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The Geographical Distribution of Health Services: A Stake for Sustainable Human Development in the Central High Plateaus Region of Algeria

Choufi Abdelhamid
Department of Earth and Universe Sciences, Faculty of Natural and Life Sciences, University of Djelfa, Algeria

Dr. Assia Lifa*
[1] – *Algerian Forest and Climate Change Laboratory Biodiversity and Forest Ecosystem "BEFOREST", Frères Mentouri University, Algeria*
[2] –*Faculty of Earth Sciences, Department of Geography and Land Use Planning, Constantine, Algeria*
ORCID ID: 0009-0005-4793-6396
*Corresponding author

Abstract
The geographical distribution of health services in the central Algerian High Plateaus region is a crucial factor in achieving sustainable human development. The availability and quality of these services directly impact the living standards and health of the population. This region suffers from a clear disparity in the distribution of hospitals and health centers between urban and rural areas, leading to difficulties in accessing necessary medical care particularly in light of the shortage of medical equipment and weak infrastructure. Geographical factors, such as long distances and rugged terrain, pose additional challenges that hinder equitable access to health services. Furthermore, the health sector in these areas faces problems related to limited financial resources and an unbalanced distribution of medical personnel, resulting in a decline in the quality of health services. To achieve sustainable health development, it is essential to adopt effective strategies that include improving health infrastructure, encouraging doctors to work in remote areas through appropriate incentives, developing transportation and ambulance services, and utilizing modern technology such as telemedicine to overcome geographical barriers. Improving the equitable distribution of health services in this region is a fundamental stake in ensuring social justice and promoting sustainable human development. Analysis of developments in the sector and its geographical focus over 26 years (1998-2024), according to national and international classifications and standards.

Keywords
Geographical distribution, Healthcare services, Human health resources, Sustainable development

1. Introduction
The equitable geographical distribution of health services is a fundamental pillar for achieving sustainable human development, as it is directly linked to improving the level of public health and reducing health disparities among populations (World Health Organization [WHO], 2021). According to the World Health Report 2021 by the World Health Organization, rural and remote areas suffer from a clear lack of health infrastructure, which limits the population's ability to access basic medical care. A World Bank report (World Bank, 2019) also indicates that the disparity in the distribution of health facilities and medical personnel leads to a decrease in the efficiency of health systems, which directly affects health indicators such as maternal and child mortality rates in developing countries. In a study published by The Lancet (Kruk et al., 2018), it was proven that improving the geographical distribution of health services can reduce mortality by up to 30% in areas with limited health services, by enhancing access to basic medical care; Additionally, a study published in the International Journal for Equity in Health (McGrail & Humphreys, 2019) confirms that rural areas in many countries suffer from a shortage of doctors and health specialists, requiring the implementation of incentive policies, such as financial incentives and field medical training, to ensure equitable distribution. A report issued by the United Nations Development Programme (UNDP, 2020) also indicates that achieving sustainable development in the health sector requires investments in telemedicine technology, which has proven effective in improving access to health

services in isolated areas. In this context, a study published by Health Affairs (Bailey et al., 2021) demonstrates that the use of technological innovations, such as mobile clinics and digital health services, has contributed to improving the delivery of healthcare in less developed regions

Based on these studies, improving the distribution of health services requires multifaceted strategies that include developing infrastructure, incentivizing medical personnel to work in remote areas, and investing in modern technological solutions to ensure more equitable and efficient access to health services, particularly in challenging geographical areas such as the Algerian High Plateaus. The concept of human development has gained special and increasing attention since 1990, when the United Nations Development Programme (UNDP) formed a team of experts to research the concept of human development and produce periodic international reports (Global Human Development Reports) and regional reports (such as the Arab Human Development Reports).It is no secret that while the term "sustainability" mandates economic development that is mindful of the environment and the interests of future generations in not depleting natural and environmental resources, the term "human" is what has become synonymous with the nature of the development to be achieved in time and place. As for Algeria, as one of the developing countries, the United Nations Human Development Report for 2023/2024, titled "Breaking the Gridlock: Reimagining cooperation in a polarized world," confirmed that it is among the third world countries that are first in long-term development achievements. The Human Development Index in Algeria has recorded a significant increase over 35 years. Accordingly, Algeria ranked (93) globally compared to (193) countries, which enabled it to achieve a qualitative leap by moving from the category of countries with a low Human Development Index in the 1990s (equal to 0.574) (UNDP, 2024) to the ranks of countries experiencing a high human development rate in the latest UNDP report for 2023/2024 (equal to 0.745). Knowing that the maximum or ideal value of the index is 1 (UNDP, 2015).Based on the foregoing, the availability of health services of all kinds plays a significant role in achieving sustainable human development, given its positive impacts on other development sectors as a factor of attraction and stability for residents within administrative units. By analyzing and studying the evolution of their spatial distribution at the administrative unit level, we can determine their adequacy and efficiency. Health institutions are distributed unevenly across the study area. There are differences between and within administrative units. Furthermore, there are significant disparities between urban and rural populations, particularly in their ability to access health services.

