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Spatial Distribution of Emerging Diseases in Madurai District: A Geo Medical Study

C.Vinothini, RUSA
II Research Assistant
Department of Geography
Madurai Kamaraj University
Madurai -625 021, Tamilnadu

V.Saravanabavan, RUSA
II Principle Investigator, Assistant Professor
Department of Geography
Madurai Kamaraj University
Madurai -625 021, Tamilnadu

Abstract:- Health services are essentially social services. It is one of the many services system that has emerged to facilitate of individual as well as social goals .An emerging infectious disease (EID) is an infectious disease whose incidence has increased recently (in the past 20 years), and could increase in the near future.Madurai district in Tamilnadu is selected for the present study. Madurai district is located in the central part of southern Tamilnadu of India. Madurai district is at 9º 30´ and 10 º 50´ of North Latitude and from 77 º 00´ to 78 º 30´ of East longitude. The total geographical area is 384,680 hectares. The total population is about 3038252 as per 2011 census. The main objectives of the study area. To Identify the Emerging disease in Madurai district. b. To analyze the spatial distribution of emerging disease in Madurai district. The data collected were taken using the method of Stratified random sampling based on total number of patients on both age and sex, and a total of 260 samples were drawn in the year2021. For the purpose of this project two important techniques used in the present study are statistical techniques and GIS cartographic interpretation. A Z- score is a statistical measurement of a scores relationship to the mean in a group of score. It is important to identify that certain areas and people which exhibit health disease and these must react to the responses of physical and social environments. The help of Z score matrix, which is derived by using SPSS.10 statistical package.

Keywords:- *EID, PHC, Z score, Ranking techniques, SPSS-GIS.*

I. INTRODUCTION

Health services are essentially social services. It is one of the many services system that has emerged to facilitate of individual as well as social goals [1].An emerging infectious disease (EID) is an infectious disease whose incidence has increased recently (in the past 20 years), and could increase in the near future[2][3]. The minority that are capable of developing efficient transmission between humans can become major public and global concerns as potential causes of epidemics or pandemics[4]. Their many impacts can be economic and societal, as well as clinical.[5] . For every decade since 1940, there has been a consistent increase in the number of EID events from wildlife-related zoonosis. Human activity is the primary driver of this increase, with loss of biodiversity a leading mechanism.[6]Many EID are zoonotic, deriving from pathogens present in animals, with only occasional cross-species transmission into human populations.[7] For instance, most emergent viruses are zoonotic whereas other novel viruses may have been circulating in the species without being recognized, as occurred with hepatitis [8].

They are creating new habitat and breeding sites for disease vectors that, in many cases, favor disease transmission [9, 10]. Land use and land cover changes have significant health environmental consequences at local, regional, and global scales.[11] These changes have intense implications at the regional and global scales for global loss of biodiversity, distresses in hydrological cycles, increase in soil erosion, and sediment loads [12]. It lurks in lowlands where mosquito breed and sting, to convey the parasitic agent of the disease plasmodium.Land-use change is a globally significant driver of pandemics and caused the emergence of more than 30% of new diseases reported [13, 14]. Land-use change includes deforestation, human settlement in primarily wildlife habitat, the growth of crop and livestock production, health infrastructure and urbanization [15, 16, 17]. Human activity is dramatically changing the global landscape.[18,19] These changes in land use and cover are, in turn, altering the dynamics of infectious disease transmission in numerous ways [20, 21, 22].

Humans impact the physical environment in many ways: overpopulation, pollution, burning fossil fuels, and deforestation. Changes like these have triggered climate change, soil erosion, poor air quality, and undrinkable water [23]. Agricultural expansion and other types of human activity could put humans at greater risk of infection disease outbreaks.[24]. Large amount of substance abuse also an important cause to the increasing number of mental disorder [25].

These changes in land use and cover are, in turn, altering the dynamics of infectious disease transmission in numerous ways. They are creating new habitat and breeding sites for disease vectors that, in many cases, favour disease transmission. Thus, economic development and public health interventions and not climate change appear to have been the primary drivers of the incidence of these vector- [26,27,28]. The promotion and protection of health people is essential for sustained economic and social developments, thus contributing for a better, quality of life.[29].

The development in health condition and in the field of health studies is essential for the sustainable economic and social development, thus increasing the life expectancy and the health condition of the people [30]. Tamil nadu was highly affected by COVIDI-19 in the 220. The major reasons are high population density, unaware of disease and not

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following the COVID-19 protocols from health department [31]. Vector borne diseases constitute an important cause of death, disease burden and health inequity, a brake on socioeconomic development, and a strain on health services [32, 33, 34]. Continued progress in controlling these diseases is therefore an important contribution to global health, development and security. Vector-borne diseases are spread by insects (such as mosquitoes) [35, 36,37].

II. STUDY AREA

Madurai district is located in the central part of southern Tamilnadu of India. Madurai district is at 9º 30´ and 10 º 50´ of North Latitude and from 77 º 00´ to 78 º 30´ of East longitude. (Fig 1). The total geographical area is 384,680 hectares. The total population is about 3038252 as per 2011 census. Madurai district in Tamilnadu is selected for the present study. This district is a combination of urban and rural cultural region. It has 11 talks , 13 blocks and 665 revenue villages.

