

GEOGRAPHIC ASSESSMENT ON DEMOGRAPHIC CONDITIONS OF MAGWAY REGION: A CASE STUDY OF INFANT MORTALITY

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Abstract

Infant mortality is defined as the number of deaths of children under one year of age per 1,000 live births. It is widely accepted as an important indicator of the health of the country's population. According to 2014 Myanmar Population and Housing Census, Magway Region has a relatively highest infant mortality rate (IMR) compared with other states and regions of Myanmar. The aim of this paper is to do geographic assessment on high infant mortality of research area. The present paper attempted to investigate using data from household survey. This study emphasizes on spatial patterns of infant mortality in Magway Region by applying qualitative method after conducting questionnaire survey on highest infant mortality area using factorial discriminate analysis. Spatial analysis was employed to explore spatial distribution and temporal variation of infant mortality in the Magway Region. Result of this study show that the environmental and geographical characteristics of the study area are strongly influence on infant mortality.

Keywords: Infant mortality, qualitative method, questionnaire survey, spatial analysis, spatial distribution, temporal variation

Introduction

The infant mortality rate is an important marker of the overall health of a society. High infant mortality rates are generally indicative of unmet human health needs in sanitation, medical care, nutrition, and education (www.britannica.com/science). Infant mortality rate in Geography means the number of deaths under one year of age occurring among the live births in a given geographical area during a given year, per 1,000 live births occurring among the population of the given geographical area during the same year (www.stats.oecd.org/glossary). According to the 2014 Myanmar Population and Housing Census Report, Magway Region is highest in infant mortality rate (89) and the lowest is Mon State (43) in Myanmar (Figure 1). Therefore, this study examines spatial distribution of infant mortality rate (IMR) of Magway Region. Geographically, infant mortality rates in 2014 were highest among townships particularly in Myaing, Natmauk and Ngaphe in this region (<http://www.dop.gov.mm>). Among them, the highest mortality rate is found in Myaing Township within ten-year study period (2010 to 2019).

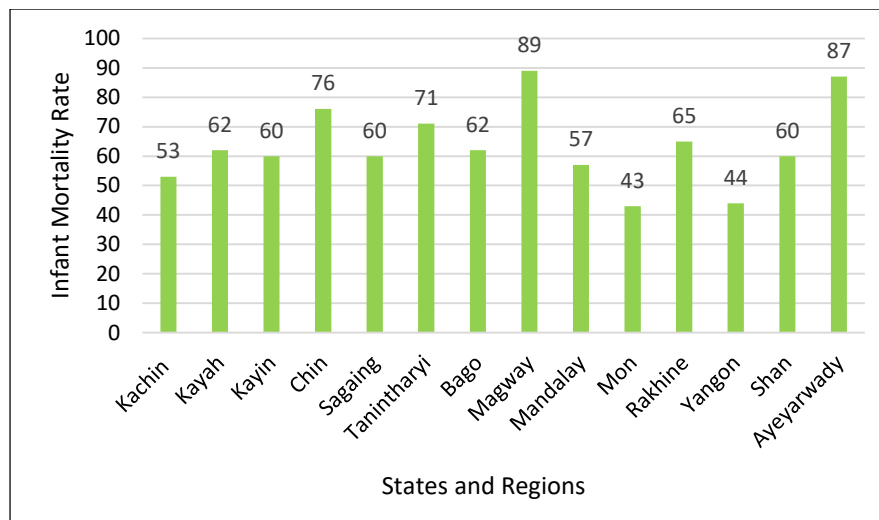
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Source: 2014 Myanmar population and housing census report.

Figure 1 Infant mortality rate in States and Regions of Myanmar.

Study Area

Magway Region is located between north latitudes $18^{\circ} 50'$ and $22^{\circ} 47'$ and between east latitudes $93^{\circ} 47'$ and $95^{\circ} 55'$. It is bounded by Rakhine and Chin States on the west, Sagaing Region on the north, Mandalay Region on the east and Bago Region on the south. Magway Region is composed of 5 districts with 25 townships (Figure 2).

Aim and Objectives

The aim of this paper is to do geographic assessment on high infant mortality of the research area. To achieve the aim of study, the specific objectives are to investigate the spatial distribution pattern of infant mortality in Magway Region, to examine the temporal variation of infant mortality in research area, to identify the causes of infant mortality and to assess the relationship between highest infant mortality and geographical, socio-economic and environmental factors of research area.

Materials and Methods

In acquiring primary data, field observation was undertaken and questionnaires were prepared according to purposive sampling design. Myaing Township was chosen among the townships due to highest infant mortality rate within Magway Region and conducted the questionnaire survey by using factorial discriminate analysis. The sample size (number of questionnaires) was 30 percent of the target population. Data collection about the demographic, social, economic, health, education and environmental factors and expert interviews took place during 2019 in which 437 questionnaires were distributed and collected to households.

