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Travel patterns of adult patients to primary health centers in Madurai district: A public health perspective

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Abstract

Access to healthcare services is a critical determinant of public health outcomes, influenced significantly by travel patterns among adult patients. In Madurai District, like many regions globally, understanding these travel patterns is essential for optimizing healthcare delivery and improving health outcomes. This study focuses on elucidating the dynamics of patient travel to primary health centers (PHCs) within Madurai District, situated in the southern state of Tamil Nadu, India. The main objectives are: 1. to identify the spatial distribution of primary health contaminants 2. To examine the travel and movement patterns of patients from their homes to the PHC in relation to their adult indicators. The study relied on both primary and secondary sources. The data was collected via stratified random sampling, and 260 questionnaire samples were picked. Graphic approaches such as overlay and buffer analysis using GIS, as well as appropriate statistical methods, were applied. PHC access was assessed using graphic approaches such as overlay and buffer analysis. The study discovered that PHC location had a significant impact on health status and travel patterns for health utilization in Madurai district.

Keywords: Accessibility; PHC; Overlay; Buffer analysis; Adult patients; GIS

1. Introduction

Promotion and protection of the health of people is essential for a sustained economic and social development, thus contributing to a better quality of life.(1,2,3) The health care services cover a wider range of activities like medical care, sanitation, immunization, counseling health education, and social security rehabilitation etc.(<https://www.who.int/about/accountability/governance/constitution>). Access to healthcare services is a critical determinant of public health outcomes, influenced significantly by travel patterns among adult patients(4,5). Primary Health Care (PHC) emphasizes the interconnected aspects of physical, mental, and social well-being, addressing broader determinants of health (WHO, 2022).Access to healthcare services is a critical determinant of public health outcomes, influenced significantly by travel patterns among adult patients(6,7,8).In Madurai District, like many regions globally, understanding these travel patterns is essential for optimizing healthcare delivery and improving health outcomes. (9,10,11).The latest trends in emerging infectious diseases focus on the impact of climate change, global travel, and antimicrobial resistance(12,13). This study explores the impact of health insurance on healthcare access and travel patterns in rural, providing insights into financial barriers and healthcare utilization. (14,15). Discusses geographic and socioeconomic barriers influencing travel patterns and access to primary healthcare services in rural communities(16,17). Examines how telemedicine influences travel patterns by offering alternative healthcare delivery

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methods, impacting patient choices and access (18,19). Explores how effective communication affects patient satisfaction and influences travel behaviors to healthcare facilities. (20,21). Discusses the adoption of telemedicine in crisis situations and its impact on reducing travel burdens for patients seeking healthcare (22,23). Provides insights into health system reforms and their effects on accessibility and travel patterns to primary health centers in developing regions (24,25). Analyzes the pandemic's impact on healthcare infrastructure and travel patterns to primary health centers in India, highlighting systemic vulnerabilities (26,27). Reviews the role of telehealth in enhancing access to healthcare services and potentially reducing travel requirements for patients (28,29). Examines policy reforms and their impact on healthcare access and travel patterns within a specific regional context. (30,31). Discusses the role of community health workers in mitigating travel barriers and improving healthcare access in underserved populations (32,33). Identifies socioeconomic and geographic barriers influencing travel patterns to healthcare facilities in rural Kenya. (34,35). Explores income-related barriers affecting travel patterns and access to primary healthcare services in Nigeria (36,37). Investigates how telemedicine addresses access barriers and alters travel patterns for non-emergency healthcare services (38,39). Analyzes healthcare-seeking behaviors among older adults and their implications for travel patterns to healthcare facilities (40,41). Examines socio-economic disparities affecting travel patterns and healthcare access post-apartheid (42,43). Reviews the effectiveness of patient navigation programs in improving access and reducing travel barriers to healthcare services (44). Discusses individual and contextual factors influencing travel patterns and access to healthcare services. Analyzes economic factors impacting travel patterns and healthcare utilization in rural and urban settings, providing insights into access barriers (45,46). Explores income-related disparities in life expectancy and their implications for healthcare access and travel patterns (47). Reviews how patient satisfaction influences healthcare service quality and its potential effects on travel. This research aims to explore and analyze the factors influencing travel patterns to PHCs in Madurai District from a public health perspective. By examining these patterns, we seek to identify barriers that hinder access to healthcare, assess the impact of these barriers on adult-age patient care-seeking behaviors, and propose strategies to enhance healthcare accessibility and efficiency.

