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RESEARCH ARTICLE

A GEOMEDICAL ANALYSIS OF DIARRHOEAL DISEASES AMONG CHILDREN IN MADURAI CITY, TAMILNADU, INDIA

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ABSTRACT

Medical Geography is a multi-dimensional structure of knowledge and understanding the spatial aspects of human health problems and issues. Diarrhoeal disease claims almost two million children's lives worldwide every year because their bodies are weak from lack of fluids and undernourishment. Africa and India alone lose 1.4 million lives to diarrhoeal diseases. UNICEF and WHO report that around four billion cases of diarrhoea are recorded each year, mostly among children under the age of five. The present study attempt to describe the diarrhoeal diseases among children and its association with environmental factor. The study area Madurai is located in the Southern part of Tamil Nadu, India. This analysis helps to understand which region has highly prone to diarrhoeal diseases and the causes of the diarrhoeal occurrence among children at Madurai city. This study analyzed the precipitating factors for the occurrence of diarrhoeal disease among children with reference to drinking water supply, personal hygiene and nutritional factors. The main aim of this study is to conceptualize the facts and bring out in a conceptual framework by applying Geographical Information System (GIS) and statistical analyses.

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INTRODUCTION

Diarrhoeal diseases is a waterborne disease. It requires safe drinking water but a city have limited access to safe drinking water, which leads to the outbreak of diarrhoeal diseases. To overcome the emerging problem diarrhoeal diseases among children, it is taken for the study. Prevalence of diarrhoeal diseases among children's is more in developing countries than in developed countries. In a country like India where diarrhoeal diseases among children are the major problem due to water scarcity, and also due to water pollution. The present study attempts to analyze the factors such as unpurified water, food contamination, personal hygiene, poor standard of living which were the major cause for diarrhoeal diseases. Hence, the present study attempt to describe the diarrhoeal diseases among children and its association with environmental factors. The issues facing health and healthcare are complex and an integrative, multidisciplinary approach is crucial to ensure that research provides relevant, high-quality evidence to reform health policy. Epidemiology is predicated in the biomedical model and focuses on the biology of disease.

Diarrhoea is one of the most important diseases in India. Diarrhoea today continues to remain an important public health problem both in rural and urban areas. All the studies in medical geography are concerned with the description of spatial variations of a particular disease and are attempted at the regional level but limited concerning to micro-level. In this context, the present study has focused its importance of micro-level to study the spatial distribution of diarrhoeal diseases among children and to analyze the interrelationships between prevalence rate of diarrhoeal diseases concerning to socio-economic, environmental, and cultural factors.

Study Area: Madurai District is situated in the south of Tamil Nadu State with an area of 143.08 km². According to 2017-2018, Statistical Handbook of Madurai District the density of population is 812 per sq.km. It is the ninth-largest populated district in Tamil Nadu. In the year 1984, Madurai District was bifurcated into two administrative division Madurai and Dindigul. Again in the year 1997, it was bifurcated as Madurai and Theni Districts. Madurai is also known as Temple City. World Famous Sri Meenakshi Sundareshwarar Temple is in Madurai. Madurai District is influenced by various religions such as Christianity, Hinduism, Islam, Sikh, Buddhist and Jain which cause diverse entity. In the year 2011, Madurai Corporation was expanded from 72 wards to 100 wards and dividing into four regions (Fig.No.1).

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The ground rises away from the city on all sides except in the south, bounded by the gently sloping terrain. Madurai is known for its hot climate. The average annual rainfall for 2018 was 85.76 cm.

MATERIALS AND METHODS

The two important techniques used in the present study are statistical technique and GIS. The maps are prepared using GIS Software. ArcGIS is one of the important GIS software, which is used to prepare the maps. The relationships and the interdependence nature of different variables are analyzed using the correlation matrix capable of explaining the relationships of one variable with all other variables. Apart from this, the multivariate statistical technique factor analysis is used to find the major associations and interrelationships between diarrhoeal diseases among children and variables. With the help of correlation matrix, derived by using SPSS 7.5 version. A significant level is attempted using one-tail and two-tail tests to find out the association between variables. Madurai Corporation provides the major data required for the present study for the year 2018. The main sources of data are based on secondary data available at Government Rajaji Hospital. Demographic and social variables for each region were obtained from the Census Book of India-Madurai City; 2011. The study area map and related information were obtained from the Town Planning office. The data related to socio-economic were collected from the respective offices. Primary data has been systematically done in the present study based on sampling. Details of personal hygiene, preference of food, socio-economic characteristics, living environment, conditions of water supply and drainage facility, age, location of affected diarrhoeal diseases patients were collected. Though the secondary data was insufficient to fulfil the aims and objectives the primary data is collected.