Secondary data were collected from Administrative Department, Immigration and National Registration Department, Township and Regional Hospital and Health Departments in Magway Region. To calculate infant mortality rate (IMR) of research area, following formula was used. In this formula, the ratio of infant deaths registered in a given year to the total number of live births registered in the same year; usually expressed as a rate per 1,000 live births (www.britannica.com/science/infant-mortality-rate).

$$\text{IMR} = \frac{\text{Number of deaths of children less than one year of age in a year}}{\text{Number of live births in the same year}} \times 1,000$$

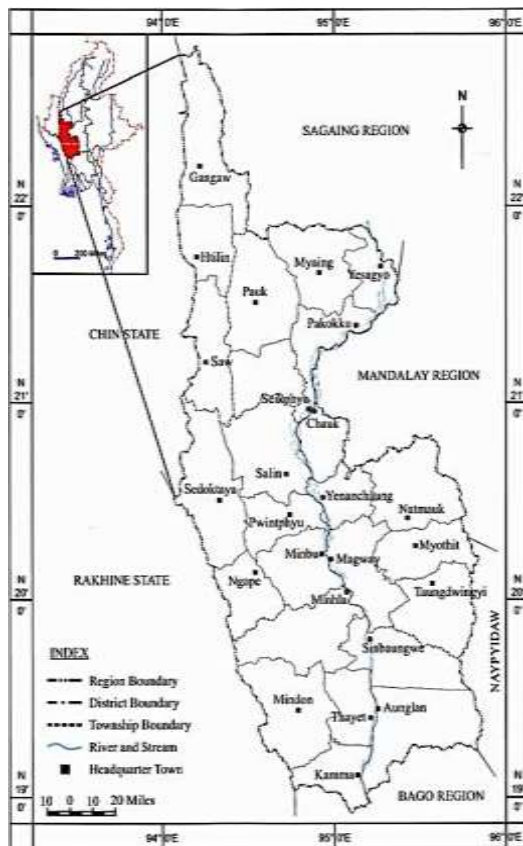
Basic Geographical Factors of Research Area

Physical Factors

Magway Region is situated in the Dry Zone of Central Myanmar. The Region has an area of 44819.74 square kilometers (17,305 square miles) and its capital is Magway. Topographically, Magway Region is located in lowland region but the western portion is occupied by higher mountain ranges and the spurs of Bago Yoma in the eastern part. The physical feature of Magway Region is divided into four units. They are the western mountain ranges, the western undulating land, the Ayeyarwady-Chindwin River basin and the eastern undulating upland (Figure 3).

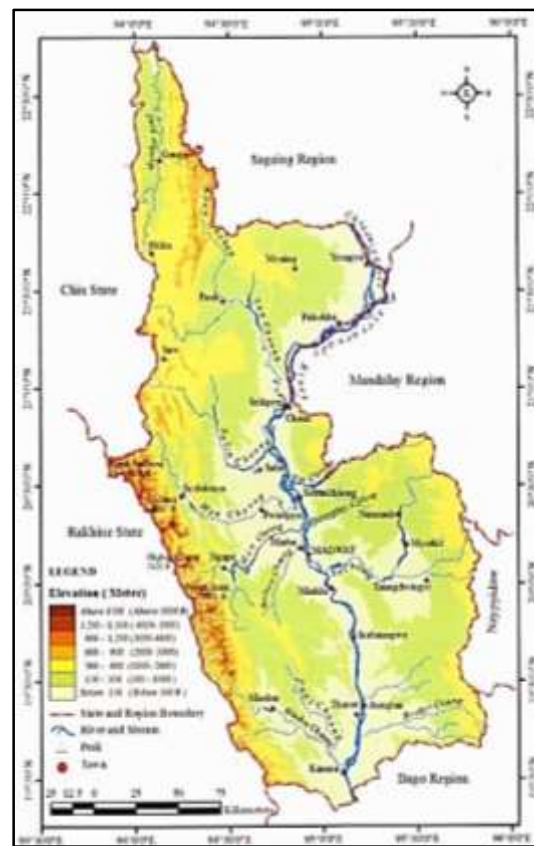
Magway Region is generally low-lying along the Ayeyarwady, the main river of Magway Region. The eastern tributaries of the Ayeyarwady River are Pin, Yin, Daungthay and Bwetgyi Streams. Tributaries entering the Ayeyarwady from the west are Yaw, Salin, Mone, Mann and Mindone Streams. Lakes and inns are found in the flooded area of Ayeyarwady River. Dams are built in the Magway Region and they are important sources of water for irrigation.

Magway Region falls within the tropical zone and experiences tropical monsoon climate. According to Koppen's climatic classification, climate is classified into three types: Tropical steppe climate, Tropical savanna climate and Subtropical monsoon climate. Except Aunglan and Kamma Townships, tropical steppe climate is found in the remaining townships in the central valley of Magway Region. Tropical savanna climate is found outside the tropical steppe climate belt in Magway Region. The subtropical monsoon climate is found in western mountain ranges of Magway Region and parts of Saw, Saytoketayar, Ngaphae, Minhla, Mindone and Kanma Townships. According to the meteorological records during 25 years period from 1995-2019, the average maximum temperature was 37.36° C (99.24° F), the average minimum temperature 17.69° C (63.84° F) and the mean temperature has 27.58° C (81.64° F). April is the hottest month with 43.84° C (110.91° F) and January is the coldest month with 9.44° C (48.99° F). According to the rainfall data from 1995 to 2019, the yearly rainfall of Magway Region is not different significantly; it is always between 20 inches and 40 inches.