2. Materials and methodological approach

2.1. Study area

This study concerns the Central High Plateaus region, which serves as a link between the four cardinal directions of the country (approximately 300 km south of the capital). Its area is 75,483 km² (SRAT, 2007), representing about 3.26% of the total national territory, and its total population is 3,932,833 according to the results of the Directorates of Planning and Budget Monitoring in 2024. It is bordered by the following provinces: Setif, Bordj Bou Arreridj, Bouira, Medea, and Tissemsilt to the north; Ghardaia to the south; Batna, Biskra, and Ouargla to the east; and Tiaret and El Bayadh to the west. The administrative structure of the region consists of three (03) provinces: (M'sila, Djelfa, and Laghouat), with a total of 37 districts, followed by 107 municipalities, as shown below in (Figure 01)

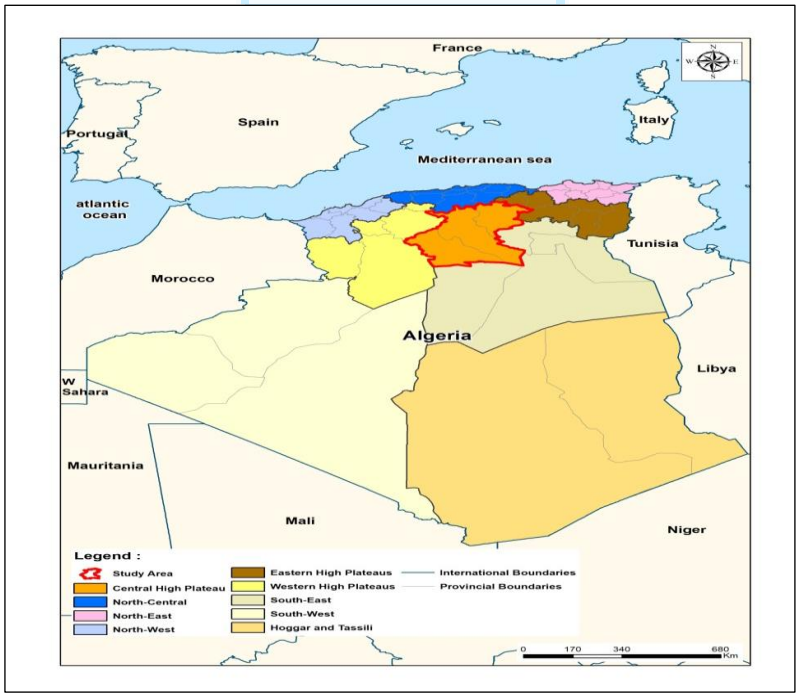

Fig. 1 Geographic location of the high plateaus region, central Algeria

The Central High Plateaus region is located within the central part of the steppe region, characterized by diversity and complexity in its topographic features. Consequently, its average altitude ranges from (400 m to 1700 m) above sea level.

It consists of two main sections: the plain section and the mountainous section. Geologically, the study area is formed of sediments dating back to the second geological era. (Figure 02) illustrates that sedimentary rocks constitute the vast majority of the High Plateaus area, which is enclosed between the two mountain ranges, the Tell Atlas and the Saharan Atlas, and which conceals significant water pockets.

