International Journal of Mosquito Research

V.Saravanabavan
Assistant Professor, Department of Geography, Madurai Kamaraj University, Madurai, Tamil Nadu-625021, India
Email:
vsaravanabavan@gmail.com

R. Sudharsan
DRS-Research Scholar, Department of Geography, Madurai Kamaraj University, Madurai, Tamil Nadu-625021, India

D. Balaji
UGC- MRP Project Fellow, Department of Geography, Madurai Kamaraj University, Madurai, Tamil Nadu-625021, India

R. Rahamath Nisha
Guest Faculty, Post Graduate and Research Department of Geography, Sri Meenakshi Government College, Madurai, India

For Correspondence:
V.Saravanabavan
Assistant Professor, Department of Geography, Madurai Kamaraj University, Madurai, Tamil Nadu-625021, India
Email: *vsaravanabavan@gmail.com*

Patient's perception and epidemiological characteristics of dengue in Madurai city-using factor analysis

V.Saravanabavan, R. Sudharsan, D. Balaji, R. Rahamath Nisha

ABSTRACT

Dengue fever is an infectious tropical disease caused by the dengue virus. Dengue is transmitted by several species of mosquito within the genus *Aedes*, principally *A. aegypti*. The Study area of Madurai is located at $9^0 30'$ and $10^0 30'$ longitudes and between $77^0 00'$ and $78^0 30'$ latitude. The purpose of selection of the study area is to investigate the spatial distribution of Dengue at the micro level in an urban area of Madurai city and to analyze the causal relationships between the distribution of Dengue and its association with socio – economic, environmental, behavioral and medical variables.

The data collected were taken by using the method of stratified Random sampling and a total of 300 samples were collected from the study area with reference to different age groups and sex ratio. It includes mapping of the disease using the Arc GIS. The data were analyzed with the help of Multivariate statistical technique known as 'Factor Analysis' The study has identified that environment parameters played a major role in the health status of Dengue.

Keywords: Epidemiology – Dengue – Socio Economic Environment – GIS- Factor analysis.

1. Introduction

The promotion and protection of the health of people are essential for a sustained economic and social development, thus contributing to a better quality of life. The social value of health care has recently emphasized the ecological approach to human health, as the human system involves constant adjustment to deterioration in the social, biological and physical environment.
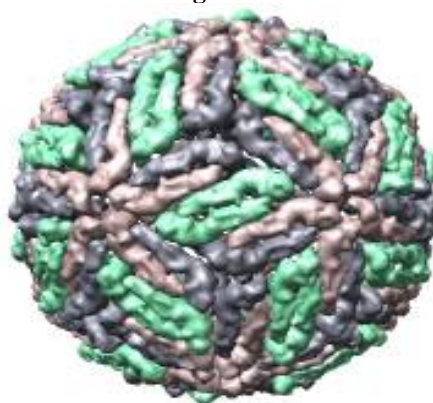
Dengue Virus

Fig 1: Dengue fever virus (DENV) is an RNA virus of the family *Flaviviridae*; genus *Flavivirus*

Dengue fever is an infectious tropical disease caused by the dengue virus (Fig 1). Symptoms include fever, headache, muscle and joint pains, and a characteristic skin rash that is similar to measles. Dengue is a disease caused by any one of four closely related viruses (DEN-1, DEN-2, DEN-3 or DEN-4). The viruses are transmitted to humans by the bite of an infected mosquito (*Aedes aegypti*) Fig 2. *The Aedes aegypti* mosquito is the vector of dengue. As there is no vaccine, prevention is sought by reducing the habitat and the number of mosquitoes and limiting exposure to bites.
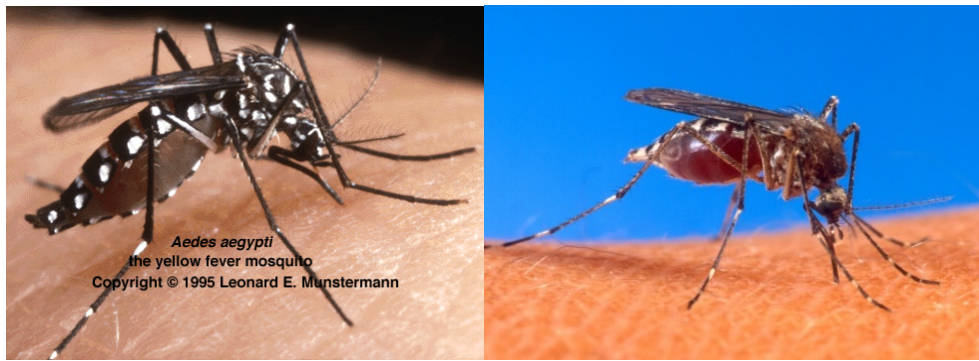
Vector is mosquito belonging to "AEDES"