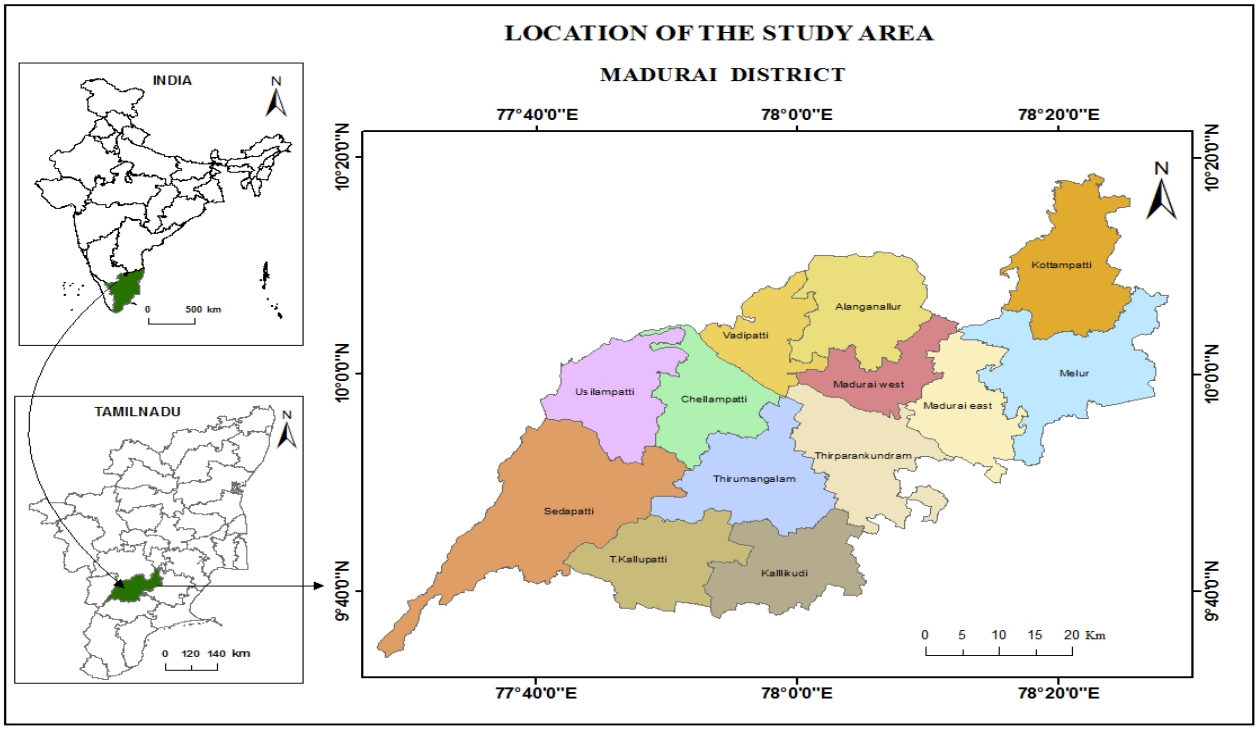

Fig. 1: Location of Study Area

A. *OBJECTIVES*

The main objectives of the study are

- To Identify the Emerging disease in Madurai district.
- To analyze the spatial distribution of emerging disease in Madurai district.

III. METHODOLOGY

To fulfill the above objectives, the information has been collected from both Primary and Secondary sources. The most important tool of analysis is the cartographic interpretation and analysis of data with the help of GIS maps. The Primary data collection for the purpose of this study was done in the form of Questionnaire survey in selected four major health centers of the study area based on Stratified random sampling procedure.

A. *Techniques used*

The primary survey conducted was based on the method of stratified random sampling and a total of 260 samples were collected. Apart from this the Z score statistical techniques is used to identified the statistical associations between diseases, socio-economic characteristics, and health –care and transportation variables, among the patients.

A Z- score is a statistical measurement of a scores relationship to the mean in a group of score. A Z- score 0 means the score is same as mean. A Z- score be positive or negative, indicating whether it is above or below the mean and by how many standard deviation. Standard score (Z-score) technique, one of the methods of scale transmission is used to synthesize the relationship between the sets of variables and this enables to bring out the exposition of total conditions of selected environmental variables with the disease incident rate. It is important to identify that certain areas and people which exhibit health disease and these must react to the responses of physical and social environments. The help of Z score matrix, which is derived by using SPSS.10 statistical package.

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IV. RESULT AND DISCUSSION

- **Z score analysis of spatial distribution of Emerging disease in Madurai district**

A. Dengue

Dengue is a viral disease spread by Andes Mosquitoes the Bites in day time. A mosquito- borne viral disease occurring in tropical and subtropical areas.Figure 2 shows the spatial distribution of Dengue .Mostly affected blocks are very high (>0.50) Alanganalur,T.Vadipatti , Madurai East,Madurai west . Moderate (-0.50-0.50) Level cases of blocks are Kottampatti, Melur,Kalikudi,Thirumangalam, Thiruparan gundram,T.Kallupatti,Chellampatti, Usilampatti, Sedapatti, are low(-1.00- -0.50) and very low (<-1.00) level of dengue affected blocks in Madurai district.

B. Cholera disease

Cholera is a bacterial disease usually speed through contaminated water. Figure 3 shows the spatial distribution of Cholera. Very highly (>0.50) affected blocks are Madurai east , Alanganallur , T.Vadipatti , Madurai west , Medium(-0.50-0.50) affected blocks one Kalli kudi,Thirumangalam, Chellampatti , Usilampatti , Kottampatti, Melur , and low(-1.00- -0.50) and very low(<-1.00) level of affected are T.Kallipatti, Sedapatti , Thiruparangundram , in Madurai district.

C. Malaria

Malaria is a mosquito born disease. A disease caused by plasmodium parasite, transmitted by the bite of infected mosquitoes. Figure 4 shows the spatial distribution of Malaria.Very high(>0.50) and moderate(-0.50-0.50) affected blocks are Madurai east , Maduari west , Usilampatti, Chellampatti , Alanganallur , T Vadipatti , Kottampatti . Low(-1.00- -0.50) and very low (<-1.00) of cases affected blocks are Melur , Kallikudi , T.Kallupatti , Thirumangalam , Thiruparangundram in the Madurai district.

D. Leptospriya

A bacterial disease spread through the urine of infected animals. Humans can get leptospirosis through direct contact with urine from infected animals or through water, soil, or food contaminated with their urine. It's most common in warm climatesFigure 5 shows the spatial distribution of Liptospirosis.Very high (>0.50) affected blocks are Madurai east , Madurai west, Alanganallur , T.Vadipatti . Medium(-0.50-0.50) affected blocks are Thiruparangundram , Thirumangalam , Chellampatti, Usilampatti , Sedapatti , T.Kallupatti , the low(-1.00- -0.50) and level and very low(<-1.00) of cases are Kallikudi , Kottampatti, Melur , in Madurai district.

E. Chikengunya

A viral infection transmitted by mosquitoes. The common symptoms of infection are fever and joint pain. Figure 6 shows the spatial distribution ofChikengunya. Very highly (>0.50) found in T.Vadipatti , Alanganalur , Usilampatti and Medium (-0.50-0.50) level of cases are Kottampatti , Melur .Low level(-1.00- -0.50) and very low (<-1.00) of cases in Madurai east , Madurai west , chellampatti , Sedapatti in Madurai district.