Source: Agricultural Land Management and Statistics Department, Magway Region

Figure 2 Location Map of Magway Region

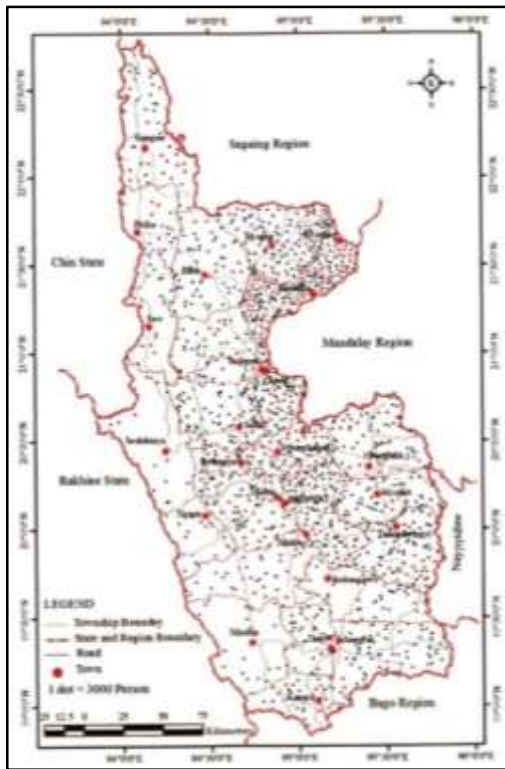


Source: Elevation Extract from Digital Elevation Model (SRTM DEM 90 Meter)

Figure 3 Relief and Drainage of Magway Region

Social Factors

Infant mortality rate of the study area is largely influenced by the social factors. Population is the most important factor regarding the outbreak of diseases and also high infant mortality rate. Magway Region is a populated area with total population was 2,632,144 persons in census year 1973. It increased to 4,167,615 persons in 2019. In 1973, population density of Magway Region was 152 persons per square mile and it increased to 241 persons per square mile in 2019. According to population data, Pakokku Township was highest number of populations with 300,689 persons and density was 660 persons per square mile. The second highest populated area is Magway Township having 284,848 persons and density was 431 persons per square mile. Saytoketayar Township has the lowest number of populations with 43,855 persons and population density has only 41 persons per square mile (Figure 4, 5, 6).



Source: Immigration and National Registration Department, Magway Region

Figure 4 Population Distribution of Magway Region (2019)

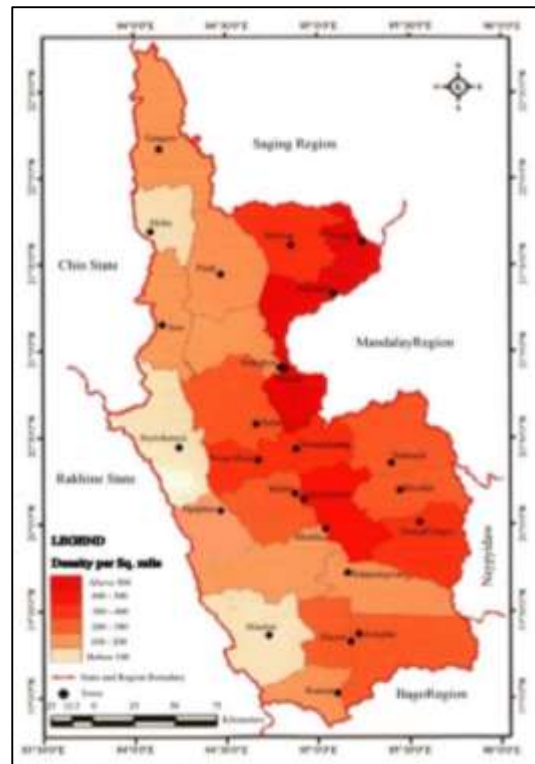
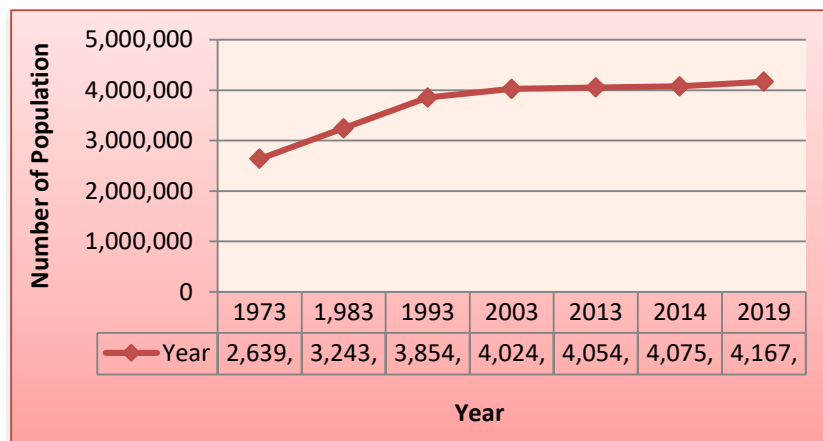


Figure 5 Population Density of Magway Region (2019)



Source: Immigration and National Registration Department, Magway Region

Figure 6 Population Growth of Magway Region (1973-2019)

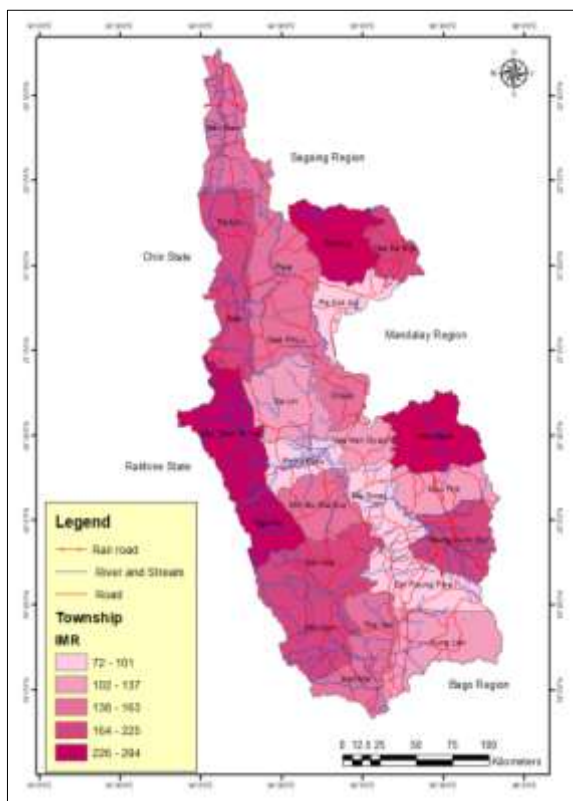
Results and Findings

According to the results of field surveys, household questionnaires and secondary data from regional health department in the study area, infant mortality rate was highest in Myaing Township and lowest infant mortality rate were found in Htilin and Pakokku townships within ten years study period (2010 to 2019) in Magway Region (Table 1 and 2).