Fig 2: Aedes aegypti is the main vector of dengue transmission

2. Study Area

The entire Madurai city located in the south central part of Tamil Nadu was chosen as the study area (Map 1). The selection of the study area is to investigate the spatial distribution of Dengue at the micro level in an urban area of Madurai city and to analyze the causal relationships between the distribution of Dengue and its association with socio – economic environmental, behavioral, medical variables.

Madurai is the oldest and the second largest city in Tamil Nadu situated on the bank of river Vaigai in south central part of Tamil Nadu. It is located at $9^0 30'$ and $10^0 30'$ longitudes and between $77^0 00'$ and $78^0 30$ latitude. It is the headquarters of Madurai district.

The maximum and minimum temperatures are 42 ^{0}C and 21^{0}C respectively in the city. The city experiences more rainfall during the northeastern monsoon season, which is in October and November and with occasional showers during the summer months under the influence of southwest monsoon. The average annual rainfall for 2010 is 881.5 mm. The health situation of the area focuses on the deteriorating environmental and socioeconomic conditions.

The object of Medical Geography is to study the geographical environment of human society and its influence on the health of man. In this direction the present study helps to understand how the disease (Dengue) is governed by the Socio-Environment, behavior and medical factors.
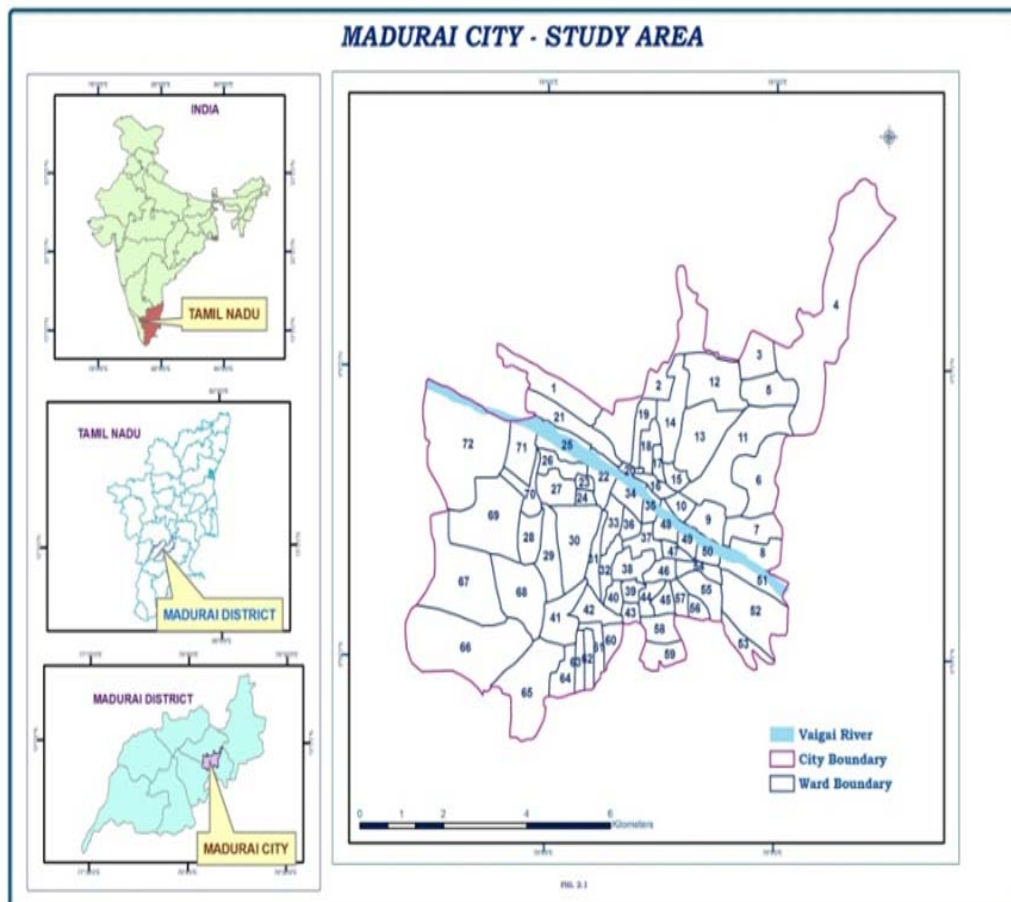
Map 1: Madurai city, the study area is about 8741.73 sq. Km. and it comprises of 72 wards)