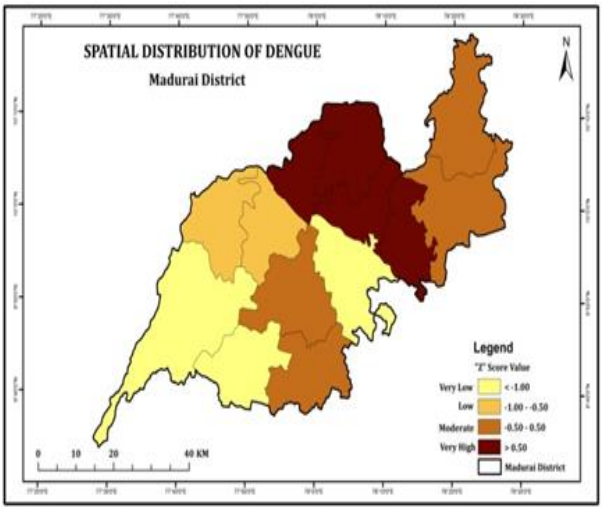

Fig. 2: Distribution of Dengue

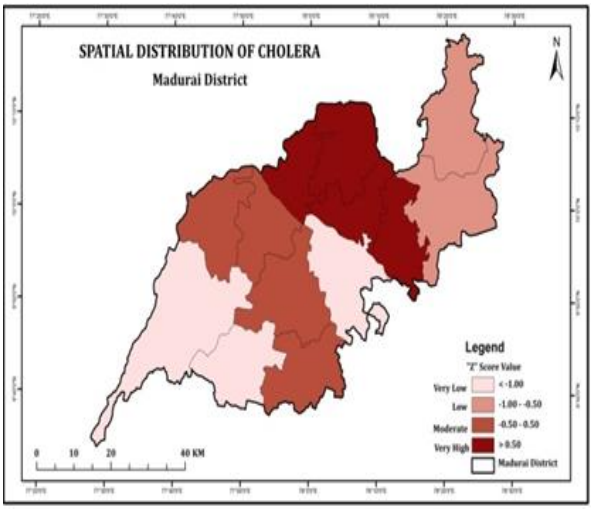

Fig. 3: Distribution of Cholera disease

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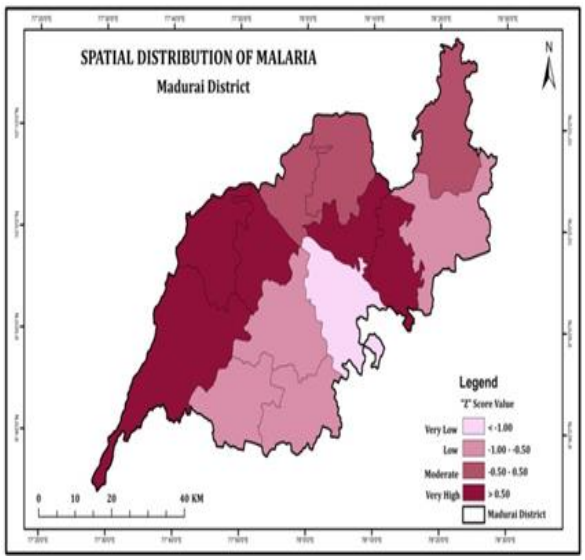

Fig. 4: Distribution of Malaria

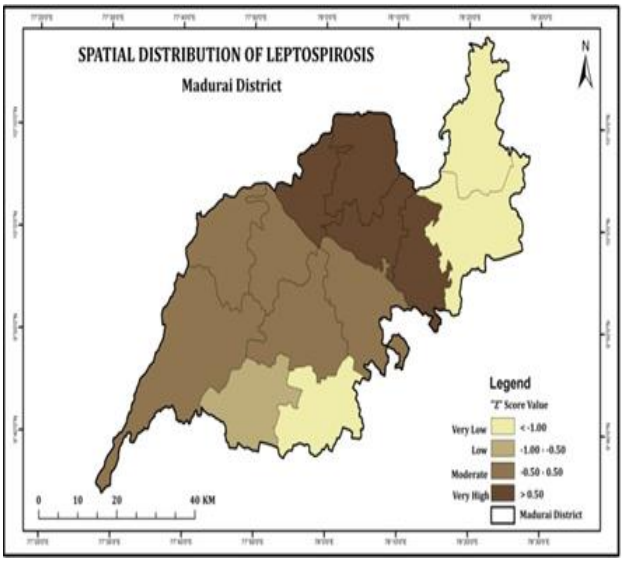

Fig. 5: Distribution of Leptospriya

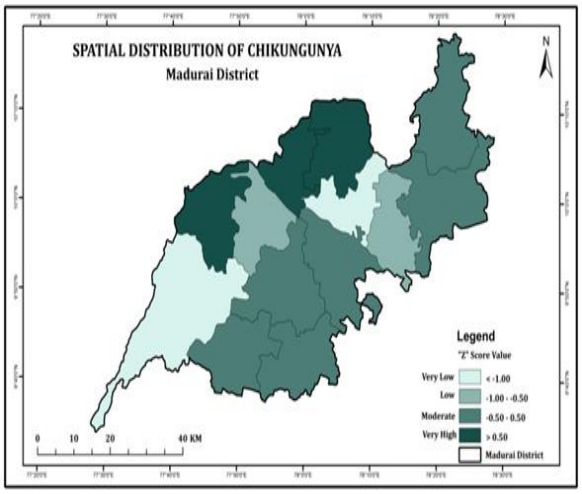

Fig. 6: Distribution of Chikengunya

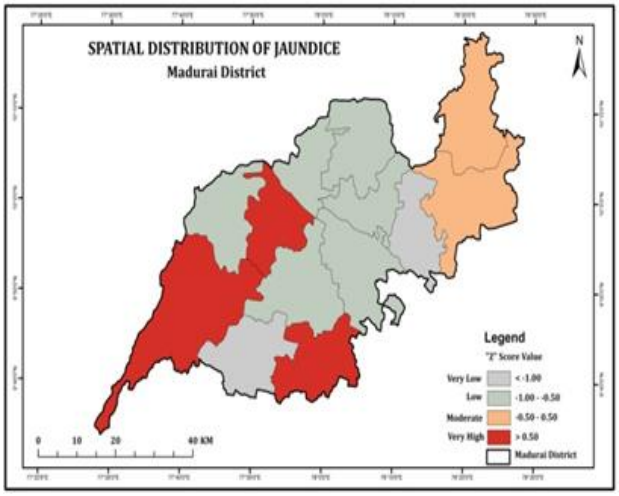

Fig. 7: Distribution of Jaundice disease

F. Jaundice disease

Jaundice may occur if the liver cant efficiently process red blood cells as the break down. At other ages it may signal infection or liver. Figure 7 shows the spatial distribution of Jaundice disease. A Very high(>0.50) to medium level(-0.50-0.50) of jaundice disease found in blocks namely Melur , Madurai west , Alanganalur , T.Vadipatti , Kottampatti , Thirumangalam , Chellampatti , Usilampatti , Sedapatti , and low level (-1.00- -0.50) and very low (<-1.00) of cases in Madurai east , T.Kallupatti , in Madurai district.

