



## Geographical Distribution of Diabetes Patients in Edduiem Locality, White Nile State, Sudan

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### Article Info

#### Article History:

Published: 4 April 2026

#### Publication Issue:

Volume 3, Issue 4  
April-2026

#### Page Number:

31-38

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### Abstract:

The study aimed to know the geographical distribution of diabetes patients in Edduiem locality, White Nile State, within the framework of medical geography, focusing on the relationship between the spatial prevalence of the disease, the distribution of health services, and geographical and social factors. The study used the descriptive-analytical approach and a spatial methodology, utilizing data from hospital and health center records, in addition to data from (33) district. The study found a clear spatial variation in the prevalence of diabetes among local neighborhoods, with the highest concentration of cases in densely populated neighborhoods close to health facilities, reflecting the impact of health coverage and access to medical services. The study recommended adopting geographic information systems (GIS) in health planning and strengthening prevention and early detection programs to contribute to achieving health equity and an effective response to the burden of chronic diseases.

**Keywords:** Medical geography, Diabetes, Spatial distribution, Health services, Edduiem locality

### 1. Introduction

In recent decades, the world has witnessed a remarkable shift in the health landscape, characterized by an increasing burden of non-communicable diseases, most notably diabetes. Diabetes has become one of the most prominent global health challenges and one of the most widespread diseases in the world today, affecting a large portion of the population. It is a disease that has been known to humankind for a very long time, with the ancient Egyptians being aware of it nearly 3,000 years ago and it was found recorded on Egyptian papyrus (Al-Saba'i, 1409, p3). The Muslim scholar Ibn Sina also linked foot ulcers to diabetes around the year 1000 AD. Interest in this disease has increased recently due to the steady rise in the number of people affected by it in most countries of the world. The percentage of deaths from diabetes is 5% of the total deaths in the world annually, and 80% of those affected by the disease live in developing countries with middle and high incomes (WHO, 2024, p6). In this context, medical geography has emerged as a significant applied branch of geography, providing analytical tools for understanding the spatial distribution of diseases and their relationship to environmental, social, and service-related factors. Edduiem locality in White Nile State is of particular importance, encompassing a network of hospitals and health centers, in addition to thirty-three residential areas that vary in their demographic characteristics and levels of healthcare services. This diversity provides a suitable environment for studying the

spatial distribution of diabetes within the framework of medical geography, and for linking prevalence patterns to healthcare services and accessibility.

### **Medical Geography: Concept and Development**

Medical geography is defined as a branch of human geography concerned with the spatial distribution of diseases, the geographical factors affecting human health, and the analysis of the relationship between the natural and human environments and health patterns. This field has evolved from a traditional focus on infectious diseases to an increasing interest in chronic and non-communicable diseases, particularly in light of urbanization and socio-economic changes (Sharaf, 2003, p18).

### **Diabetes**

Is a chronic disease characterized by high blood glucose levels due to impaired insulin secretion or effectiveness, or both? This disease results from either genetic or environmental factors, particularly in the elderly, or from changes in the body's immune system, especially in children who often come from families with a history of the disease. Diabetes is primarily classified into two types:

#### **Type One**

This is called insulin-dependent diabetes. This type affects young children, adolescents, and young adults. On average, it affects one in every 200 people in the community. It results from genetic factors that make the affected person susceptible to environmental factors represented by viral infections that lead to an autoimmune disease. The immune system produces antibodies targeting the pancreatic cells responsible for insulin secretion and stimulating lymphocytes to attack these cells, causing them to stop secreting insulin.

#### **Type Two**

Known as non-insulin-dependent diabetes, is the most widespread form, representing 55-75% of all diabetes cases and affecting 3 out of every 100 people in the population. This type typically affects middle-aged and older adults and is often associated with obesity. Heredity plays a greater role than in type 2 diabetes, as the body's cells become unresponsive to insulin. It is the most common type worldwide (Babble, 2002, p9).