3. Objectives
The main objectives of the study
i. To analyze and identification of the endemic area of Dengue in Madurai city
ii. To analyze the spatial and temporal variation of the disease
iii. To analyze the Epidemiological and Ecological aspects of disease variation and associated factors of Dengue

iv. To derive a conceptual framework towards control of the disease

4. Materials and Methods
To fulfill the above objectives, the information was collected from both primary and secondary sources. The most important tool of analysis for geographers is cartographic interpretation and analysis of data with the help of the maps.

4.1 Source of Information
The data collected for the present study are mainly based on the information provided by the government institutions. The collected information includes both primary and secondary sources obtained from the respective offices.

4.1.1 Primary Data
The primary data collected for the purpose of this project was done in the form of the 600 sample questionnaire survey in selected wards of the study area. The patient address was collected from leptospirosis clinic. The data collected is used by the method of stratified Random sampling. The primary data in the present study was based on direct Questionnaire scheduled method.

4.1.2 Secondary Data
The main source of secondary data was available at Leptospirosis clinic (Madurai west zone), the data collected from the above institution are ward wise. Vector borne disease of Madurai profile was collected from the Deputy Directorate of the health department .The rainfall, ward wise population data were collected from Asst. Director of statistics Madurai. The information about vectors was collected from ICMR (Indian Council Medical Research) and Madurai Corporation provided Madurai city map and Dengue endemic area with epidemiological details.

4.2 Techniques Used
To fulfill the above objectives, the information was collected from both primary and secondary sources. By using a stratified random sampling method about 600 samples were collected from the study area with the help of a questionnaire.

The data were analyzed with the help of Multivariate statistical technique known as 'Factor Analysis'. It includes mapping of the disease using the Arc GIS software. Factor analysis is useful technique to explore a content area, structure a domain map of unknown concepts, to Classify or to reduce data, relationships, test hypothesis, formulate theories, control variables or inferences. It also aids to induction and deduction; description and inference; causation, explanation and classification (Rummel, (1970) [1]. Factor analysis has been extensively used in a variety of geographical problems by several scholars (Berry, 1961 [2], Rajmohan (1982) [3] Shanmuganandan (1987) [4], Saravanabavan (1993) [5].
Based on the above said techniques the data structure was designed into 600X 32. A data matrix size of the Dengue M x N (M= Number of Questioner N= Variables) was reduced into a factor solution matrix of (600x11) The 32 x 32 co relation matrix of the present analysis has been reduced into 32 x 11 taking into account the factors with their eigenvalue greater than unity.

5. Results & Discussion
The spatial patterns of Dengue for the year of 2011 were very high when compared with the year of 2010. In areas like Arapalayam, Azhagaradi, Krishnarayar Teppakulam, Jaihindpuram, Solai Alagupuram, Anna Nagar, K.K. Nagar, Pudur the affected rate was in decline in 2011. However, in areas of B.B.Kulam, Mattichiam, Narimedu, Perumal Teppakulam, Anuppanadi, Lurdhu Nagar, Reserve Line, Thathaneri, Ponmeni, Madakulam, Muthuramalingapuram, TVS Nagar, Ellis Nagar, Krishnarayanagar the rate of Dengue increased in 2011. The environmental reason for the increasing attack rate may be due to population explosion in the city, poor drainage facilities, scarcity of water supply, the behavior of the people like storing water in open containers etc.,