RESULTS AND DISCUSSION

Medical Services: In Madurai City, about 62% of the Respondents are satisfied with the medical services in the PHC's, remaining 38% of them were not fully satisfied with the medical services.

Infrastructural Facilities: About 85% of the respondents are not satisfied with the infrastructural facilities available in the PHC's and 15% of them are satisfied with these infrastructural facilities.

Sanitary Condition: All the primary health centres in Madurai City do not have toilet facilities. About 95% of the respondents were not satisfied with the sanitary conditions and only 5% of them are satisfied.

Availability of Medicine: So 97% of the respondents are satisfied with the availability of medicines and only 3% of them are not fully satisfied.

Perception of Treatment: Regarding the perception of treatment, about 40% of respondents state that it was satisfactory and 21% of them state that the treatment was excellent. Likewise, 29% of them state that the treatment in the PHC's of Madurai City was highly satisfactory and the remaining 10% state that the treatment was not so satisfactory.

The treatment in the PHC's of Madurai City is fully free, so there is no cost for treatment.

Patients' Satisfaction Level: The factor analysis employed in the study identified seven dimensions explaining a total variance of more than 61.56 Percentage. The first four dimensions explained a total variance of more than 42% and Eigen value of above 1.41. Only seven factors are taken for analysis of factor solution concerning to the dimensions. Table no. 1 explains the Eigen value and the percentage variance explained by each factor. Among these, the first dimension alone account for 17.82% of the total variance and qualified as the primary factor with an Eigen value of 3.97. This primary dimension is essentially associated with Cholera Versus Patient's Health Status in Madurai City. The second dimension with an eigen value of 1.79 explained a total variance of 8.74. The third factor with an eigen value of 1.46 explained a total variance of 7.71 %. The contribution of last 4 dimensions altogether account with an eigen value of 5 explained a total variance of 27.29 percent.

Table No. 2 states that the very high negative loadings such as cholera (-0.43) and very high positive loadings patients outcome (0.96), the treatment has undergone (0.96) and outpatients admission (0.92). Cholera is mostly associated with the intensity of dehydration. The occurrence of cholera is reported more and however, so the patient outcome is also high. It is inferred that severe cholera is associated with the severity of diarrhoea, and dehydration. As stages advance the patients' outcome depends on the treatment and enter hospitalization as inpatient and increased frequency of visits to the hospital as an outpatient. The very high positive loadings of diarrhoea are 0.81 and a negative loading of dysentery is -0.79. If diarrhoea and dysentery are inter-related, whenever there is an increase in the frequency of diarrhoea and dysentery are high, the admission period and hospitalization are long. In acute diarrhoeal cases, dysentery (-0.79) is the most important factor. The vulnerability of diarrhoea is remarked by the intensity of dysentery followed by the immediate increase in the hospitalization (0.54). Table no.3 states that the positive factor loadings are conformation of diarrhoea is 0.82 and cholera is 0.55. If there is a severity of diarrhoeal diseases associated with acute gastroenteritis then it will lead to an outbreak of cholera. The cholera outbreak (0.55) is usually associated with acute gastroenteritis; otherwise, there is an increase in the frequency of diarrhoea (0.82). As and when cholera is accomplished with diarrhoea it should be treated immediately, otherwise, it will leads to fatality. This dimension has established this fact. This factor consists of both positive and negative factor loadings. Positive loading reported as dehydration is 0.49. The very high negative loading such as fever is -0.76 and vomiting is -0.58. This loading describes that high complications noticed on diarrhoea leads to more water loss in the body. Usually, it is observed that dehydration will lead to complications in the disease progression associated with vomiting (-0.58) and fever (0.76). Untreated diarrhoea will result in heavy water loss and it will finally cause fatality. Increase in the intensity of water loss as experienced in the dysentery is always associated with loose motion. Hence, the patient must be treated thoroughly with water (saline) or fluid support during hospitalization to supplement the loss. Table No. 4 states that the high positive loadings such as complication are 0.78 and the clinical investigation is 0.73. More complications are associated with it, which is clinically tested and confirmed.