### **The Global Status of Diabetes**

International reports indicate that diabetes is one of the fastest-growing chronic diseases worldwide, posing an increasing health and economic burden, particularly in developing countries. The literature confirms that the geographical distribution of the disease is not homogeneous, but rather influenced by factors such as urbanization, income level, quality of health services, and accessibility (American Diabetes Association, 2004, p18).

### **Medical Geography and the Study of Diabetes**

Numerous studies have shown that the spatial analysis of diabetes contributes to:

- 1) Identifying areas with the highest disease burden
- 2) Revealing gaps in health coverage
- 3) Supporting health planning based on spatial equity (Junaid, 1984, p23).

### **Study Problem**

The problem addressed in this study is the lack of a precise spatial analysis of diabetes prevalence in Edduiem locality, and the unclear correlation between the geographical distribution of the disease and the distribution of health facilities. This may limit the effectiveness of health planning and the response to the disease burden. Furthermore, diabetes represents an economic burden on countries due to the need for continuous treatment as a chronic disease. It also affects individual productivity and, consequently, the national economy. The number of deaths among working-age individuals due to the disease leads to a high dependency ratio.

**Study Objectives:** This study aims to achieve the following objectives:

- 1) Analyze the geographical distribution of diabetes patients in Edduiem locality.
- 2) Highlight the high prevalence of diabetes in Edduiem locality.
- 3) Demonstrate the differences in prevalence between males and females.
- 4) Provide scientific recommendations to support spatial health planning.

## 2. Study Methodology

The study employed a descriptive-analytical approach and a spatial approach. Data were collected from the statistical records of hospitals and health centers in Edduiem locality regarding individuals with diabetes.

### Study Area

Edduiem locality in White Nile State is located on the west bank of the White Nile. It is characterized by a clear urban and demographic diversity, comprising thirty-three residential neighborhoods, in addition to a number of hospitals and health centers serving the locality and surrounding areas.

### The Analytical

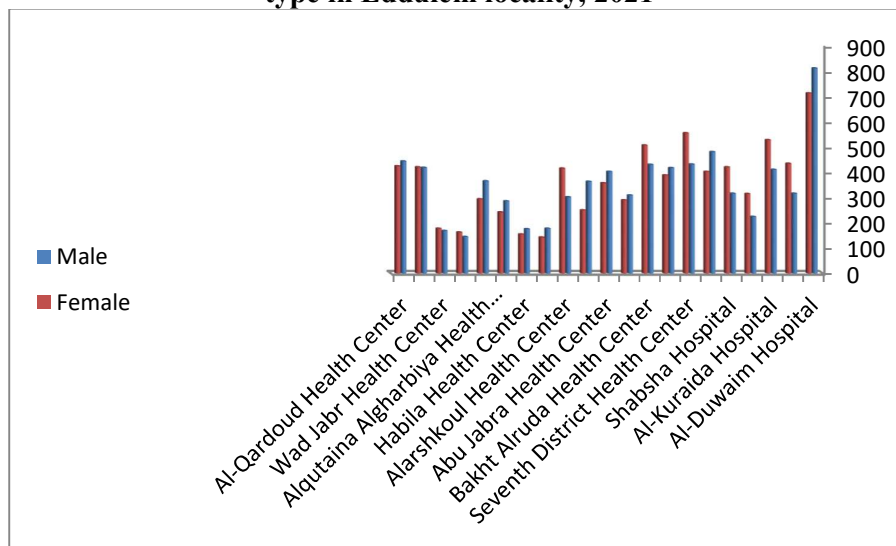
**Table (1) Frequency Distribution of the Number of Hospitals, Health Centers, and Diabetes Patients by Type in Edduiem Locality, 2021**