G. Pregnancy induced hyper tension

Preeclampsia happens when a women who previously had normal blood pressure suddenly develops high blood pressure, and protein in her urine or other problems after 20 weeks of pregnancy. Figure 8 shows the spatial distribution of Pregnancy induced hyper tension. High (>0.50) and medium level(-0.50-0.50) of cases in Madurai east , Madurai west, T.Vadipatti , kottampatti ,Melur , Kallikudi , T. Kallupatti , Chellampatti , Usilampatti , Sedapatti , Alanganallur , and low level (-1.00- -0.50) and very low (<-1.00) of cases are Thiruparangunram , Thirumangalan , Madurai district.

H. ENT (Ear, Nose, Throat)

Ear, Nose, Throat infections are often caused by bacteria and viruses. Any part of the ears, nose and throat can be affected by many of the same viruses and bacteria, however, certain types of infection are more likely to happen in different areas and the symptoms can be a little bit different, depending on exactly where the infection is located. Figure 9 shows the spatial distribution of ENT (Ear, Nose, Throat). Highly(>0.50) affected cases are Madurai east , Melur , Kallikudi , and Medium(-1.50-1.50) level of cases are Madurai west , Alanganallur , T.Vadipatti , Kottampatti , Chellampatti , Usilampatti , Sedapatti , Low (<-1.50) level of cases in Thirumangalam.

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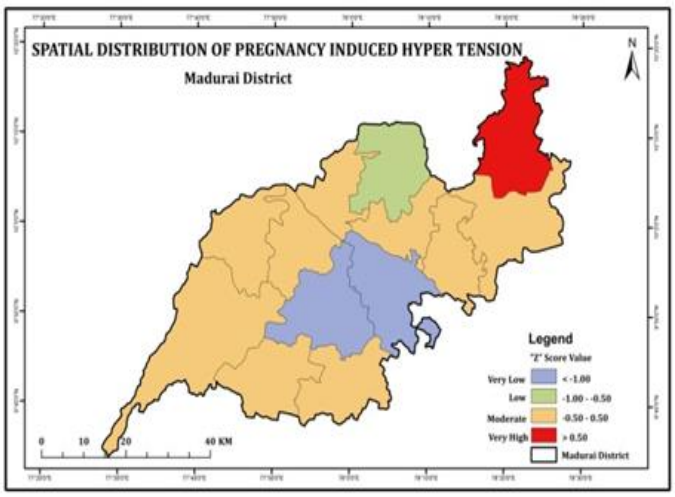


Fig. 8: Distribution of Pregnancy induced hyper tension

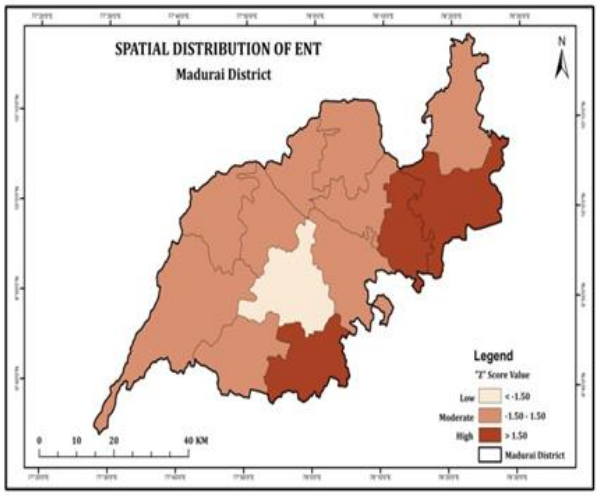
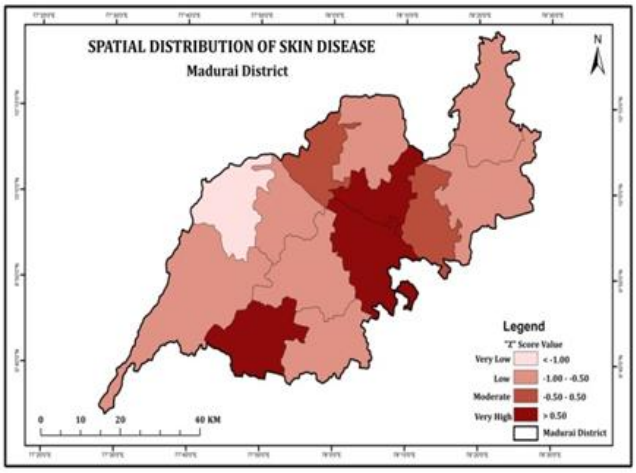