2. .Study area

Madurai district is located in the central part of southern Tamilnadu of India. It is bordered by Dindigul and Tiruchirappalli district on the north, Sivagangai district on the east, Virudhunagar on the south and Theni on the west. (Statistical hand book of Madurai district 2018). Madurai district is at $9^{\circ} 30'$ and $10^{\circ} 50'$ of North Latitude and from $77^{\circ} 00'$ to $78^{\circ} 30'$ of East longitude (**Fig1**). The total geographical area is 384,680 hectares. The total population about 3038252 as per 2011 census. Madurai district in Tamil Nadu is selected for the present study. This district is a combination of urban and rural region. (Statistical Handbook, 2018 Madurai) According to 2011 census the study area has the total population of 1,470,755. Spread over an area of 147.97 km². The study area is the most famous and most important district in Tamil Nadu and India.

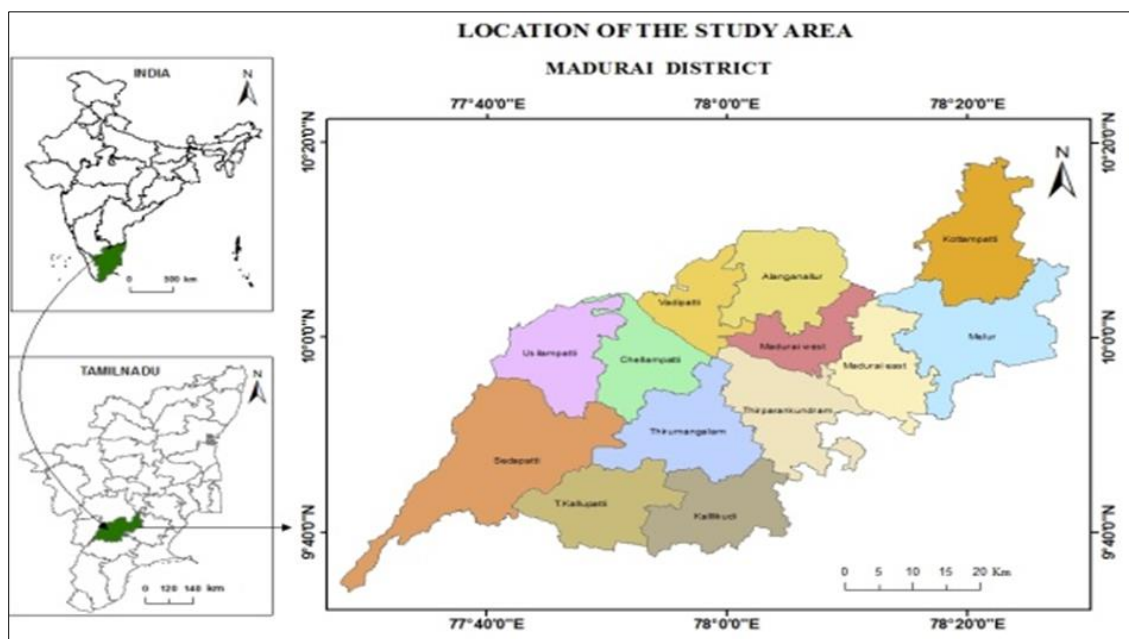


Figure 1 Location of the study area

This study focuses on elucidating the dynamics of Adultpatient travel to primary health centers (PHCs) within Madurai District. Its diverse demographic and geographic characteristics, presents a unique context where access to healthcare services can vary significantly across urban and rural areas.

Objective

The main objectives are:

- To identify the spatial distribution of primary health contaminants
- To examine the travel and movement patterns of patients from their homes to the PHC in relation to their adult indicators.

3. Data base and methodology

3.1. Methodology

Both primary and secondary sources of information have been collected with the objective of fulfilling the mentioned purposes. Cartographic interpretation and data analysis using GIS maps are the most significant analytical tools. 13 PHC centers in the study area were selected through a stratified random sample approach to serve as the sites for the primary data collection for this study. The primary data collection for the purpose of this study was done in the form of questionnaire survey in selected four major health centres of the study area based on stratified area random procedure. The data collected were taken using the method of random sampling based on total number of patients total of 260 samples were drawn. The units were almost uniformly (each 20 samples) drawn from the total by following the spatial distribution of patients with in the selected health care centre. The main sources of secondary health data were collected at joint director of health, and demographic data sources obtained from the respective statistical offices in Madurai district.