Spatial Distribution of Infant Mortality

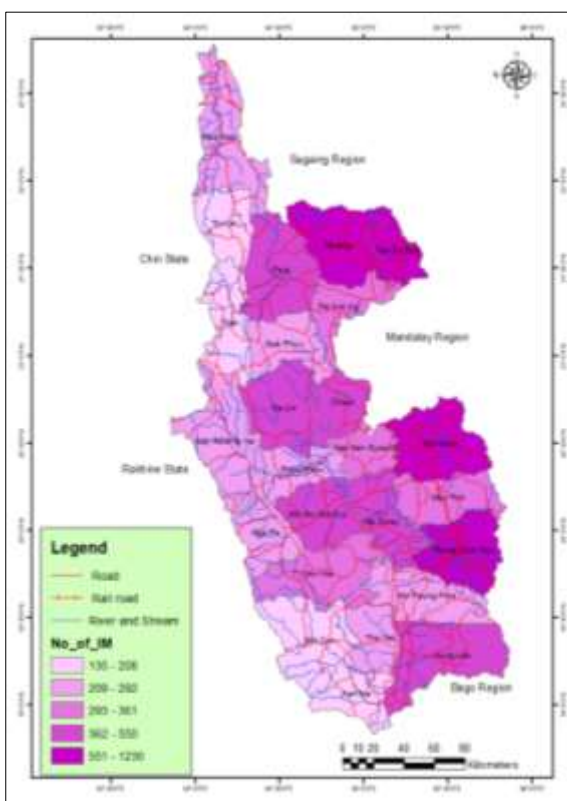
The spatial analysis on high Infant Mortality Rate (IMR) was worked out by using questionnaires and interview. The data were collected by applying questionnaires was conducted to various sample household in study area. Currently highest infant mortality within ten years is in Myaing Township and the lowest in Htilin Township.

According to the calculated results of infant mortality rate, high IMR was found in Myaing and Natmauk Townships located in the eastern part and Saytoketayar and Ngaphae townships in the western part of Magway Region. And also, high number of infant mortalities was found in Myaing and Yaesagyo Townships in northeastern part and Natmauk and Taungdwingyi Townships in the southeastern part of Magway Region (Figure 7 and 8).



Source: Based on Table 1

Figure 7 Spatial distribution of infant mortality rate in Magway Region (2010-2019)



Source: Based on Table 2

Figure 8 Spatial distribution of number of infant mortality in Magway Region (2010-2019)

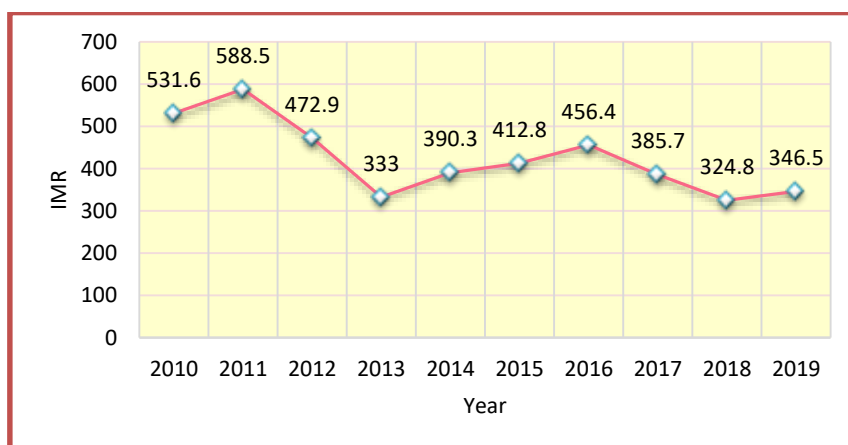
Temporal Variation of Infant Mortality

During the study period from 2010 to 2019, highest infant mortality rate was 588.3 in 2011 and the lowest rate is 333 in 2013. Number of infant mortalities within ten years has the highest is 1,548 in 2010 and the lowest is 777 in 2018 (Figure 9 and 10). In the study area, this high infant mortality is due to some of the seasonal diseases such acute respiratory infection (ARI), dengue hemorrhagic fever (DHF), heart disease, etc. in the year 2010-11. The trend of infant mortality in Magway Region generally decreases from 2010 to the present.