5.1 Socioeconomic and Epidemiological Characteristics of Dengue
The socioeconomic and demographic resources and tools are increasingly recognized as relevant to management of vector borne disease. In analyzing the age structure of the respondents, it is observed that 32% of the older age group above 65 is highly affected. The analysis of the distribution of Dengue reveals that there is a high rate among females (60%) while compared to males (40%). The majority of the respondents, 40% have (3000-6000) low income. Poverty is the main reason for infectious disease. This is true here because about 76% of respondents are of low and very low income group; this may be one of the reasons for Dengue in Madurai city.

5.2 Dengue and House Environment
The present study reveals that the dengue cases are found to be high (62%) in Unclean areas which shows greater part of respondents reside in unhygienic surroundings.
Probably the most basic way in which human –vector contact may be managed is via improvements in the placement and construction of housing Rozental (1997) [6]. The study area is a city, due to the population expansion majority of the affected respondents 42% reside in compound houses.

5.3 Patient Living Environment
Housing structure is another important reason for infectious disease Rozental (1997) [6]. The present study clearly showed that dengue attack rate 36% was noticed in the houses with single room About 32% of respondents have 1-2 rooms in their house, 28% of the respondents have 3-4 rooms and 4% of the respondents have above 4 rooms in their house. This shows the reduction in normal living space increases the degree of close contact with vectors, where by disease spreads easily.
The absence of ventilation helps breeding of vectors, 14% of the respondents have very good ventilation facilities, 30% of the respondents have good ventilation, 36% of the respondents have somewhat good ventilation and 20% of the respondents do not have ventilation in their house.
The methods of Waste disposal give the sanitation measure of an area. There is a lack of cleanliness in the surroundings of the houses. Around 32% of the respondents dispose their wastes by indiscriminate throwing and throwing on the street. This shows that 32% of them give shelter for mosquitoes.
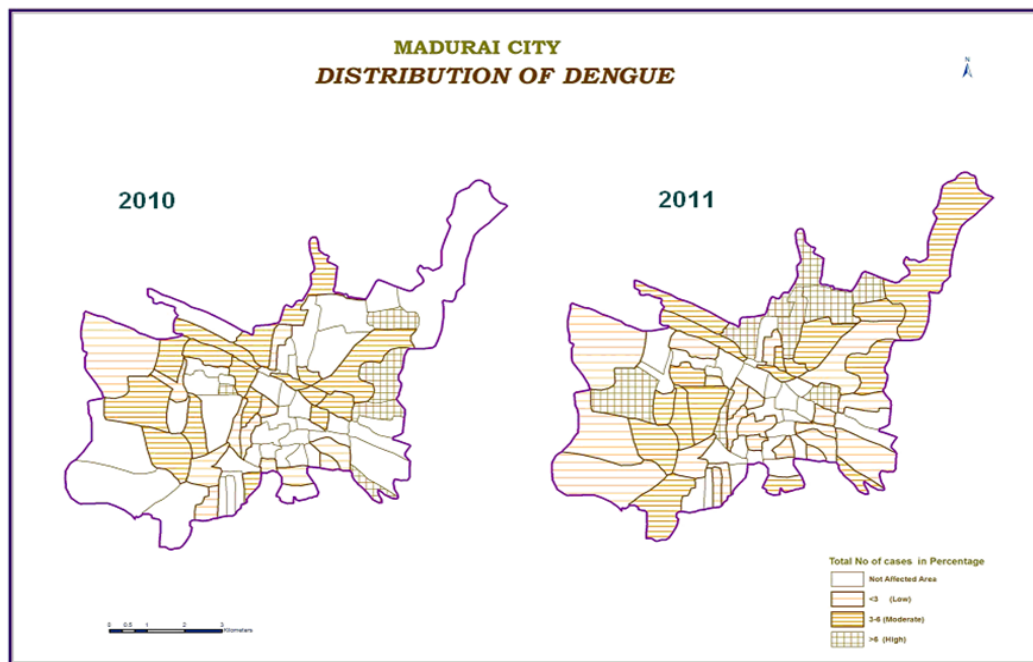
Map 2: The map shows the spatial distribution of dengue in Madurai city for the year 2010 & 2011.