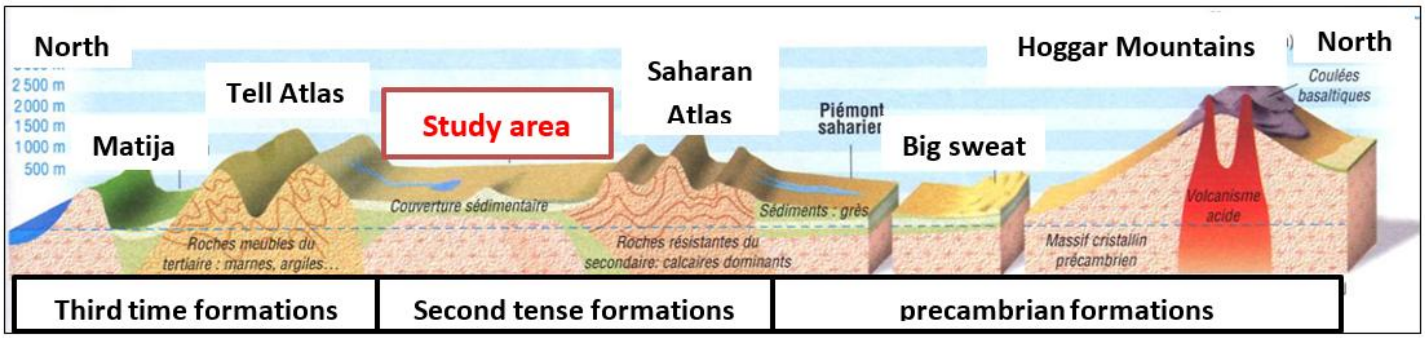

Fig. 2 Longitudinal section (north-south) of Algeria showing the most important topographical and geological units
Source: Regional land use planning scheme (R.L.P.S) for the central highlands by 2025, volume 02, p 03.

To determine the general climate of the study area, in the elevated regions, we record a semi-arid climate, characterized by monthly temperature averages exceeding monthly precipitation averages from May to September, and the opposite in the remaining months of the year.
As for the second, it indicates that the regions close to the desert are dominated by an arid climate. Consequently, monthly temperature averages are almost always higher than monthly precipitation averages throughout the year.

2.2 Materials and methodologies

The study of the geographical distribution of health services relies on quantitative and qualitative methodologies, where demographic and health data are analyzed using Geographic Information Systems (GIS) and specialized statistical software. According to the World Health Organization (WHO, 2021), geographical analysis is an effective tool for identifying health gaps and distributing medical facilities more equitably.The study relies on primary data from field surveys and questionnaires conducted with residents and health officials, as well as secondary data derived from reports of the Algerian Ministry of Health and international organizations such as the World Bank (World Bank, 2019). Data are analyzed using statistical programs like SPSS to extract health indicators, while software like ArcGIS is used to create digital maps that illustrate the distribution of hospitals and health centers relative to population density (McGrail & Humphreys, 2019). Heatmaps are also used to identify areas suffering from service shortages, along with charts like pie charts, population pyramids, and histograms that facilitate the comparison of health service development over time.This methodology contributes to providing a precise visual analysis that helps decision-makers develop more equitable and effective health policies, thereby enhancing sustainable human development, especially in areas with challenging terrain such as the Algerian Central High Plateaus (UNDP, 2020).

3. Results and Discussion

The study area, by virtue of its quadruple nature: location, area, population, and administrative organization (107 administrative units), is characterized by heterogeneity in terms of natural and human potential, which inevitably has an impact on the overall distribution of health services.

3.1 Evolution of Size and Trends of Population Growth Rates

The official results of the General Housing and Population Censuses (R.G.P.H) issued by the National Statistics Office (O.N.S) in Algeria, in addition to the data from the Directorates of Planning and Budget Monitoring, have shown the extent of population change in the Central High Plateaus region during the period (1966/2024). We find that the population has almost quadrupled (3.91 times) in more than four decades (42 years), with an increase of (1,883,633 people), an average of nearly one million people every quarter of a century (25 years) between 1966 and 2008, and about 3,279,603 people compared to the 2024[1] estimates. This means that the population of the study area has increased by about 6 times in 58 years, at an average of 56,545 people per year, as follows:

(1) In population estimates, we relied on the following equation: **Pn = p0 (1+r)n**

where: **Pn**: population in the subsequent census, **p0**: population in the previous census
r: annual population growth rate, **n**: number of years between the two censuses.