In fact, the information often has to be collected at first hand by questionnaire method. Thus desire line maps usually illustrate pattern of movement undertaken for some specific behaviour purpose. The procedure involved in constructing such a map is as follows: a. Identify the health centre in the study area b. Choose a suitable stratified random sampling to analyze the respondents c. Conduct a sample questionnaire survey to discover the travel behaviour pattern on d. Plot each patients travel behaviour pattern to show desire line to built up the finished map based on GIS software techniques. Geographical techniques such as overlay analysis using GIS and suitable statistical techniques were used to analyse the data. In the present study GIS is not only used to locate the spatial location of the health centre, but also used for the analysis of various demographic and health indicators.

3.2. Patients travel pattern

The use of health care services was obtained from the level of utilization and preference of the consumers to these services. This will ultimately help us to understand the spatial behaviour in the movement pattern. The present study approaches the term utilization of movement behaviour only from the point of view of spatial behaviour manifestations of the behaviour to avail distance-based services and how it is attended and like desire line maps have a variety of uses, one of which is to represent the movement of a dispersed population to and from a focal point, such as health centre, PHC, Hospitals etc. Clearly the information required for the construction of a desire line map is more difficult to collect that needed for flow lines.

Details of the origin and destination of each line are similar to flow lines in that their width represent a given quantity of movement. The main difference between them is that a desire line is drawn straight line to know the point of origin and destination and this takes no account of either the actual route followed or the type of transport used. It represents diagrammatically the need for and general direction of movement between two points rather than the flow of traffic along the path of route network. The calculated value of minimum-maximum-mean distance travelled for health care centre are selected by stratified random sampling procedure. The spatial pattern of consumer travel was modeled by maps and movement pattern of desired lines of GIS software(48).

3.3. Health care centers spatial distribution in Madurai district

Madurai district boasts a well-developed healthcare system, featuring a General Hospital (GH) in Goripalayam, Madurai city, and a total of 13 Primary Health Centers (PHCs). (Fig 2). Additionally, a few private clinics cater to the increasing health needs of the population. A sample survey conducted in the study area revealed that approximately 72.98% of

respondents live within 3 km of a health center, 23.17% live 3 to 4 km away and around 3.85% reside more than 5 km from the nearest health center. The region is well-connected by roads to all village panchayats.

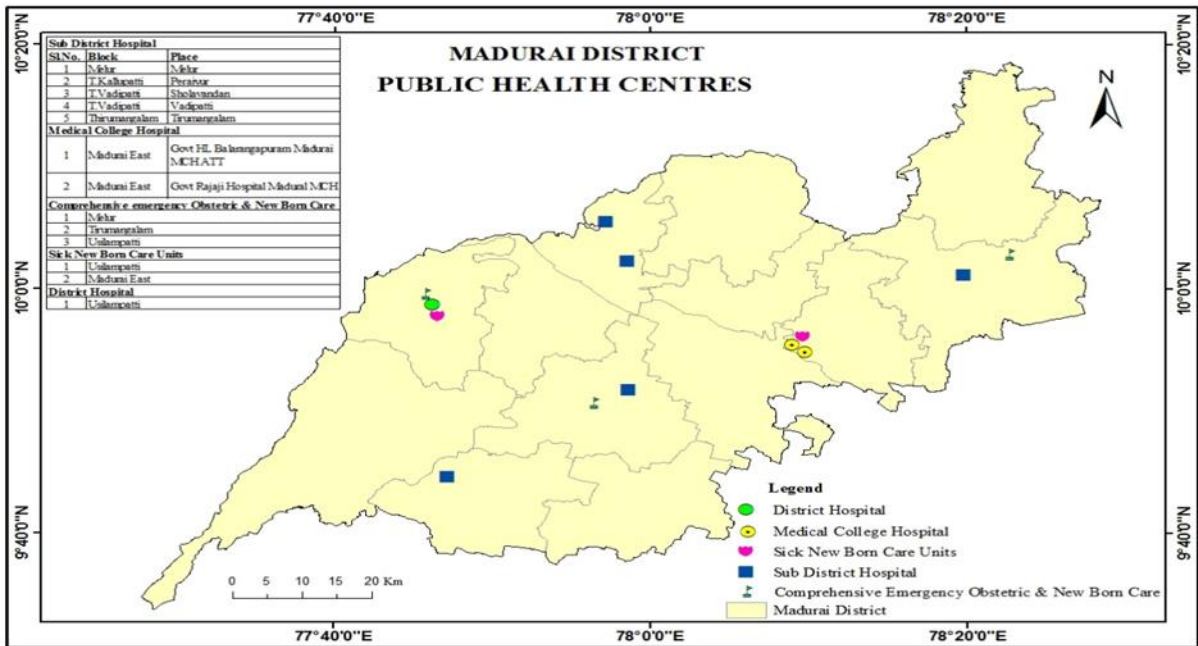


Figure 2 Public health centre's in Madurai district

The modes of transport used by residents to reach health centers vary, with about 46% of respondents traveling on foot, 38% by bus, 11% by two-wheelers, and 5% using other modes. In terms of travel time, approximately 65% of respondents reported that it takes them within 30 minutes to reach a health center, 23% indicated a travel time of 30-45 minutes, 5% needed more than 45 minutes, and 7% could reach within 15 minutes. The availability of free medical services at health centers is another indicator of their efficiency. Regarding wait times, about 58% of respondents reported waiting 15 minutes to see a doctor, 29% said it took 30 minutes, 8% mentioned a wait time of 30-45 minutes, and 5% indicated it took more than 45 minutes to receive treatment.