Table 1 Infant mortality rate of townships in Magway Region (2010 to 2019)

| Sr. No. | Township | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---------|----------------|-------|--------------|-------|------------|-------|-------|-------|-------|-------|-------|
| 1 | Magway | 9.8 | 10 | 14.3 | 5.9 | 11.9 | 10.3 | 13.6 | 10.5 | 8 | 7 |
| 2 | Chauk | 21 | 15 | 7.9 | 11.4 | 15.4 | 14.5 | 24.6 | 19.2 | 7.7 | 11.2 |
| 3 | Taungdwingyi | 28.5 | 26.3 | 20.7 | 14 | 18.8 | 27.3 | 28.9 | 15.6 | 12 | 11.5 |
| 4 | Natmauk | 31.5 | 32.9 | 34.1 | 26.3 | 42 | 29.8 | 20.9 | 16.7 | 12.3 | 7.5 |
| 5 | Myoethit | 14 | 12.3 | 6.6 | 3.2 | 4.6 | 11.3 | 13.2 | 11.9 | 14.9 | 20.5 |
| 6 | Yenachaung | 11 | 17.3 | 10.8 | 3.7 | 11.1 | 14.9 | 20 | 12.1 | 14.3 | 13 |
| 7 | Minbu | 24.2 | 28.2 | 25.6 | 12.3 | 7.8 | 13.3 | 15 | 11 | 14.4 | 11 |
| 8 | Ngaphae | 33 | 41 | 28.1 | 21.9 | 28.2 | 18.8 | 30.7 | 23.1 | 23.4 | 19.5 |
| 9 | Salin | 20 | 16.4 | 8.2 | 5.3 | 7.1 | 7.2 | 10.6 | 10.1 | 13.9 | 12.9 |
| 10 | Saytoketayar | 43.6 | 39.7 | 21.5 | 15.5 | 22.3 | 27 | 34.4 | 20.5 | 25.3 | 23.6 |
| 11 | Pwintphyu | 14.1 | 7 | 8.9 | 6 | 4.8 | 7 | 12.8 | 10.2 | 4.3 | 5.2 |
| 12 | Pakokku | 8.7 | 9.5 | 7.2 | 2.2 | 1.5 | 2 | 9.3 | 10.8 | 8.9 | 12.2 |
| 13 | Seikphyu | 20.7 | 15.7 | 9.6 | 4.6 | 8.6 | 8.9 | 20.1 | 31.9 | 14.2 | 23.2 |
| 14 | Pauk | 17.3 | 15.9 | 16.7 | 22.2 | 8.5 | 17.7 | 19.8 | 10.1 | 10 | 14.4 |
| 15 | Myaing | 27.2 | 49 | 60.3 | 26.1 | 33.5 | 24.2 | 21 | 24.1 | 14.4 | 14.3 |
| 16 | Yesagyoy | 28 | 28.4 | 30.8 | 19.4 | 19.4 | 19.2 | 17.2 | 11.4 | 14.5 | 15.3 |
| 17 | Gantgaw | 24.6 | 17.9 | 9.4 | 5.8 | 5.8 | 8.9 | 13.8 | 18.1 | 19.9 | 16.3 |
| 18 | Saw | 27.2 | 31.7 | 25.2 | 24.9 | 20.8 | 15 | 23 | 17 | 17 | 13 |
| 19 | Htilin | 12.8 | 22.9 | 28.2 | 9.7 | 18.1 | 25.1 | 17.7 | 23 | 13.1 | 24.5 |
| 20 | Thayet | 11.6 | 35 | 9.4 | 14 | 19.7 | 18.8 | 25.2 | 10 | 7.2 | 7.8 |
| 21 | Kanma | 9.3 | 7.1 | 15.4 | 18 | 25.9 | 24.7 | 8.5 | 14.7 | 17.7 | 22 |
| 22 | Sinpaungwae | 20.4 | 15 | 13.5 | 6.8 | 6.1 | 8.7 | 11.6 | 2.7 | 4.7 | 2.1 |
| 23 | Mintone | 34.3 | 46.9 | 18.8 | 26.8 | 9.7 | 19.8 | 23.3 | 19.3 | 9.8 | 16.5 |
| 24 | Minhla | 22.8 | 35.4 | 22.3 | 7.6 | 25 | 27 | 9.7 | 21.7 | 11.3 | 10.3 |
| 25 | Aunglan | 16 | 12 | 19.4 | 19.4 | 13.7 | 11.4 | 11.5 | 10 | 11.6 | 11.7 |
| | Total | 531.6 | 588.5 | 472.9 | 333 | 390.3 | 412.8 | 456.4 | 385.7 | 324.8 | 346.5 |

Source: Regional Health Department, Magway Region.



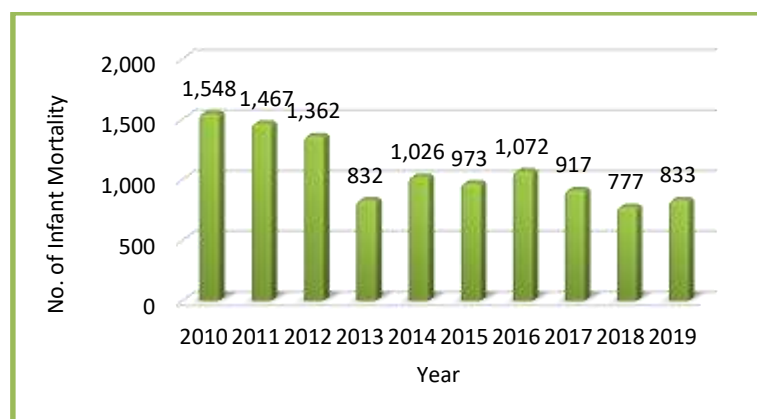
Source: Based on Table 1

Figure 9 Temporal variation of Infant Mortality Rate (IMR) in Magway Region (2010-2019)

