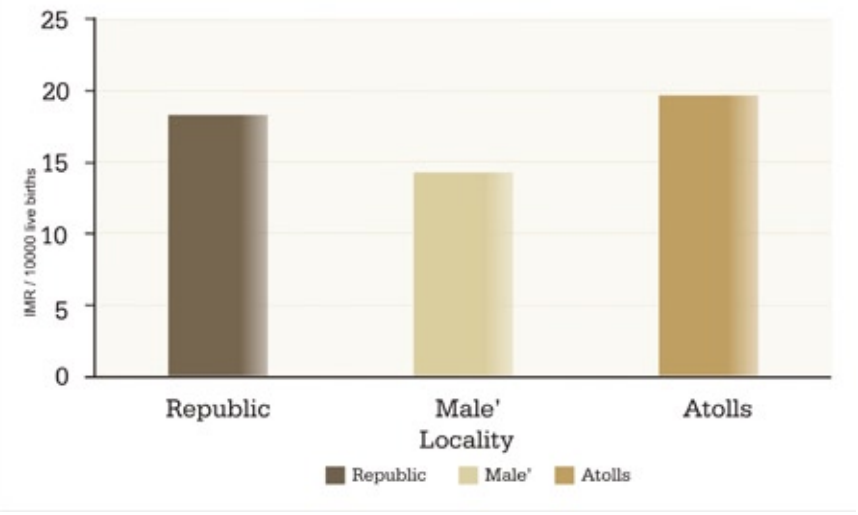
4.1: Locality

Due to the unique geographical nature and the spread of the islands in Maldives there are variations observed for the mortality levels in the country for Atolls and Male'. Male' is the capital island city of the Maldives and its characteristics differs considerably from the atolls. Male' is densely populated with 34.6 percent of the country's population residing in Male' (Ministry of Planning and National Development, 2006). Male' is considered to be an urban setting and there are more health facilities and tertiary health care is available in Male'.

The atolls are sub-divided into regions namely, north, north central, central, south central and south region. The number of health facilities has increased considerably over the past few years and at present there is a hospital in each atoll in addition to the regional hospitals. Additionally there are Health Centres, Health Posts and Family Health Sections spread throughout the country.

Over the past decade, there is a gradual decline in Infant Mortality Rate both in Male' and in atolls. The graph below shows the direct estimate of IMR per 1000 live births by locality. In Male' the IMR stands at 14.23 per 1000 live births and for the atolls, IMR stands at 19.65 per 1000 live births.

Figure 8: Direct estimates of infant mortality rate per 1000 live births by locality 2005

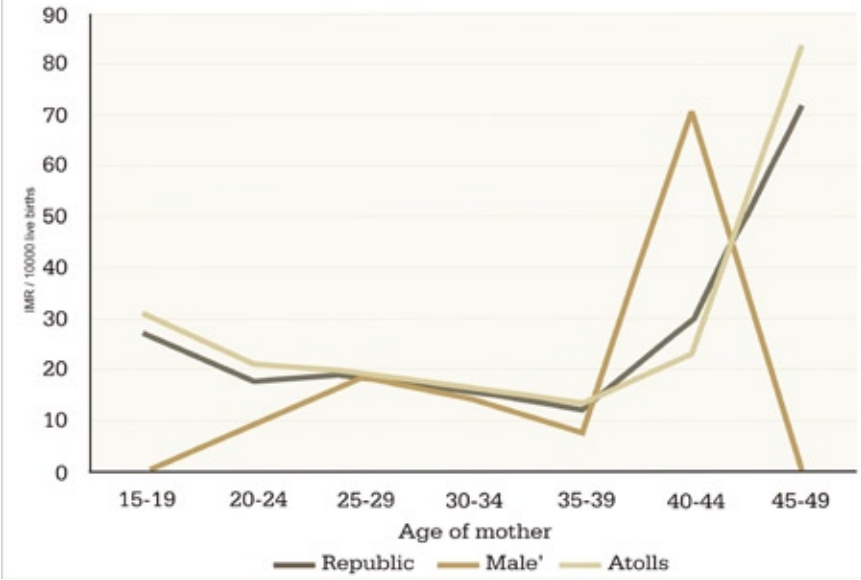


The lower IMR in Male' could be attributed among other factors to the improved quality and accessibility of care than in the atolls. Moreover the skilled birth attendance rate is above 90 percent in Maldives (Ministry of Health, 2007) which contributes to reducing the maternal and child mortality in the country. The gap between Male' and atolls have narrowed down considerably over the years, and needs to be further bridged by improved quality of care in the atolls.

4.2: Age

As the age specific mortality has been discussed in section 2.2, this section will focus on the correlation between infant mortality rate and age of the mother. The graph below shows the relationship between IMR per 1000 live births and age of the mother.

Figure 9: Direct estimates of infant mortality rate per 1000 live birth by age 2005



As can be expected the characteristic U-shape pattern is illustrated in the graph. As a whole for the Maldives, the IMR rate is higher for teenage mothers and then stabilizes before the IMR increases sharply from age 40 onwards. This is to be expected as the risk of infants dying to mothers who are aged 40 or above increases considerably with age.

When considering the Infant Mortality Rates for Male' the pattern is a bit different as there are no infant deaths for mothers in age group 15-19. The sharp peak at age group 40-44 indicates high mortality rate which is more noticeable as the next age group has no reported infant deaths. These should be interpreted with caution as the accuracy of information is very much dependent on the responses given by mother's particularly their responses in categorizing infant deaths and child deaths which may be subjected to recall bias. In addition slight variation in the number of deaths may contribute to a larger difference which results from the small population of the country hence these should be interpreted carefully. Nevertheless it can be said that Maldives has gained considerable progress in reducing the mortality levels of the country including a reduction in infant mortality rate.

5. Conclusion

As compared to previous censuses, the basic health indicators such as the crude death rate, life expectancy at birth, age specific mortality rate and infant mortality rate has shown marked improvement which reflects to the progress in health and well-being of the Maldivian population for the past decade. Although the method of comparison of Infant mortality Rate is different from previous censuses, based on the other indicators and information derived from the Vital Registration system, it can be concluded that there is a vast improvement which can be explained by the development of health care facilities and accessibility of services in the atolls. Public health measures such as almost universal immunization rate, more than 90 percent of births being conducted in health facilities rather than in home and increased awareness in public has also attributed to better health outcomes for the infants and mothers. The development of health infrastructure has lend a hand in reducing the overall mortality levels of the country. In addition the increased number of health professionals in service has played a major role in improving the efficacy of the health system of the country. These factors among others have led to significant reduction in mortality levels in the Maldives.