Fig. 9: Distribution of ENT



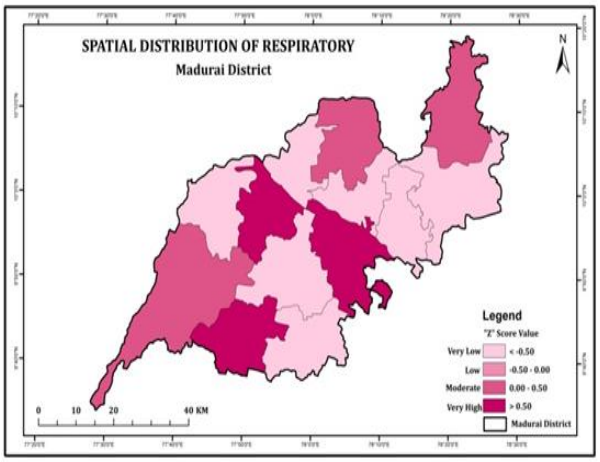


Fig. 10: Distribution of Skin disease Fig. 11: Distribution of Respirators

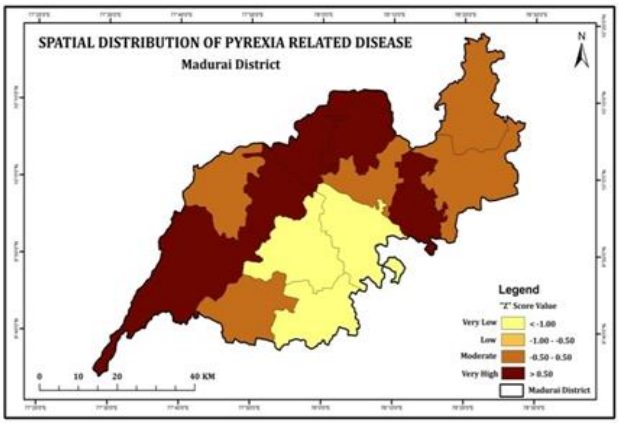


Fig. 12: Distribution of Pyrexia

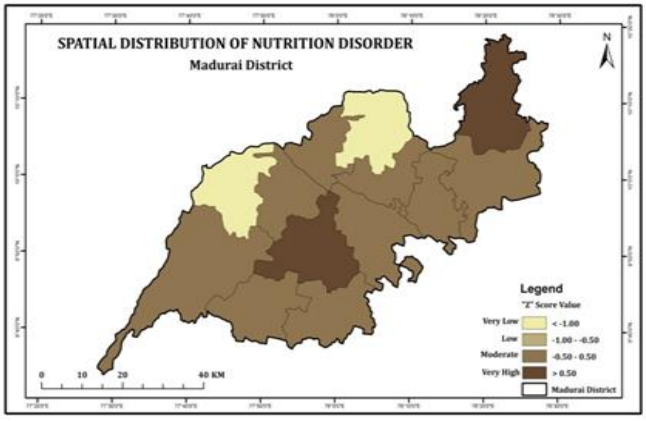


Fig. 13: Distribution of Nutrition disorder

I. Skin disease

Some of the most common skin diseases include, Acne, blocked skin follicles that lead to oil, bacteria and dead skin buildup in your pores Atopic dermatitis (eszema), dry , itchy, skin that lead to swelling, cracking or scaliness. Figure 10 shows the spatial distribution of Skin disease. A Very high (>0.50) and medium level(-0.50-0.50) of skin disease found in blocks namely Madurai east , Madurai west, Alanganallur, T.Vadipatti, Kottampatti, Melur, Thiruparangundram, Kallikudi, T.Kallupatti, Thirumangalam, Chellampatti ,Sedapatti and low level (-1.00- -0.50) and very low (<-1.00) of cases in Usilampatti block.

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J. Respirators

In the study of respiratory disease in known as pulmonology. In this disease include ashma, chronic obstructive pulmonary disease (COPD), pulmonary fibrosis, pneumonia, and lung cancer. The environment conditions association with air pollution causes damage to the lungs. The process of industrialization and exhaust fumas from mills and factories pollute the atmosphere. Figure 11 shows the spatial distribution ofRespirators**.** Veryhigh(>0.50) and medium level(-0.00-0.50)of cases are Alanganalur,Maduraiwest,T.Vadipatti,Kottampatti,Melur,Thiruprangundram,Kallikudi,T.Kallupatti,Thirumangalm,Chellampatti ,Usilampatti, Sedapatti, low(-0.50-0.00) and very low(<-1.50) level of cases in Madurai district.

K. Pyrexia related disease

Pyrexia, also known as fever, is an increase in the body temperature of an individual beyond the normal range this increase in temperate is usually considered dangerous, but it is a natural defensive mechanism, of the body to fight against infection. Figure 12 shows the spatial distribution ofPyrexia related disease. Very high(>0.50) and medium level(-0.50-0.50) of affected blocks are Madurai east, Alanganalur, Madurai west , T.Vadipatti, Kottampatti, Melur, T.Kallupatti , Chellampatti, Usilampatti, Sedapatti, and low level (-1.00- -0.50) and very low (<-1.00) of cases in Thirumangalm , Kallikudi, Thiruparangundram, in Madurai district

L. Nutrition disorder

Nutritional disease, any of the nutrient-related disease and condition that cause illness in humans. They may include deficies or excesses in the diet, obesity and eating disorders, and chronic disease such as cardiovascular disease, hypertension, cancer, and diabetes mellitus. A high and medium level of Nutrition disorder disease .Figure 13 shows the spatial distribution ofNutrition disorder. Very high(>0.50) and medium level (-0.50-0.50) of affected blocks namely, Alanganalur, Madurai east , Madurai west, Madurai west, T.Vadipatti, Kottampatti, Melur, Thiruparangundram, Kallikudi, T.Kallupatti, Chellampatti Usilampatti, Sedapatti, and low(-1.00- -0.50) and very low (<-1.00) level of cases found in Thirumangalm ,Thiruparangundram.

M. Ophtholmic disease

Ophtholmic (eye dis-or-des) diseases a neoplastic or neoplastic disorder that affects the eye Representation examples include conjunctive, glaucoma, cataract conjunctional squamous cell carcinoma, uveal melanoma, and retinoblastoma. Figure 14 shows the spatial distribution ofOphtholmic disease. Very (>0.50) high level and moderate level (-0.50-0.50) of cases in Madurai east , Madurai west , Alanganalur, T.Vadipatti , Kottampatti, Thiruparangundram, Kallikudi, T.Kallupatti, Chellampatti, Usilampatti, Sedapatti, low level(-1.00- -0.50) and very low (<-1.00) of cases are Melur , Thirumangalam in Madurai district.

N. Dental disease

Our months host millions of bacterial cells; some are beneficial, while others can be very harmful. A bacterium is only one cause of the many oral diseases that can affect the different areas of our mouths. . Figure 15 shows the spatial distribution ofDental disease. Very high (>0.50) and medium level(-0.50-0.50) of Dental diseases affected blocks namely Madurai east ,Madurai west , T.vadipatti Kottampatti, Melur, Tiruparangundram, Kallikudi, T. Kallupatti, Thirumangala,Chellampatti , Sedapatti. Low(-1.00- -0.50) and very low(<-1.00) level of cases are Alanganalur , Usilampatt.