5.4 Health Measures and Related Aspects

In analyzing the treatment period of the dengue patients it shows the severity of the disease. Among 18% of the respondents took treatment for less than 1 week. The majority of the respondents, about 68% of them took treatment for 1 week. 18% of the respondents took treatment for 1 month.

The study of consumption of medicine also shows the severity of the disease. In sampling survey about 18% of people took medicine for less than 1 week, 66% of respondents took medicine for 1week, 16% of the respondents took medicine for 1 month. There are no specific drugs to cure the disease. Treatment is directed primarily at relieving the symptoms, including joint pain. There is no commercial dengue vaccine.

In a sample survey, about 48% of respondents had the opinion that they have a progress of treatment. About 52% of the respondents had the opinion that they have no progress of treatment because they still suffer from joint pain and fever.

5.5 Characteristics of Dengue and Utilization of Water

Storing water for a long period of time gives opportunity for infectious disease like dengue, malaria, Chikungunya etc., In this perspective the survey analyze the duration of getting water in dengue patient homes. The majority of the people 50% of them regularly use the water, 30% of the respondents get water twice a week, 20% of the respondents get water for once in a week. People using lots of water containers for storing water give more opportunities for breeding of mosquitoes and higher the vector abundance. About 52% of the affected people use more than 10 water containers to store water and these containers are not in good condition.

Most of the containers are broken, open, very old containers. 20% of the respondents stored water in eight water containers, 10% of them use six, 10% of them use four, and 8% of the respondents use only two water containers. The condition of water container is the main determinants of vector population. Unused and unprotected outdoor water containers in shaded areas were in the highest of pupal production (McCall, 2006, [7] Molyneux, 2003 [8], Rozental 1997 [6]). Dengue patient in Madurai city had used broken, old, open containers to store water. About 38% of the respondents temporarily closed their

water container, 36% of respondents have broken old water containers, 22% tightly closed their water container, 4% of the respondents used open water containers.

People living in the city usually use the stored water. About 16% of the respondents use the water which is stored for more than six days, 34% of the respondents use 3-4 days stored water, 40% of the respondents use 1-3 days stored water, Only 10% of the respondents clear their containers regularly and change their water for bathing and cleaning purposes, This shows that 90% of the respondents used stored water.

Dengue patients used different types of water containers like Mud pot, Silver, Plastic, and Cement containers. In 2009 The Madurai Corporation held a survey on Dengue affected areas in Madurai city. Public health officers visited every area and advised people to destroy the Cement and broken containers which are the main birthplace of *Aedes* mosquitos. In the sampling survey, 18% used cement containers. In the study area, cement containers were found outside the patients' houses or near the patients' neighboring houses.

5.6 Season variation

The season is a major factor in determining, the geographical and temporal distribution of arthropods. About 48% of the disease, infection spread in on the month of September – November, the rainy season, 24% of the dengue cases are reported in the months of December- February. 16% of the people were affected during June-August month 12% of the respondents were affected in Mar-May, the hot season. This shows that the disease transmission is increased from hot to cool season.

5.7 Patient Attitude

At the end of sampling survey people attitude about covered water is perceived. Most of the people 70% are of the opinion that it is not easy to do that any time. About 20% of the respondents are of the opinion that it is unnecessary, and 4% of the respondents have knowledge about infectious disease and they are of the opinion that covered water protects them from disease.

6. Ecological Dimensions of Dengue

The factor analysis, a well-known technique was used in the present study to identify the ecological analysis of dengue in Madurai city. The 32 x 32 co-relation matrix of the present analysis has been reduced into 27 x 11 taking into account the factors with their eigen value greater than unity.