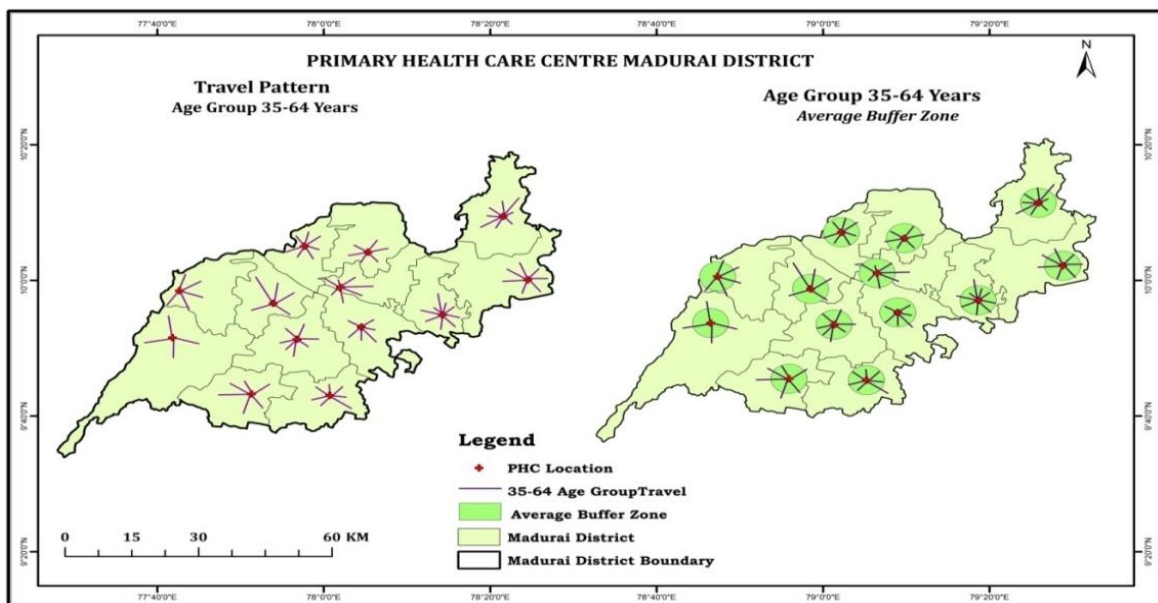


Figure 3 Travel pattern 35- 64 age group

3.4. Adult age travel behavior pattern using overlay analysis

Based on the travel patterns of adults aged 35-64 and those over 64 in Madurai district, buffer and overlay analysis reveal that individuals in the 35-64 age group travel an average distance of 16.05 km to reach primary health centers, which constitutes approximately 46.41% of the total travel distance. (Fig 3). Meanwhile, adults aged over 64 travel an average distance of 10 km, accounting for 33.06% of the total travel distance. The total distance traveled by the 35-64 age group is 208.76 km, while for those over 64, it is 130.09 km. This analysis highlights the disparities in travel distances among different age groups across various blocks in Madurai district, with older adults generally traveling shorter distances. The region is well connected to all villages via road.

5.3 Adult age travel pattern using buffer analysis

The first buffer zone extends up to 1 KM from the PHC shows frequent travel of age group belonging to more than 64 ages (Table 1). In all the thirteen PHCs first buffer zone is the maximum accessible region and second buffer zone is average accessible and third buffer zone is in accessible for the region of less utilization. Only limited number of people comes from the third buffer zone and they are male patients. This travel pattern reveals the general movement pattern of patients in Madurai district to the health centre. From the overall analysis it is clear, that male patients travel longer distance to reach the health centre (49).35-64Adults Aged Average Distance: 16.05 km and Maximum Distance: 20.45 km (Kottampatti), Minimum Distance: 12.9 km (Sedapatti) (Fig 4).