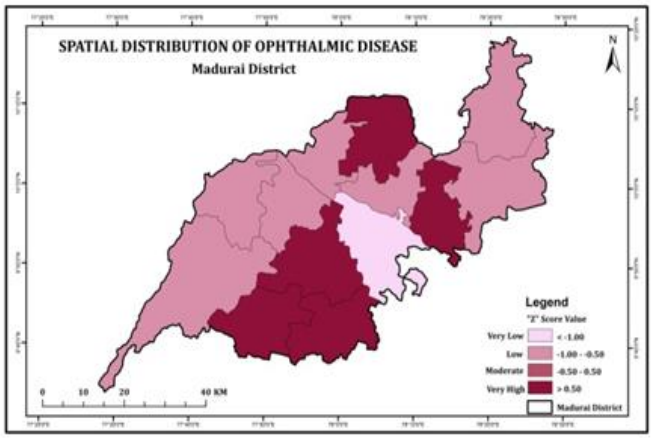

Fig. 14: Distribution of Ophtholmic disease

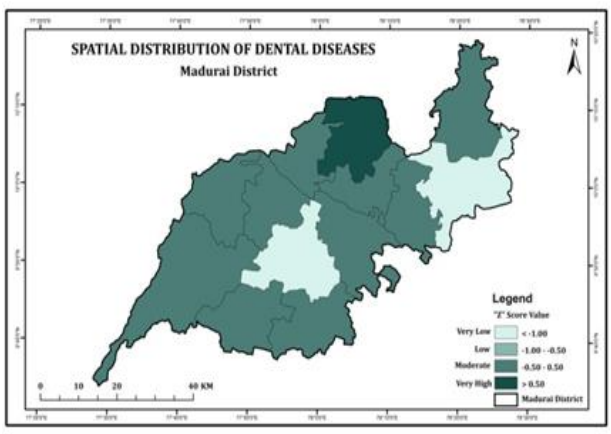

Fig. 15: Distribution of Dental disease

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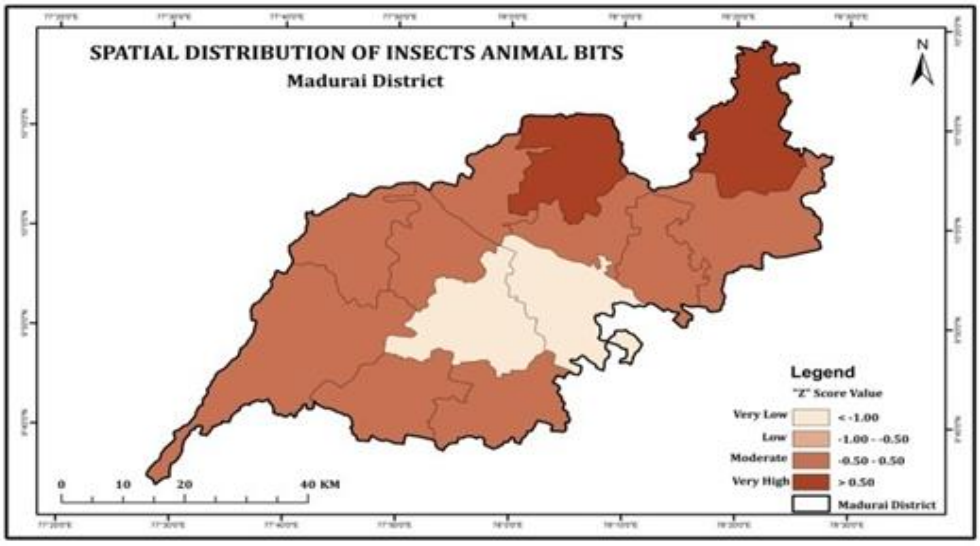

Fig. 16: Distribution ofInsect's animals bits disease

O. Insect's animals bits disease

The need to be aware of diseases transmitted by insect bites is crucial lyme disease, transmitted by ticks, and malaria, transmitted by mosquitoes. Figure 16 shows the spatial distribution ofInsects animals bits disease. Very highly(>0.50) affected cases are,Madurai west , T.Kallupatti ,Kallikudi , Thirumangalam, and Medium level of cases are Madurai west , Alanganalur,T.Vadipatti ,Kottampatti, Melur ,Chellampatti, Usilampatti, Sedapatti. Low (-1.00- -0.50) and very low(<-1.00) level cases are Thgiruparangundram in Madurai district.

V. RANKING OF EMERGING DISEASE BLOCK WISE IN MADURAI DISTRICT

Geography ranking is a technique. It used to identify the significance of the selected variable in its order of importance. The selected variable in its order of importance. A ranking is a relationship between a set of items such that, for any to items, the first is either "ranked higher than", "ranked lower than" or "ranked equal to" the second.

The number of cases registered in each block of primary health care centre for each of the disease is calculated as percent to the total number of cases in each primary health centre, for the purpose of the interpretation the seven ranking disease are selected, in 13 blocks. The ranking disease thus arrived in (Table 2).

First ranking blocks are Madurai east, T.Vadipatti, Usilampatti. Second rank Block is Madurai west. Third rank block is chellampatti, and fourth ranking blocks are Kottampatti, Thiruparangundram, Kalikudi. The fifth ranking block is Melur.Sixth rank block is T.kallupatti. Finally seventh rank block sedapatti is Thirumangalam. 1-4 ranking blocks are high level of cases and 4-6 ranking blocks are medium level of cases, above 6 ranking blocks is low level of cases.(Fig 17).