Table 1: Factor Solution: The Eigen Values and the total Percentage of Variance Explained by Each of the Eleven Factors

Factor	Name of the dimension	Eigen value	Percentage Variance	Cumulative Percentage
I	Behaviour and disease Transmission	3.34	12.49	12.49
II	Breeding habitat & spread of disease	2.56	9.45	21.95
III	Seasonal Transmission	2.33	8.65	30.61
IV	Treatment &Ecological Causes	2.22	8.23	38.84
V	Knowledge of mosquito bites	1.90	7.00	45.85
VI	Health status and Ignorance of people	1.70	6.24	52.10
VII	Precaution Measures and treatment	1.60	6.00	58.09
VIII	Treatment utilization	1.45	5.40	63.47
IX	Cost of Treatment	1.32	4.90	68.36
X	Demographic structure	1.20	4.47	72.82
XI	Causes of housing construction	1.14	4.20	77.05

Source: Compiled by the computer

6.1 Dimension I: Behavior and Disease Transmission

Nine variables were found to be significant in explaining the first dimension. The first dimension and the variables loaded in the dimension explained the behavior of people such as using lots of water containers in houses, storing water for a long duration, and less consumption of protected water are the main causes for Spread of disease. The disease duration and the transmission of disease through other members of the family is controlled by taking treatment and regular drugs. After taking treatment the patients cannot completely recover as it affects the joints of the body. The disease transmission is very high in the rainy season. People's behavior is the main cause for disease transmission in this dimension, so this dimension is named as "Behavior and disease transmission".

Table 2: Behaviors and Disease Transmission

Variable Number	Name of the variables	Factor loading
3	Suffer from disease in Family members	-0.56
4	Disease duration	- 0.52
5	Affected part of Disease	0.57
9	Duration of treatment	0.48
10	Duration of taking drug	0.53
13	Water stored in open container	0.47
14	Number of containers in house	0.54
24	Season	0.42
26	Consumption of protected water	-0.55
Eigen value =3.34	Percentage of Trace= 12.49	

6.2 Dimension: Ii Breeding Habitat and Spread of Disease

The second dimension is an important factor that highlights the Breeding habitats and the spread of disease. This factor contains 7 variables. The high positive loadings on water stored in open container shows the major breeding site of mosquitoes and Spread of disease and prolonged the duration of dengue (0.53) Water stored in ("no coverage" or "partial coverage") have high pupal/larval infestation rates (Pandian 2006) [9]. The congested housing construction is another important factor for breeding of mosquitoes. This breeding site helps in disease transmission for all age groups (-0.54). More breeding sites in the city lead to increase in the spread of disease, so this dimension is named as breeding sites and spread of disease.

6.3 Dimension: Iii Seasonal Infection

This factor contains 5 variables with positive and negative loadings explaining as much as 8.65 percent of the total variance with an Eigenvalue of 2.33. The high positive loadings were seen in suffer from disease family members (0.56) the duration of dengue (0.53), Utilization of health center (0.48),Rainy Season (0.45) The highest negative loading is seen in Age (-0.52). The high positive variable is suffer from disease family members In Dengue patient's home,

the transmission is very high in the monsoon month (Arunachalam *et al*., 2010 [10]). In this dimension, season is an important factor that increases the rate of infection

6.4 Dimension: IV Ecological Causes and Treatment

The fourth dimension highlights the ecological causes and treatment. This factor contains as much as 6 Variables with positive and negative loadings explaining as much as 8.2 percent of total variance with an eigen value 2.2. High positive loading were seen in the duration of taking treatment (0.92), Waste disposal (0.63) and no progress of Treatment (0.42) and negative factor loading are living environment (-0.57) housing construction (-0.46) and number of containers (-0.44).

In this dimension the variables explain environmental pollution, such as less quality of living environment like slum inhabitant, congested housing construction, using number of water containers. In Madurai city most of the slums are located near the railway line, Bus stand and near the sewage. These are the camp of vector habitats, the carrying capacity of the environment for vector populations and infectious disease transmission (Mani and Arunachalam 2005 [11]). Another important environmental factor is waste disposal. People living in urban areas throw their waste, mostly by indiscriminate throwing on the street, etc. This leads to environmental pollution that shelter *Aedes* mosquitoes and cause disease transmission. People who live in this kind of environment are of the opinion of no progress of treatment because they suffer from joint pain, muscle pain, fatigue etc., and they are taking treatment for long duration of 1week to 1month and in some cases the duration of taking treatment lasts for 1 year. The increasing ecological pollution leads to decreasing progress of treatment.