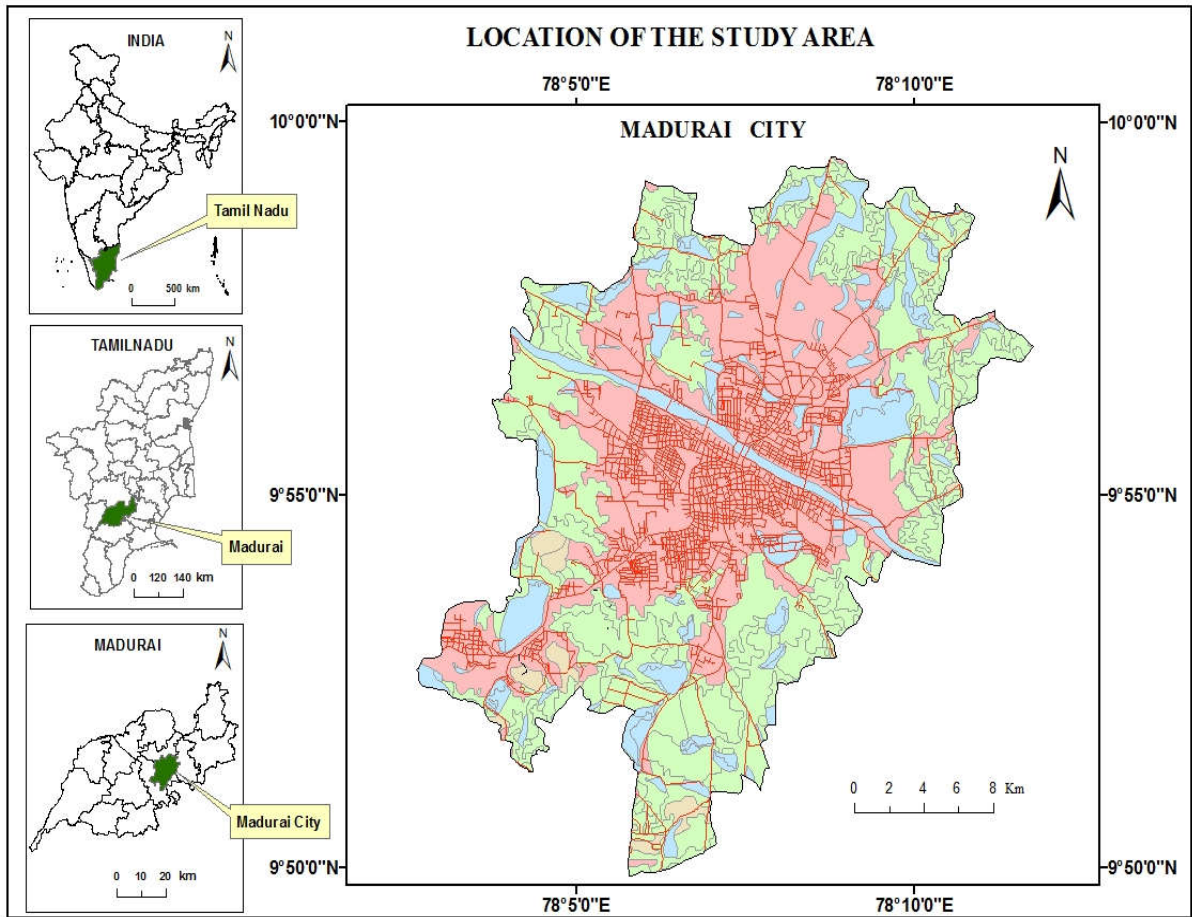


Fig. No. 1 Location of the Study Area

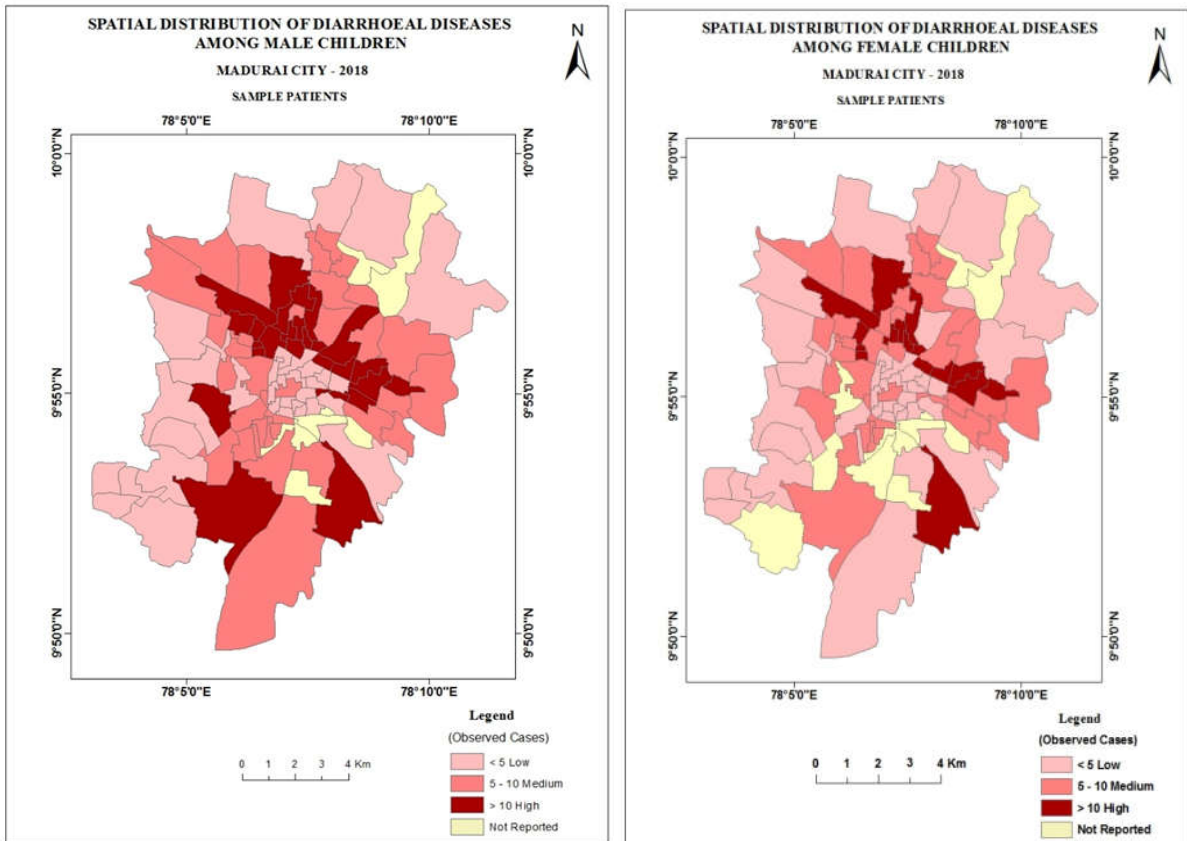


Fig. No. 2 Spatial Distribution of Diarrhoeal Diseases among Male and Female Children

Table No. 1. Factor Solution: The Eigen Value and the Total Percentage Variance is Explained by each of the Variables

Factor	Dimension Name	Eigen Value	Percentage of Variance	Cumulative Percentage
I	Cholera Versus Patient's Health Status	3.97	17.82	17.82
II	Diarrhoea and Frequency of Dysentery	1.79	8.74	26.55
III	Diarrhoeal Severity and Outbreaks of Cholera	1.46	7.71	34.26
IV	Diarrhoeal Complications, Extent and Intensity of Water Loss	1.42	7.32	41.58
V	Clinical Manifestation of the Disease and Associated Complications	1.35	7.16	48.74
VI	Age Structure and Severity of Illness Pattern	1.21	7.03	55.78
VII	Gender Variation and Frequency of Diarrhoea	1.02	5.78	61.56

Source: Compiled by the Author

Table No. 2. Cholera Versus Patient's Health Status and Diarrhoea and Frequency of Dysentery

CHOLERA VERSUS PATIENT'S HEALTH STATUS			
Variable No.	Name of the Variable	Factor Loading	
19	Patients Outcome	0.96	
16	Treatment Undergone	0.96	
1	Patients Admission	0.92	
13	Dehydration	0.46	
15	Cholera	-0.43	
Eigen Value = 3.97		Total Value = 17.82 %	
DIARRHOEA AND FREQUENCY OF DYSENTERY			
Variable No.	Name of the Variable	Factor Loading	
7	Diarrhoea	0.81	
5	Admission Period	0.54	
8	Dysentery	-0.79	
Eigen Value = 1.79		Total Value = 8.74 %	