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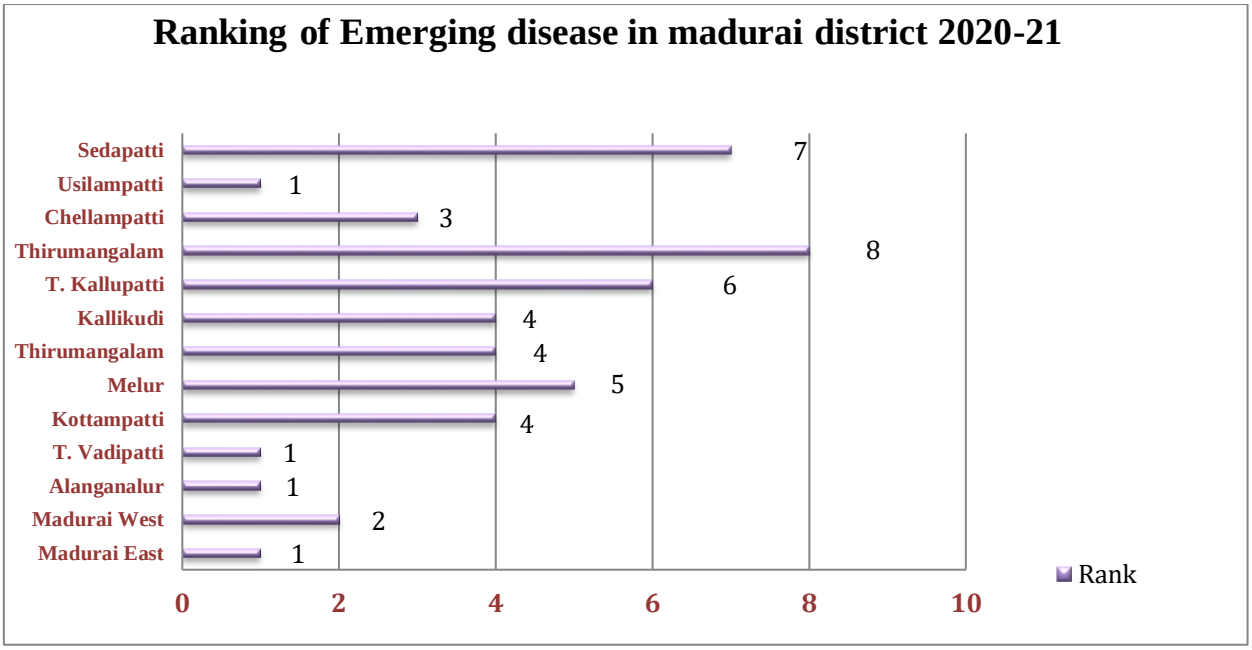

Fig. 17: Ranking of Emerging disease in Madurai district

VI. CONCLUSION

Emerging infectious diseases are infections that have recently appeared within a popular or those whose incidence or geographic range is rapidly increasing or threatens to increase in the near future. It concluded by Madurai district emerging diseases randomly collected highly affected disease are Dengue(9.85%), Chickenkoniya(9.85%), Liptospriya (9.5%), Cholera (8.96%). They commonly spared in mosquito, water born disease andA bacterial disease spread through the urine of infected animals.

Medium affected disease are Malaria (7.17%), Jaundce (6.63%), Pragnency hyper tension(6.09%), In sets animals bits (6.66%), Dental disease (),Ophtholmic (5.55%).Then low level of cases are ENT (5.01%) , Respiratory(4.46%) , Pyrexia related disease (4.48%), Skin disease (4.66%), Nutrition disorder(4.48%). First ranking blocks are Madurai east, T.Vadipatti, Usilampatti. Second rank Block is Madurai west. Third rank block is chellampatti.,and fourth ranking blocks are Kottampatti, Thiruparangundram, Kalikudi.The fifth ranking block is Melur.Sixth rank block is T.kallupatti. Finally seventh rank block sedapatti is Thirumangalam. 1-4 ranking blocks are high level of cases and 4-6 ranking blocks are medium level of cases, above 6 ranking blocks is low level of cases.

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- **Conflict of Interest :** On behalf of all authors, the corresponding author states that there is no conflict of interest.

REFERENCES

[1.] Alma-Ata.(2020) Primary healthcare definition, goal, principles and satergies. http://www. Publichealth.com.ng>..may26,2020.
[2.] "Emerging Infectious Diseases - NIOSH Workplace Safety and Health Topic". www.cdc.gov. Centers for Disease Control and Prevention. 17 October 2018. Archived from the original on 18 April 2020.
[3.] A brief guide to emerging infectious diseases and zoonoses. WHO Regional Office for South-East Asia. 2014. hdl:10665/204722. ISBN 9789290224587.
[4.] Jump up to:a b c Woolhouse, ME; Gowtage-Sequeria, S (2005). "Host Range and Emerging and Reemerging Pathogens".Emerging Infectious Diseases. 11 (12): 1842–7. doi:10.3201/eid1112.050997. PMC 3367654.PMID 16485468.
[5.] Morens DM, Fauci AS (2013). "Emerging infectious diseases: threats to human health and global stability".PLOS Pathogens. 9 (7): e1003467. doi:10.1371/journal.ppat.1003467. PMC 3701702.PMID 23853589.
[6.] Felicia, Keesing (2010). "Impacts of biodiversity on the emergence and transmission of infectious diseases".Nature.PMID 21124449.
[7.] Jump up to:a b "The 2019–2020 Novel Coronavirus (Severe Acute Respiratory Syndrome Coronavirus 2) Pandemic: A Joint American College of Academic International Medicine World Academic Council of Emergency Medicine Multidisciplinary COVID 19

Working Group Consensus Paper". Research Gate. Retrieved May 16, 2020.

[8.] Houghton M (November 2009). "The long and winding road leading to the identification of the hepatitis C virus".Journal of Hepatology. 51 (5): 939–48. doi:10.1016/j.jhep.2009.08.004. PMID 19781804.

[9.] Sudharsan, R., Saravanabavan, V., Devanathan, D., & Tech, M. (2019). Patient Satisfaction and Perceptions about Quality of Healthcare at a Primary Healthcare Centre of Thanjavur District, Tamil Nadu. *International Journal of Research in Science and Technology*, *9*, 2249-0604.

[10.] Saravanabavan V. Bicycles and health-a geo medical study of Madurai city. InVeloAustralis and VeloCity'96, International Bicycle Conference, 1996, Fremantle, Western Australia, 1996.

[11.] Saravanabavan V, Balaji D, Sudharsan R. A GeoMedical Analysis of Chikungunya and Patients Environmental Perception in Madurai City. Journal of JAC Journal of Science, Humanities, and Management. 2014 Jun;1(2):111-120. ISSN 2347-9868.

[12.] Javadi, Mohammad HosseinMoshref, HosseinRezaeiDolatabadi, MojtabaNourbakhsh, Amir Poursaeedi, and Ahmad Reza Asadollahi. "An analysis of factors affecting on online shopping behavior of consumers." *International journal of marketing studies* 4, no. 5 (2012): 81.