6.5 Dimension: V Knowledge about Mosquito Bites

The fifth dimension highlights the knowledge of mosquito bites. This factor contains as much as 4 Variables with positive and negative loadings explaining as much as 7.0 percent of total variance with an eigenvalue 1.90. High positive loading were seen in Suffer from disease family members (0.56) and Utilization of health center (0.42). Negative loadings were seen in Condition of water container (-0.53) and Using mosquito repellents (-0.48). These variables explain the knowledge of people about mosquito bites. People utilizing health center (0.42), the disease infected to other family members (0.56). are the causes of people not taking action against mosquitoes. People give opportunity for Mosquito breeding in the way of using broken, old, cement, iron drums, food tins, large uncovered jars etc., to store water. This condition of water containers helps *Aedes aegypti* mosquitoes to deposit their eggs. The other important factor is that the majority of the people does not use mosquito repellents. This dimension clearly explains that people give opportunity to mosquito breeding and they do not take action to control the Mosquitoes. This dimension proved that the Knowledge of Mosquitoes is very low among people.

6.6 Dimension: VI Health Status and Ignorance of People

The sixth dimension highlights the health status and ignorance of people. This factor contains as much as 4 Variables with positive and negative loadings explaining as much as 6.24 percent of total variance with an eigenvalue of 1.7. The high positive loadings were seen in Migration (0.52), Education (0.48). Utilization of health center (0.57) and the negative loadings are seen in People attitude toward protected water (-

0.78).This dimension explains that the ignorance of people toward protected water is the main cause of disease transmission. The majority of the people are of the opinion that water protection is must for drinking water only and water stored for other purpose need not be properly protected because it is unnecessary. Most of the opinions come from uneducated people and most of them migrated from rural to city, and the majority of them utilized health center to cure the disease. This dimension explains the ignorance of people towards protected water, which leads to ill health.

6.7 Dimension: VII Precaution Measures

The seventh dimension highlights the Precaution measures. This factor contains as much as 4 Variables with positive and negative loadings explaining as much as 6.00 percent of total variance with an Eigenvalue 1.6. The high positive loadings were seen in Waste disposal (0.78). Precaution measures are not followed by the people. People do not dispose their waste in the correct manner, which is the main reason in determining disease infection.

6.8 Dimension: VII Treatment Utilization

The eighth dimension highlights the Treatment Utilization. This factor contains as much as 4 Variables with positive and negative loadings explaining as much as 5.40 percent of total variance with an Eigenvalue 1.45.The positive loadings are seen in Sex (0.43), Duration of Dengue (0.66), Utilization of Health center (0.68), Housing construction (0.51). The negative loadings were seen in Source of drinking water (-0.48). Mostly females are affected than males.

6.9 Dimension: IX Cost of Treatment

The ninth dimension highlights the cost of Treatment. This factor contains as many as 3 variables with positive and negative loadings explaining as much as 4.9 percent of total variance with an eigenvalue1.3. The positive loadings were seen in the cost of treatment (0.44), the affected part of the body (0.42). After recovering from a severe fever, it affects different parts of the body. The majority of the people suffer from severe joint pain, muscle pain and some of them have problems with their visibility. These problems are not immediately cured. The cost of treatment is determined by the type of illness.

6.10 Dimension: X Demographic Structure

This factor contains as much as 6 Variables with positive and negative loadings explaining as much as 4.5 percent of total variance with an eigenvalue 1.2. The high positive loading was seen in Housing Construction (0.81), age (0.77), migration (0.54), sex (0.51) consumption of water at the travel (0.44). The Negative loading was seen in duration of using the stored water (-0.57). Rapid migration from rural to urban, urban to urban leads to congested housing construction in the urban area. The rural people attracted by the urban way of living migrate to the city, The result of such process increases severe disease outbreaks in human population, particularly the attack rate were high among (0-14 and above 64) the young and the old age group. The disease mostly affects the females than the males. Urbanization creates new pressure on the ecosystem that, in turn, have a profound impact of vector habitats, the carrying capacity of the environment for vector population and infectious disease transmission (Getis A Morrison 2003) [12].