Hospital (Center) Name/Type	Female	Male	Hospital (Center) Name/Type	Female	Male
Al-Duwaim Hospital	712	810	Keteer Balla Health Center	251	364
Umm Jar Hospital	435	317	Alarshkoul Health Center	416	303
Al-Kuraida Hospital	528	411	Alshatib Health Center	143	178
Al-Ban Jadid Hospital	316	225	Habila Health Center	155	176
Shabsha Hospital	421	317	Altura'a Alkhadra Health Center	243	287
Al-Zariqa Hospital	403	481	Alqutaina Algharbiya Health Center	295	366

Seventh District Health Center	555	432	Alhalba Health Center	163	145
Tenth District Health Center	389	418	Wad Jabr Health Center	178	169
Bakht Alruda Health Center	507	431	Alshurta Neighborhood Health Center	421	419
Alwihda District Health Center	291	310	Al-Qardoud Health Center	425	444
Abu Jabra Health Center	358	403			

Source: Fieldwork, visits to hospitals and health centers, 2021.

Figure (1) Frequency distribution of the number of hospitals, health centers and people with diabetes by type in Edduiem locality, 2021



From Table (1) and Figure (1), it is clear that the number of primary healthcare centers is (21) centers in all neighborhoods of Edduiem locality. It should be noted that these centers are not located in all (36) neighborhoods of Edduiem locality. The number of patients registered in primary healthcare units varies from one hospital to another and from one center to another. The total number of diabetic patients registered in the Diabetes Medication Dispensing Regulation Program at the Medical Information and Statistics Center of the Primary Healthcare Administration reached (15,118) patients in 2021, representing (2.8%) of the total number of patients registered in healthcare centers in White Nile State. This percentage is much lower than the known prevalence of the disease in Sudanese society, which ranges between 19% and 25% (White Nile State Primary Healthcare Information Center, 2022). This significant discrepancy between the recorded percentage and the actual percentages in Sudanese society is attributed to:

- a) The differences in the economic and social characteristics of the population in Edduiem locality.

b) The varying levels of care provided by health centers for diabetic patients, which influences patient preference over other centers.

Hospitals: The highest percentage was recorded at Edduiem Hospital, reflecting the locality's high volume of patients. This is attributed to the regular influx of villagers seeking shopping and medical treatment there. The lowest percentage was recorded at Al-Ban Jadid Hospital at 3.6% (541 patients), due to patients seeking specialized care at clinics and their ability to purchase medication. Health centers in residential neighborhoods can be categorized according to the percentage of diabetic patients relative to the total population as follows:

**Category One:** More than 6%, including the Seventh District, Bakht Alruda, and the Police District.

**Category Two:** Health centers with a percentage of diabetic patients ranging from 5% to less than 6%, including the Tenth District, Abu Jabra, and Al-Qardoud.

**Category Three:** 4% to less than 5%, including Al-Wahda, Katir Balla, Al-Arshkoul, and Alqutayna Algharbiya.

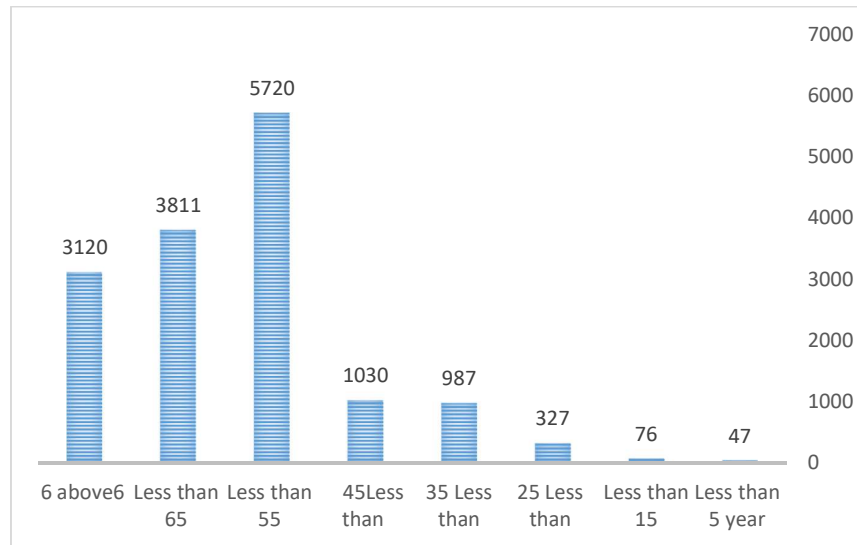
**Category Four:** 3% to less than 4%, including Altur'a Al-Khadra.