Source: Compiled by the Author

Table No. 3. Clinical Manifestation of the Disease and Associated Complications, Age Structure and Severity of Illness Pattern and Gender Variation and Frequency of diarrhea

CLINICAL MANIFESTATION OF THE DISEASE AND ASSOCIATED COMPLICATIONS			
Variable No.	Name of the Variable	Factor Loading	
17	Complications	0.78	
18	Clinical investigation	0.73	
Eigen Value = 1.35		Total Value = 7.16 %	
AGE STRUCTURE AND SEVERITY OF ILLNESS PATTERN			
Variable No.	Name of the Variable	Factor Loading	
9	Abdominal Pain	0.67	
2	Age Structure	-0.74	
Eigen Value = 1.21		Total Value = 7.03 %	
GENDER VARIATION AND FREQUENCY OF DIARRHOEA			
Variable No.	Name of the Variable	Factor Loading	
6	Frequency of Diarrhoea / Day	0.60	
12	Other Diseases	0.43	
3	Gender	-0.62	
Eigen Value = 1.02		Total Value = 5.78 %	

Source: Compiled by the Author

Although the diarrhoeal occurrence is caused by many factors of disease pathogens, it is essential to find out the history and nature of infection only by clinical means such as laboratory test (0.73). The clinical manifestation such as complications (0.78) of the disease reported by symptoms can help to diagnose the disease-causing organism and this can be identified only-by microbiological examination and biochemical explanation. The positive factor loadings such as abdominal pain are 0.67 and high negative loadings of age structure are -0.74. It is observed from the study that abdominal pain (0.67) is the common initial symptom steadily leads to severe diarrhoea. However diarrhoeal occurrence and associated symptoms are more vulnerable among the children (-0.74) due to biological reasons and also due to the nutritional status of the children at the time illness occurrence. The positive loadings of the frequency of diarrhoea per day are 0.60 and other disease is 0.43. The negative loading of gender is -0.62. The frequency of diarrhoea is also associated with the disease; it also depends upon the body condition of male or female.

The frequency of diarrhoea per day (0.60) determines the vulnerability and severity of the disease and this shows no variation irrespective of males or females (-0.62). The frequency also explains the disease condition concerning to its source of infection and nature of disease-causing organisms. Vulnerability is severe in diarrhoea when compared to other diseases (0.43).

Identification of Diarrhoeal Diseases Affected Regions:

Figure No.2 shows the spatial distribution of diarrhoeal diseases among male and female children in Madurai city and it depicts that more number of male children are affected by diarrhoeal diseases than female children. Diarrhoeal diseases are one of the major water-borne diseases. Since Madurai city experiences Monsoon type of climate. More number of cases is reported in Madurai city. The map shows high concentration diarrhoeal diseases occurrence are observed in Sellur, Goripalayam, Pudur, Thathaneri, Vilangudi, Anna Nagar, Mathichiyam, Alwarpuram, B.B.Kulam, Narimedu, Ahimsapuram, Meenakshipuram, Kailasapuram,

Bethaniyapuram, Arapalayam, Tamil Sangam, Ismailpuram, Sourashtra School, Palanganatham, Ellis Nagar, Solai Alagapuram, Jaihindpuram, Keerathurai, Villapuram, Kamarajarapuram, Anupanadi. Mostly male children are highly prone to diarrhoeal diseases than female children. The high concentration in these regions is due to poor maintenance of child health, lack of personal hygiene among mother of the affected children. Poor socio-economic condition also leads to diarrhoeal diseases. The medium concentration of diarrhoeal diseases among children are noticed in the regions of Reserve Line, Chokkikulam, K.K Nagar, Ponnagaram, Viswasapuri, Mela Ponnagaram, Railway Colony, S.S Colony, Subramaniapuram, SappaniKovil, T.V.S Nagar, AnumarKovil, Meenakshi Amman Kovil, Ponmeni, ChokkanatharKovil, JadamuniKovil. Moderate cases are reported in these regions because these regions have a good drainage system and proper housing facilities this restricts the occurrence of diarrhoeal diseases among children.