6.11 Dimension: Xi Causes Of Housing Construction

The last dimension highlights the housing construction. This factor contains as many as 6 variables with positive and

negative loadings explaining as much as 4.22 percent of total variance with an eigenvalue 1.14. In this dimension positive loadings were seen in utilization of health center (0.58), types of houses (0.93). The Negative loading was seen in housing construction (0.42). In Madurai city majority of Dengue affected areas have congested housing construction. People live in apartments, Compounds and the majority of these houses have tiled roofs, poor walls and they have totally unclean condition and the surroundings are also unclean. Most of the houses are surrounded by sewage and have only one room. Thickly populated and closely constructed houses in urban areas get more mosquito bites Pandian and Chandrasekharan (1980) [12]. Vectors live directly in poor walls of poor houses, including concrete floors, plaster and brick walls, and tiled roofs (Nathan *et al*. 2006) [13].

7. Conclusion
In this context the present study forms a new frontier for social research of health care study. The following are the hypotheses constructed to fulfill the objectives:

1. The placement and construction of housing settlements is the most basic way in which human- vector contact.

2. Social and behavioral resources and tools are therefore increasingly recognized as relevant to the management of vector –borne disease.

3. Uneducated and household water containers are the main determinants of infectious disease.

4. There is a strong link between overall social well -being and disease impact. In particular improved awareness of hygiene and sanitation, particularly among women may be important in reducing infectious disease among children.

5. Climatic condition is the main determinant for the re-emergence of Dengue.

6. Increasing or decreasing the rate of Dengue depends upon the type of living environment.

The health care delivery systems are a un- avoidable part in the modern society. The health care of the people is mainly concerned with the differences in environmental and way of life in various geographical areas.

8. References
1. Rummel RJ. Applied Factor analysis, North Western University Press, Evanston 56:551-569.
2. Berry BJL. A method for deriving Multi-Factors uniform Region Puzegl. Geographers, 1961.
3. Rajmohan A. The Hierarchical organization and structural pattern of Urban centres; A Multivariate approach. Transactions of Institute of Indian Geographers 1982; 4(1).
4. Shanmuganandan S. Ecological structure and spatial pattern of Primary Health care system in Madurai District (Tamil Nadu). Ph.D Thesis, Department of Geography, Madurai Kamaraj University, Madurai, 1987.
5. Saravanabavan V. Leprosy and Multidrug therapy in Tamil Nadu, India: A Factor Analysis. Published in The Indian Geographical Journal 1998; 73(1):41-50. ISSN.NO 0019-4824
6. Rozental A. Vector Control methods used by individuals and communities. Geneva: World Health Organization 1997; 119-20.
7. McCall P *et al.* control of dengue vectors: tools and strategies: Report of the Scientific working group on Dengue. Geneva: World Health Organization, 2006.
8. Molyneux D. Lymphatic Filariasis (Elephantiasis) Elimination: A public health success and Development opportunity. Filariya Journal 2003; 2:13.
9. Pandian RS. Distribution pattern of mosquito in on urban "International symposium Vector and Vector-borne diseases, organized by CRME (ICMR) Madurai, Tamil Nadu, India, N.VBDC Delhi & NA Delhi, 2006, 176.
10. Arunachalam *et al.* BULL, World Health Organ, 2010, 88.000-000,doi 10-2471/BLT 09.067892 PP 1-10
11. Mani TR, Arunachalam N. Efficacy of thermal fog application of deltoid, a dynergized mixture of opyrethroids against *Aedes aegypti*, the vector od dengue. Tropical Med Int Health, 2005; 10PMID 16359411.
12. Getis AMAC. Characteristics of the spatial pattern of the dengue vector *Aedes aegypt* in lquitos, Peru. American Journal of Tropical Medicine Hyg 2003; 69 494-505.
13. Nathan MB *et al*. Recent epidemiological trends, the global strategy and public health advances in dengue: Report of the Scientific working Group on Dengue: Geneva: World Health Organization, 2006.