Table 2 The number of infant mortality in townships of Magway Region (2010 to 2019)

| Sr. No. | Township | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---------|---------------|--------------|-------|-------|------|-------|------|-------|------|------------|------|--------------|
| 1 | Magway | 44 | 47 | 75 | 31 | 59 | 45 | 59 | 48 | 37 | 33 | 478 |
| 2 | Chauk | 91 | 64 | 34 | 47 | 53 | 50 | 82 | 67 | 26 | 36 | 550 |
| 3 | Taungdwingyi | 158 | 133 | 106 | 85 | 101 | 115 | 127 | 66 | 52 | 53 | 996 |
| 4 | Natmauk | 125 | 125 | 126 | 96 | 168 | 109 | 79 | 62 | 49 | 29 | 968 |
| 5 | Myoethit | 43 | 35 | 19 | 9 | 14 | 31 | 32 | 31 | 45 | 61 | 320 |
| 6 | Yenachaung | 31 | 58 | 45 | 16 | 36 | 38 | 41 | 25 | 31 | 31 | 352 |
| 7 | Minbu | 71 | 84 | 87 | 40 | 26 | 37 | 40 | 33 | 41 | 31 | 490 |
| 8 | Ngaphae | 36 | 45 | 31 | 32 | 28 | 18 | 28 | 22 | 21 | 16 | 277 |
| 9 | Salin | 85 | 67 | 35 | 23 | 30 | 26 | 36 | 40 | 55 | 58 | 455 |
| 10 | Saytoketayar | 42 | 35 | 19 | 12 | 18 | 21 | 25 | 14 | 17 | 16 | 219 |
| 11 | Pwintphyu | 39 | 23 | 26 | 18 | 14 | 18 | 33 | 26 | 12 | 13 | 222 |
| 12 | Pakokku | 49 | 42 | 31 | 11 | 8 | 10 | 49 | 54 | 46 | 61 | 361 |
| 13 | Seikphyu | 46 | 24 | 17 | 8 | 17 | 16 | 35 | 58 | 24 | 41 | 286 |
| 14 | Pauk | 57 | 50 | 51 | 35 | 26 | 56 | 60 | 34 | 34 | 46 | 449 |
| 15 | Myaing | 174 | 163 | 258 | 101 | 133 | 97 | 85 | 101 | 59 | 59 | 1,230 |
| 16 | Yesagyoo | 108 | 115 | 119 | 76 | 83 | 72 | 65 | 45 | 56 | 62 | 801 |
| 17 | Gantgaw | 48 | 37 | 19 | 10 | 11 | 17 | 29 | 40 | 44 | 37 | 292 |
| 18 | Saw | 29 | 31 | 26 | 24 | 19 | 13 | 20 | 15 | 16 | 15 | 208 |
| 19 | Htilin | 10 | 23 | 20 | 7 | 12 | 16 | 11 | 14 | 8 | 14 | 135 |
| 20 | Thayet | 40 | 64 | 20 | 16 | 27 | 26 | 35 | 13 | 10 | 9 | 260 |
| 21 | Kanma | 18 | 11 | 17 | 18 | 28 | 24 | 8 | 14 | 18 | 21 | 177 |
| 22 | Sinpaungwae | 72 | 40 | 35 | 12 | 12 | 15 | 21 | 5 | 9 | 18 | 239 |
| 23 | Mintone | 25 | 27 | 14 | 18 | 7 | 15 | 16 | 14 | 7 | 13 | 156 |
| 24 | Minhla | 35 | 62 | 40 | 12 | 43 | 48 | 18 | 41 | 21 | 18 | 338 |
| 25 | Aunglan | 72 | 62 | 92 | 75 | 53 | 40 | 38 | 35 | 39 | 42 | 548 |
| | Total | 1,548 | 1,467 | 1,362 | 832 | 1,026 | 973 | 1,072 | 917 | 777 | 833 | 10,807 |

Source: Regional Health Department, Magway Region



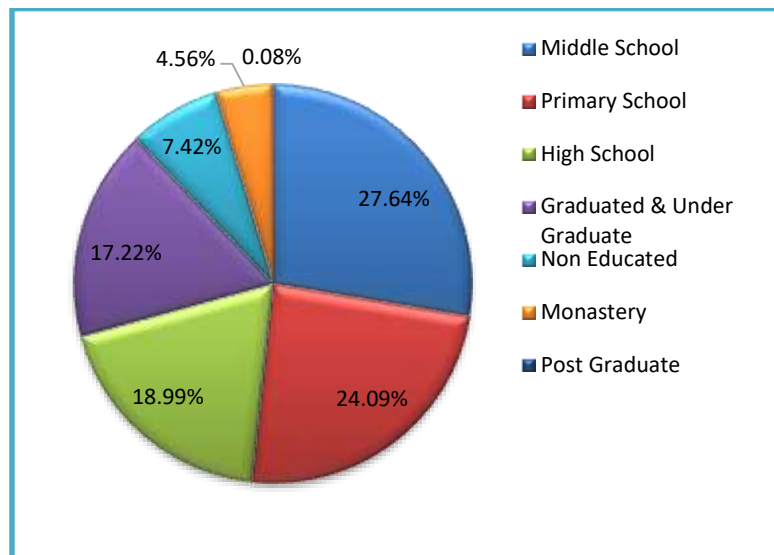
Source: Based on Table 2

Figure 10 Temporal variation of number of infant mortality in Magway Region (2010-2019)

Factors Causing High Infant Mortality

The results of household questionnaire survey in 2019, shows that socio-economic status of the household and environmental factors, such as mother's educational level and head of the household, occupation conditions, health knowledge, condition of house type, household's access to drinking water and water utilization, sanitation facilities as type of toilet, waste disposal, and environmental awareness, etc. are major factors causing high infant mortality in study area.