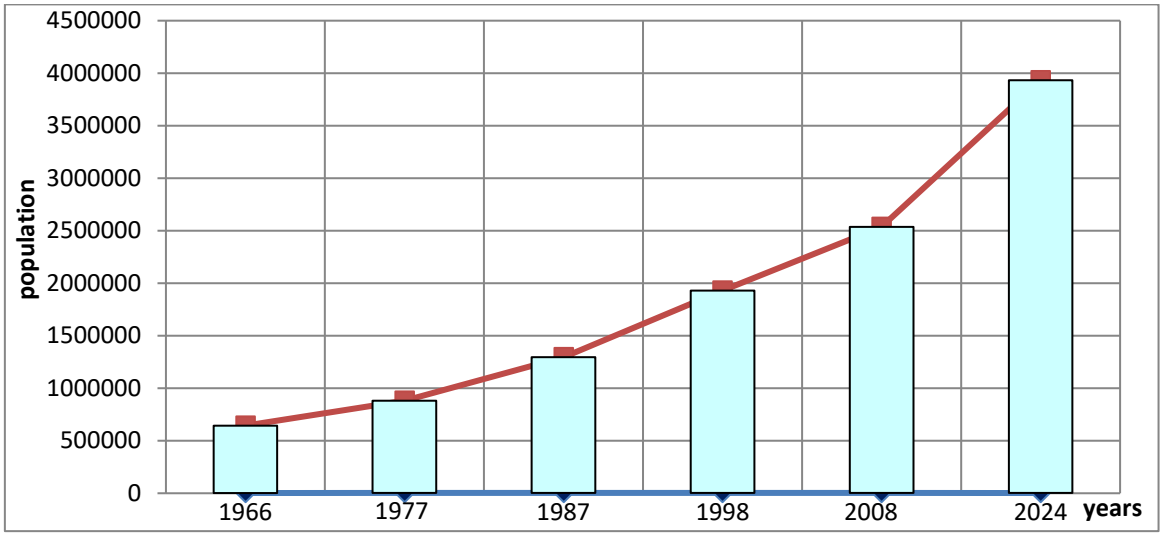

Fig. 3 Evolution of the population of the central highlands region during the period (1966/2024)
Source: National Bureau of Statistics (1966, 1977, 1987, 1998, 2008+populations projections 2024

The population growth rate(1) in the study area (Figure 03) is therefore higher than the national average over 58 years, except for the period (1966-1977), and it exceeds it by double during the decade from 1998 to 2008, where this rate is 1.6% at the national level and 2.65% in the study area. Like most regions of Algeria, the period 2008/2024 witnessed a continued decline in the population growth rate, which decreased from 2.65% between 1998/2008 to 2.62% between 2008 and 2024. While the national rate decreased from 1.6% to 1.52% during the same period. However, the high population growth rate in the region as a whole conceals a large disparity between the municipalities of the three provinces. Very high rates were recorded in a number of municipalities, most notably the municipalities of Zarzur and Ouled Sliman in M'sila Province (10%, 7.3%) and Ain Sidi Ali in Laghouat (9.7%), compared to a sharp decline in other municipalities (12 municipalities), such as those that recorded a significant decline with a negative rate ranging between (-0.5% and -6%). It is not expected that the overall average rate will witness a significant decline in the next few years because population growth in the study area is only experiencing a slow decline. Under the assumption of continuing the same growth rate recorded during 2024, the population residing in the study area will reach 5,896,506 people on January 1, 2039 (long-term).

(1) The annual population growth rate is calculated according to the following equation:

$$r = ((pn/p0)^{(1/n)} - 1) * 100$$

where: **r**: annual population growth rate, **pn**: population in the subsequent census,
p0: population in the previous census, **n**: number of years between the two censuses.