**Category Five:** 2% to less than 3%, including Wadjabr, Alhalba, Habila, and Alshatib.

**Table (2) Frequency distribution of the number of people with diabetes according to the age structure of the population in Edduiem locality, 2021**

Categories	Number
Less than 5 year	47
Less than 15	76
Less than 25	327
Less than 35	987
Less than 45	1030
Less than 55	5720
Less than 65	3811
66 above	3120

**Figure (2) Frequency distribution of the number of people with diabetes according to the age structure of the population in Al-Duwaim locality, 2021**



### Distribution of Diabetes Patients by Population Composition

Table (2) and Figure (2) point out that the total number of registered diabetes patients in health care centers in Edduiem locality reached (15,118) patients, of whom (7,706) were males (51%) and (7,412) were females (49%). The disparity in the percentage of males and females affected by the disease is evident as follows:

- The percentage of females with diabetes exceeded that of males in Edduiem Hospital (53.2%), Alzariqa Hospital (54.4%), and in nine neighborhood health centers.
- The highest prevalence of diabetes is among males at Al-Ban Jadid Hospital, reaching 58.4%, while the highest prevalence among females is 55.5% at Alshatib Health Center. The higher prevalence among females is attributed to their lower mobility compared to males and their reliance on transportation.
- The number of diabetes cases varies significantly according to age, with a higher incidence in older and middle-aged individuals, representing 13,681 out of 15,118 cases, or 90.5% of the total.

### 3. Results and Discussion

The study revealed a significant spatial disparity in the distribution of diabetes patients, with cases concentrated in densely populated neighborhoods, while peripheral neighborhoods recorded lower rates. Proximity to healthcare facilities was also found to be associated with higher diagnosis rates, reflecting the effect of easier access to healthcare services rather than necessarily a true increase in prevalence.

#### Results

- Diabetes is a chronic disease requiring ongoing treatment. Therefore, many patients with low and middle incomes visit health centers to receive free treatment each month.
- The percentage of males with diabetes is higher than females in most neighborhoods of the locality. This is attributed to the frequent invitations extended to men to feasts, leading to excessive consumption of rice and meat, in accordance with local traditions. In contrast, females tend to avoid overindulging in rich foods to maintain their figures.

- 3) The 45-55 age group recorded the highest rate of diabetes, as did older age groups. Children and young adults recorded the lowest rates of the disease.
- 4) Diabetes in Al-Duwaim locality is characterized by an uneven distribution across the neighborhoods.
- 5) Health services play a pivotal role in disease detection.
- 6) There is an urgent need to adopt spatial analysis in health planning to reduce the incidence of the disease.

### **Recommendations**

- 1) Raise awareness about a healthy diet that includes essential nutrients, especially vitamins (sourced from fruits and vegetables), along with proteins and fats.
- 2) The Sudanese Ministry of Health should expand the distribution of medication to a larger number of patients to encourage regular adherence and thus reduce the mortality rate from diabetes.
- 3) Increase public awareness through media campaigns about the importance of regular checkups and medical tests for early detection of diabetes, and the necessity of adhering to daily and consistent medication regimens if diagnosed.
- 4) Focus on preventative healthcare services to educate those most vulnerable to diabetes (prevention is better than cure).
- 5) Reassess the geographical distribution of health centers to ensure equitable access to healthcare.
- 6) Educate the population about the nature of the disease, inform them about optimal treatment methods, and promote early detection at the neighborhood level.
- 7) Develop health services and programs to align with global advancements and integrate Geographic Information Systems (GIS) into healthcare systems.

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