Low education level with limited knowledge and information reflects the high incidences of infant mortality (www.britannica.com/science). Health knowledge is limited to the local people due to low level of education and a few people have no health knowledge. According to the results of questionnaire and interview in 2019, 27.64 percent of household head is middle school level, 24.09 percent is primary school level and 0.08 percent is post graduate level in education (Figure 11).



Source: Result of questionnaires and field survey, 2019.

Figure 11 Educational level of household head in study area.

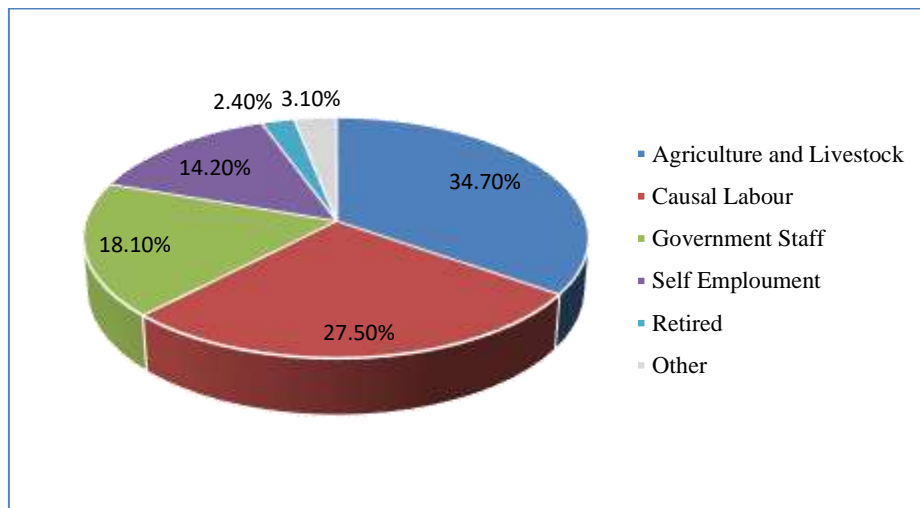
About 63 percent of the respondent families use water from ponds, 30 percent from tube-well and 7 percent from surface wells. The majority of inhabitants use poor quality water. Most households store rain water in their house compounds for whole year-round consumption. Plate 1 shows the condition of drinking water sources in Myaing Township.

In occupation, 34.7 percent of the people are engaged in agriculture and livestock, 27.5 percent earn as casual labourers and 18.1 percent are government employees. Some retired persons also live in this study area. Another occupation are self-employment and others. (Figure 12).



Source: Field Survey, 2019

Plate 1: Drinking water pond and water storage in the study area.

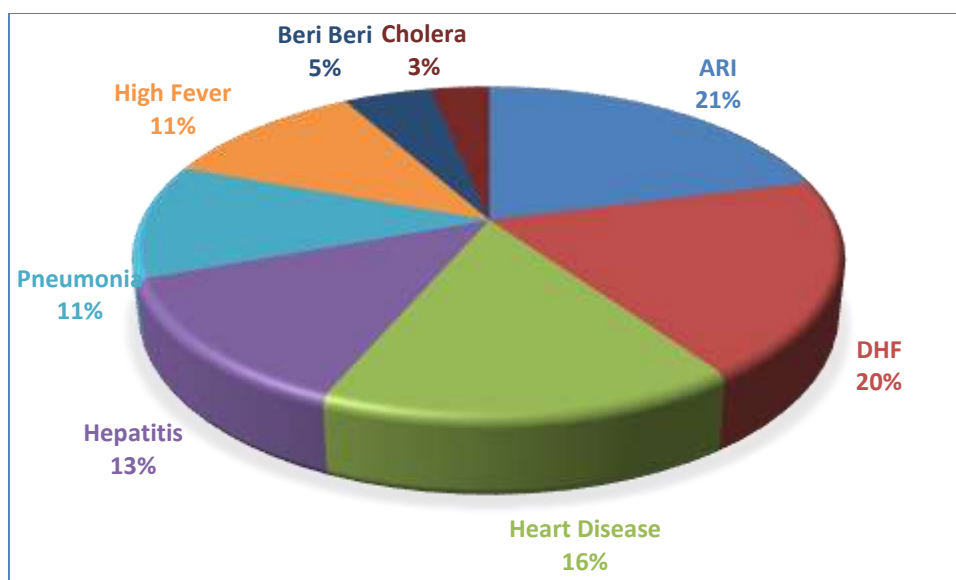


Source: Results of questionnaires and field survey, 2019.

Figure 12 Occupation of sample household member.

Local people encounter blocking of seasonal creeks during the rainy season. Therefore, difficulty for local people to go to hospital during the time of emergency. It is one of the factors for high mortality (Plate 2). According to their traditional habits, some families collect drinking water from ponds and store the tank in their house compound whole year round. It also affects health for their families. Most of the people do not want to go to the clinic, hospital, etc. when they suffer from ill health and it causes high infant mortality.

Some infected infant diseases is acute respiratory infection (ARI- 21%), dengue hemorrhagic fever (DHF- 20%), heart disease (16%), hepatitis (13%) pneumonia (11%), high fever (11%) etc. (Figure 13). DHF occurs when a mosquito carrying the arbovirus bites a human. Children especially between 1 to 14-year-old suffer from DHF. The incidence of respiratory disease ARI was caused due to cigarette smoking. Smokers can give negative effects on family member specially to infant as passive smokers. Moreover, the use of fuel wood and charcoals for cooking fuel at their home are also a factor causing respiratory disease. Smoke emission from their kitchen can cause air pollution and the number of infant deaths increases due to the respiratory disease (www.mayocline.com/health/dengue-fever).