Table 1Adult age (35-64 &> 64) travel pattern – Madurai district

S.No	Adult Age	35-64		>64	
	Blocks Name	Distance in Km	Distance in %	Distance in Km	Distance in %
1	Kottampatti	20.45	9.79	6.7	5.15
2	Thiruparangundram	17.9	8.57	11.3	8.69
3	Madurai-west	15.05	7.21	2.9	2.23
4	Melur	14.6	6.99	6.7	5.15
5	Madurai-east	13.36	6.39	3.39	2.60
6	Vadipatti	16.3	7.80	7.6	5.84
7	Alanganallur	18.7	8.96	11.7	8.99
8	Kallikudi	13.8	6.61	8.4	6.4
9	Thirumangalam	20.3	9.72	7.4	5.69
10	Usilampatti	13.8	6.61	17.9	13.76
11	Chellampatti	13.4	6.42	15	11.53
12	Sedapatti	12.9	6.18	15.5	11.98
13	T.Kallupatti	18.2	8.75	15.6	11.99
Total		X=208.76	> \bar{x} =53.59	X=130.09	> \bar{x} =66.94
		\bar{x} =16.05	< \bar{x} =46.41	\bar{x} =10	< \bar{x} =33.06

Source: Field Work

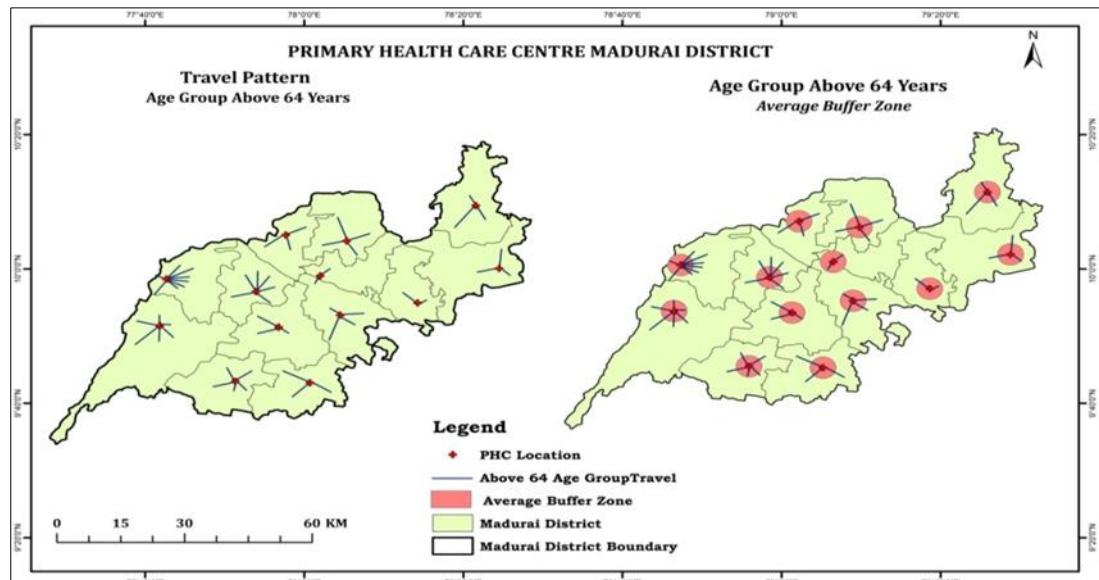


Figure 4 Travel pattern above 64 age group

For Adults Aged above 64 Average Distance: 10 km, Maximum Distance: 17.9 km (Usilampatti), Minimum Distance: 2.9 km (Madurai-west) that adults aged 35-64 generally travel longer distances to reach primary health centers compared to adults aged over 64 in Madurai district. The high accessible blocks are North-western part of Chellampatti, Vadipatti, Kalikudi, T. Kallupatti, and the central part of Madurai west and Madurai east. In Thirumangalam, Thiruparangundram blocks have medium accessibility and Kottampatti, Melur, Sedapatti blocks have very low access.

4. Conclusion

Travel patterns of those aged 35 to 64 and those over 64 in Madurai district, as revealed by buffer and overlay analysis, suggest significant disparities in primary health care access. The study emphasizes that male patients often travel longer distances to health centers. Madurai East, Thirumangalam and Thiruparangundram blocks have medium accessibility, whereas Kottampatti, Melur, and Sedapatti blocks have extremely limited access. Finally, the study emphasizes the importance of targeted public health strategies to promote accessibility, particularly for the elderly and those living in blocks with limited access to primary health clinics. Improving road connections and increasing healthcare facilities in disadvantaged regions might reduce travel burdens and increase healthcare use in Madurai district.

Compliance with ethical standards

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Disclosure of conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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