Low concentration is seen in Loorthu Nagar, Karpaga Nagar, Sathamangalam, Kailasapuram, Panthalkudi, Kochadai, Arasaradi, Veera Kali Amman Kovil, Thennagaram, Kovalan Nagar, Perumal Teppakulam, Kajimar Street, Krishnarayer Teppakulam, Lakshmipuram, St Mary's, Mariamman Teppakulam, Alagaradi, Madakulam, Mathura Baskara Doss Nagar, Krishnapalayam, North Krishnan Kovil, Manjanakkara street, Mahal, Swami Sannathi, Pankajam Colony, Balarengapuram. Since these regions have a good living environment and drainage facilities, so it prevents the occurrence of diarrhoeal diseases among children. Mostly male children are highly prone to diarrhoeal diseases than female children due to their exposure to pathogens very easily and due to their genetic make-up. Especially Sellur, Pudur, Anna Nagar, Thathaneri regions have moderate population density exposure to partially sewage system, low income, lack of personal hygiene, poor literacy rate, poor living environment and unhygienic conditions and these are the reason for the high prevalence of diarrhoeal diseases in these regions. Since diarrhoeal diseases are waterborne diseases the overhead tanks in these regions are not maintained properly, so the source of drinking water is poor in these regions, which facilitates to catch diarrhoeal diseases.

Age Distribution of Diarrhoeal Cases in Madurai City:

Mostly the children below three years are highly affected. There are so many variables associated with diarrhoeal diseases among them the important variables responsible for the cause of diarrhoeal diseases are personal hygiene, preference of food, age structure, socio-economic characteristics, living environment, conditions of water supply and drainage facility. Majority of the children belongs to the age group < 3 years (67%) are highly infected by diarrhoeal diseases, next comes the age group of 3-6 years (17%) were affected by diarrhoeal diseases. The age group of > 9 years (10%) and 6 - 9 years (6%) were less prevalence to the diarrhoeal diseases because of poor maintenance of child health, nutrition deficiency (under nutrition), low per capita income, illiteracy among mothers, and lack of personal hygiene among patients. The prevalence of diarrhoeal diseases is high in male children (63%) than female children (37%) due to their exposure to pathogens very easily and due to genetic make-up. Low-income people were highly affected by the diarrhoeal diseases in Madurai city than the high-income group people i.e., the prevalence rate is 50% in the low-income group, 27% of the middle-income group, and 23% of the high-

income group. This condition indicates that a low standard of living and low per capita income is highly associated occurrence of diarrhoeal diseases.

Conclusion

The main aim of the present study is to identify the spatial distribution of diarrhoeal diseases among children in Madurai city. The distribution of diarrhoeal diseases is not uniform everywhere it differs from place to place. To support the objectives 30 sample patients who have attended 'The Department of Medicine' at Government Rajaji Hospital in Madurai city at the time of the Interview was selected by Random sampling method were used for primary data. Details of personal hygiene, preference of food, socio-economic characteristics, living environment, conditions of water supply and drainage facility, age structure, location of affected diarrhoeal diseases patients were collected. Though the secondary data was insufficient to fulfil the aims and objectives the primary data is collected. The main sources of secondary data are collected from textbooks, journals, and Internet source.

Mostly male children are highly prone to diarrhoeal diseases than female children. The high concentration in these regions is due to poor maintenance of child health, Lack of personal hygiene among mother of the affected children. Poor socio-economic condition also leads to diarrhoeal diseases. Since diarrhoeal diseases are waterborne diseases the overhead tanks in this region are not maintained properly, so the source of drinking water is poor in these regions that gives way to catch diarrhoeal diseases. The children below 3 years are highly affected by diarrhoeal diseases due to poor maintenance of child health, nutritional deficiency, low per capita income, illiteracy, and lack of personal hygiene among parents. More number of the case are reported in the summer season than in winter season due to excess of heat and lack of access to safe drinking water in Madurai city. The facts such as the factors related to the occurrence of diarrhoeal diseases among children are hypothesized. To minimize or to control the occurrence of diarrhoeal diseases awareness should be created. Since diarrhoeal diseases are waterborne diseases, provision of safe drinking water is a must to most vulnerable areas. Thus, the hypothesis is proved to explain the relationships between socio-cultural, socio-economic characteristics and occurrence of diarrhoeal diseases among children in Madurai city.

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