Source: Results of questionnaires and field survey, 2019.

Figure 13 Diseases affecting infant mortality in study area.

Another factor causing high infant mortality rate is insufficient health staff for the township’s population. One of the staff from Rural Health Care Center (RHC) takes responsible for health care services for people living in more than 3 villages. Table 3 shows the ratio of health staff and the number of populations in these townships and it causes high infant mortality in this study area. The ratio of health staff and population in Htilin Township is 1:512 and that of Myaing Township 1:1574 respectively. It is one of the evidences for high infant mortality in this study area.

Table 3 Health Staff and Population of Myaing and Htilin Townships.

| Name of Township | Health Staff | No. of Population | Health Staff : No. of Population |
|------------------|--------------|-------------------|----------------------------------|
| Myaing | 173 | 272,324 | 1: 1574 |
| Htilin | 98 | 50,168 | 1: 512 |

Source: Regional Health Department, Magway Region

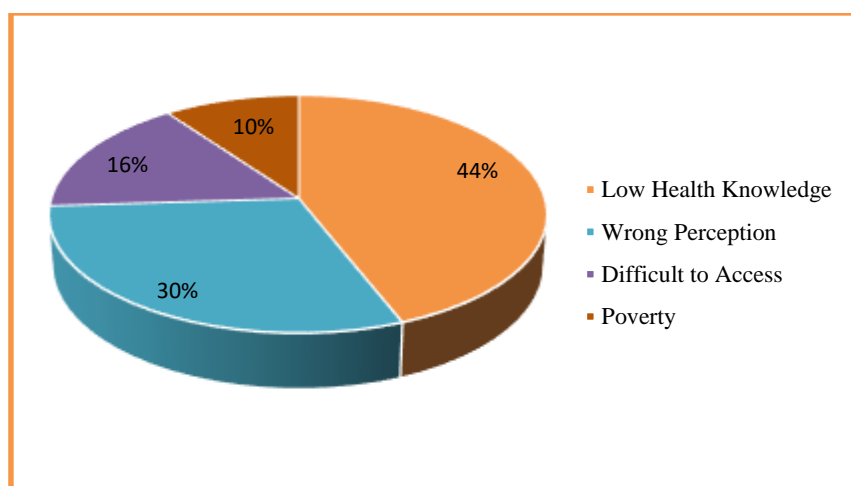


Source: Field Survey, 2019

Plate 2: Seasonal creeks in the study area.

Discussion

Infant mortality is defined as the number of deaths of children under one year of age per 1,000 live births (www.stats.oecd.org/glossary/detail). It is widely accepted as an important indicator of the health of the country's population. According to the result of questionnaire survey, high infant mortality rate is related to low health knowledge (44 percent), low education level with high rate of illiterates, wrong perception (30 percent), the difficulties of transport especially in rainy season (16 percent) and insufficient of health care services poverty (10 percent) and low hygienic environment (Figure 14).



Source: Result of Questionnaire and Field Survey, 2019.

Figure 14 Factors causing infant mortality in study area.

In the study area, chief causes of diseases are almost directly related to health knowledge and awareness of local people. Medical staffs of the township's health care centres should do coordination with NGOs and launch educative talks to the local inhabitants particularly low-income families. Townships with high infant mortality in research area should be adopted as hot spot for health care services and health campaign should also be done. Therefore, these areas should be given as priority and not only for the effective treatment but also for the development of awareness on health issues should be carried out.

Magway Region is located in the Dry Zone of Central Myanmar, it received tropical climate and the amount of rainfall is less than other areas. The diseases causing infant mortality are found due to high temperature, low rainfall, crowded population and low-level awareness on health of the local people. Social factors, educational status, socio-economic factors, living style (living standard), health facility (favorable health care center), drinking water and domestic water use, basic sanitation, transportation and communication facility are the factors causing high infant mortality in the study area.

Conclusion

According to the result of study, spatial distribution pattern of infant mortality varies spatially from one place to another. The temporal variation of infant mortality was gradually decreased in ten year study periods in Magway Region. It is a good indicator for infant health and also demographic conditions of the research area. The result from household survey, common diseases affected to the infant are high fever, acute respiratory infections (ARI) and dengue hemorrhagic fever (DHF), pneumonia, heart disease, and hepatitis, etc. These diseases are major causes of high infant mortality rate (IMR) in this study area.

This paper presents the spatial analysis on infant mortality from the geographical point of view, expresses the various diseases effected to infant and high infant mortality rate relating to geographical factors, socio-economic, environmental and demographic conditions. Low education level is associated with high incidence of infant mortality rate. Therefore, socio-economic conditions should be promoted by providing the essential infrastructural bases like transportation, education, poverty reduction, health care facility, fresh water facility, high medical awareness level and effective treatment programs for the purpose of reducing infant mortality rate. Some rural health care center (RHC) and Sub-RHC are now working medical services not only for their adopted areas but for other settlements from nearby areas.

Human health especially infant health is important for sustainable development of the region. Since without good health, human beings would not be able to engage in development, combat poverty or care for their environment. Health knowledge and education should be promoted for the local people in this study area. In turn, caring environment is essential for human well-being and the development process of local people. A healthy environment leads to a healthy population and healthy life which will eventually lead to the reduction of infant mortality.

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<http://www.stats.oecd.org/glossary/detail>

<http://www.britannica.com/science>