[13.] Saravanabavan, V., &Shanmuganandan, S. (1996). Impact of MDTon changing scenario of Leprosy in Tamil Nadu. *The Journal of Region, Health and Health Care*, *1*(2), 19-27.

[14.] Saravanabavan, V., Balaji, D., Reshma, C. U., Sheheersha, S. K., Sudharsan, R., VimalaVinnarasi, J., ... &Balasubramani, K. (2021). Urban disease ecology and its spatial variation of Chikungunya in Madurai City, Tamilnadu, India: a geo-medical study. *GeoJournal*, *86*(5), 2335-2350.

[15.] Saravanabavan V, Reejo RJ, Neethidevi A, Jayashree R. Travel and health care utilization pattern of patients in Vadippatipanchayat union: A micro level study using GIS. Journal of Deccan Geographer. 2006;44(2):97- 108.

[16.] Saravanabavan V. Geo-Medical analysis of Multibacilary leprosy in Tamilnadu. The Deccan Geographyer.1997;35(2);179-189.

[17.] Saravanabavan V, Shanmuganandan S. Geo- Medical analysis of Leprosy patients in Tamilnadu. The Indian Geographical Journal.1994;69(2);135-139.

[18.] Saravanabavan V, Sudharsan R, Balaji D, RahamathNisha R. Patient's perception and epidemiological characteristics of dengue in Madurai city-using factor analysis. International Journal of Mosquito Research. 2014;1(2):18-24.

[19.] Sarvanabavan, V., &Shanmuganandan, S. (1997). Identification of Health Care Delivery System for Paucibacillary Leprosy in Tannilnadu. *Calcutta*, *3*(59), 216-24.

[20.] Saravanabavan V. GIS analysis of pedestrian problem and spatial risk areas for each buffer zone in urban cities A case study of Madurai city in Tamlnadu, India. In 1st International symposium held on 19-21 April, at South Eastern University of Sri Lanka, 2011. http://ir.lib.seu.ac. lk/handle/123456789/862

[21.] Saravanabavan, V. (2013). Patients perception and travel behavior pattern in primary health care center in Haripad block-A micro Geo-medical study. *Journal of Language in India*, *13*(4), 194-207.

[22.] VimalaVinnarasi J, Saravanabavan V. Tuberculosis types and its characteristics in Dindigul District-A Geomedical study using GIS. International Journal of Geomatics and Geosciences. 2017;7(3):262-74.

[23.] Eswari, S., Saravanabavan, V., &Balaji, D. (2020). Infant neonatal and post neonatal mortality in Madurai district, Tamil Nadu, India: A Geomedical Study. *International Journal of Geography, Geology and Environment*, *2*(2), 102-112.

[24.] Vinothini, C., Neethidevi, A., &Saravanabavan, V. Health impact and nine fold classification of land use change in NilakottaiTaluk, Dindigul District, Tamil Nadu.International Journal of Geography, Geology and Environment 2019; 1(1): 80-86

[25.] Saravanabavan, V., Keerthi, S. P., Anupama, A., &Vinothini, C. Psycho-social characteristics of mental disorder patients in Thiruvananthapuram District: A geo medical study.International Journal of Geography, Geology and Environment 2019; 1(2): 08-16

[26.] Saravanabavan, V., Vinothini, C., Balaji, D., Manna, Alok.,Arya Mohan, ., &Athira Rajesh.(2022) A geo-spatial approach on COVID-19 mortality in Tamil Nadu. International Journal of Geography, Geology and Environment 2022; 4(1): 123-131

[27.] Saravanabavan V. An analysis of pattern of leprosy and regional classification of Health Care service in Tamilnadu.Geography Review of India. 2000;62(4);379-386.

[28.] V. Saravanabavan · V. Emayavaramban · V. Thangamani · I. K. Manonmani · R. S. Suja Rose ·D. Balaji · R. RahamathNisha · K. Kannadasan · S. Vinothkanna · C. Vinothini (2022) Spatial variation of covid-19 morbidity statusand identification of risk zone in Tamil Nadu (India) during first wave.Geojournal , Springer, https://doi.org/10.1007/s10708-022-10680-x

[29.] Vinothini, C., Saravanabavan, V., &Balaji, D. (2021). Travel pattern of health utilization to primary health care centres in Madurai district. International Journal of Geography Geology and Environment, 3(2), 144-151.

[30.] Saravanabavan, V., Vinothini, C., Balaji, D., Manna, A., Mohan, A., & Rajesh, A. A geo-spatial approach on COVID-19 mortality in Tamil Nadu.International Journal of Geography, Geology and Environment 2022; 4(1): 123-131.

[31.] Saravanabavan, V., Aneesh, P., Babu, H. M., & D Harieswari, M. (2021). Patient's perception and level of primary health care utilization in east block of Madurai North taluk: A geo-health study. International Journal of Geography, Geology and Environment, 3(1), 34-41.

[32.] Saravanabavan V, Reshma CU, Preethi S. Determinants of reproductive health in working

women in Thrissur district, Kerala. GeoJournal. 2019 Feb;86(1):239-53.

[33.] Lim, Yi Jin, Abdullah Osman, ShahrulNizamSalahuddin, Abdul Rahim Romle, and Safizal Abdullah. "Factors influencing online shopping behavior: the mediating role of purchase intention." *Procedia economics and finance* 35 (2016): 401-410.

[34.] Saravanabavan V, C.S AswathiLekha, T.Aparna, R. RahamathNisha,D. Balaji,K. Kannadasan, S.VinothKanna (2021). Spatio-temporal variation of dengue in Kozhikode District, Kerala: A medico geographical study. *International Journal of Mosquito Research*, *8*(1 Part B), 130-40.

[35.] Sheheersha, S. K., &Saravanabavan, V. (2020). Geo-Medical Analysis of the Detection of Cervical Pre-Cancer Cases Using Telemedicine System in Kerala State, India. *IOSR Journal of Dental and Medical Sciences*, *10*(11), 12.

[36.] Saravanabavan V, Balaji D, Preethi S. Identification of dengue risk zone: A geo-medical study on Madurai city. GeoJournal. 2019 Aug;84(4):1073-87.

[37.] Balaji, D., &Saravanabavan, V. (2021). Geo spatial variation of dengue risk zone in Madurai city using autocorrelation techniques. *Geojournal*, *86*(3), 1481-1501.