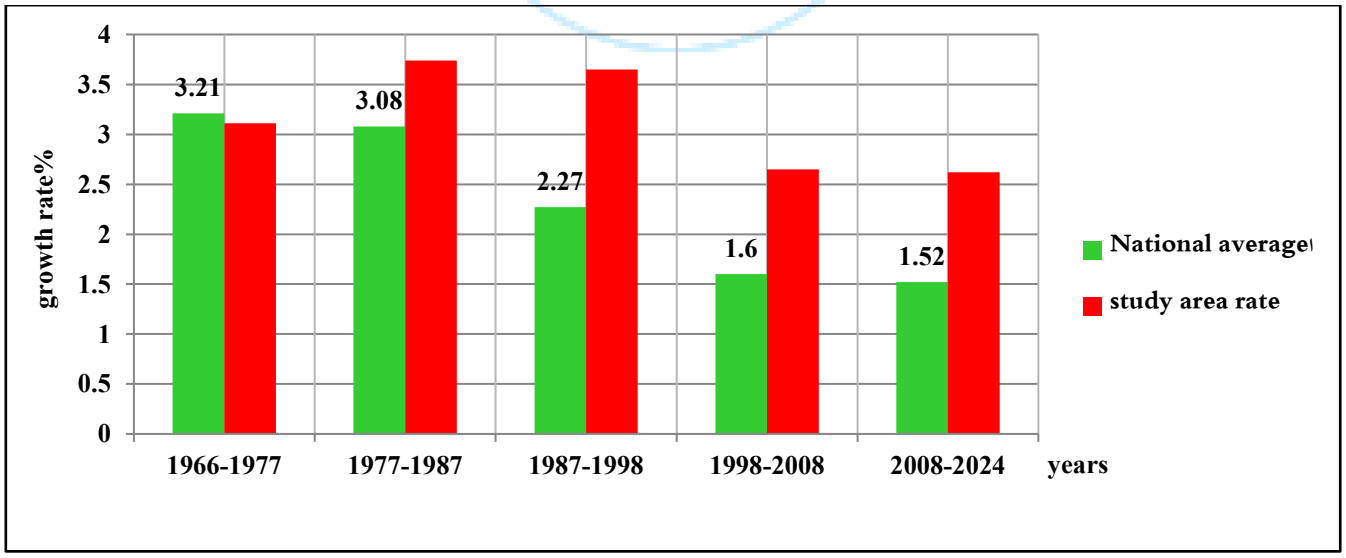

Fig. 4 Evolution of the annual growth rate of the central high plateaus region 1966/2024
Source: National Statistics Office + Directorates of Planning and Budget Follow-up + Population Projections

3.1.1 Age and Gender Structure

The population pyramid of the Central High Plateaus region belongs to the category of expanded pyramids, also known as broad-based pyramids, which are generally characterized by large proportions of the population in younger age groups and, conversely, small proportions of the elderly. This indicates that the population pyramid of this region (the expanded pyramid) is characterized by rapid growth, with a high percentage of youth and children among the population. This

constitutes an advantage for the region, but it poses a continuous challenge for expansion in various services, including health and education, and the resulting provision of jobs in the next few decades. In 2024, according to the Directorates of Planning and Budget Monitoring for the provinces of the study area, 32.32% of the region's total population of 3,923,642 were under 14 years old (young age group/high dependency). The population aged 15 to 64 (middle age/working) constituted about 56.04% of the total population, indicating that we are studying a young and youthful society, as evidenced by the broad base of the pyramid, and 11.64% are dependents, retirees, or the elderly. By 2039 (long-term), the number of young people under 25 is estimated to reach 3 million (2,803,980 people), and nearly one million (881,236 people) for the 06-19 age group. In parallel, the population pyramid data (Figure 04) shows a male percentage of 50.99% of the total population, which is equivalent to 102 males per 100 females, knowing that the national average is 103 males per 100 females (ONES, 2020-2024). This is natural because the index called "sex ratio" ranges in almost all countries of the world between 100 and 105 (Dr. Hassan bin Ibrahim Al-Muhannadi, 2014). Accordingly, the above data can be explained by several reasons, the most important of which are the high fertility rate, improved health services, increased life expectancy, and quality of life. Therefore, the general trend of the population, as mentioned above, will witness an increase in the population in the future due to the wide base of the young age group.

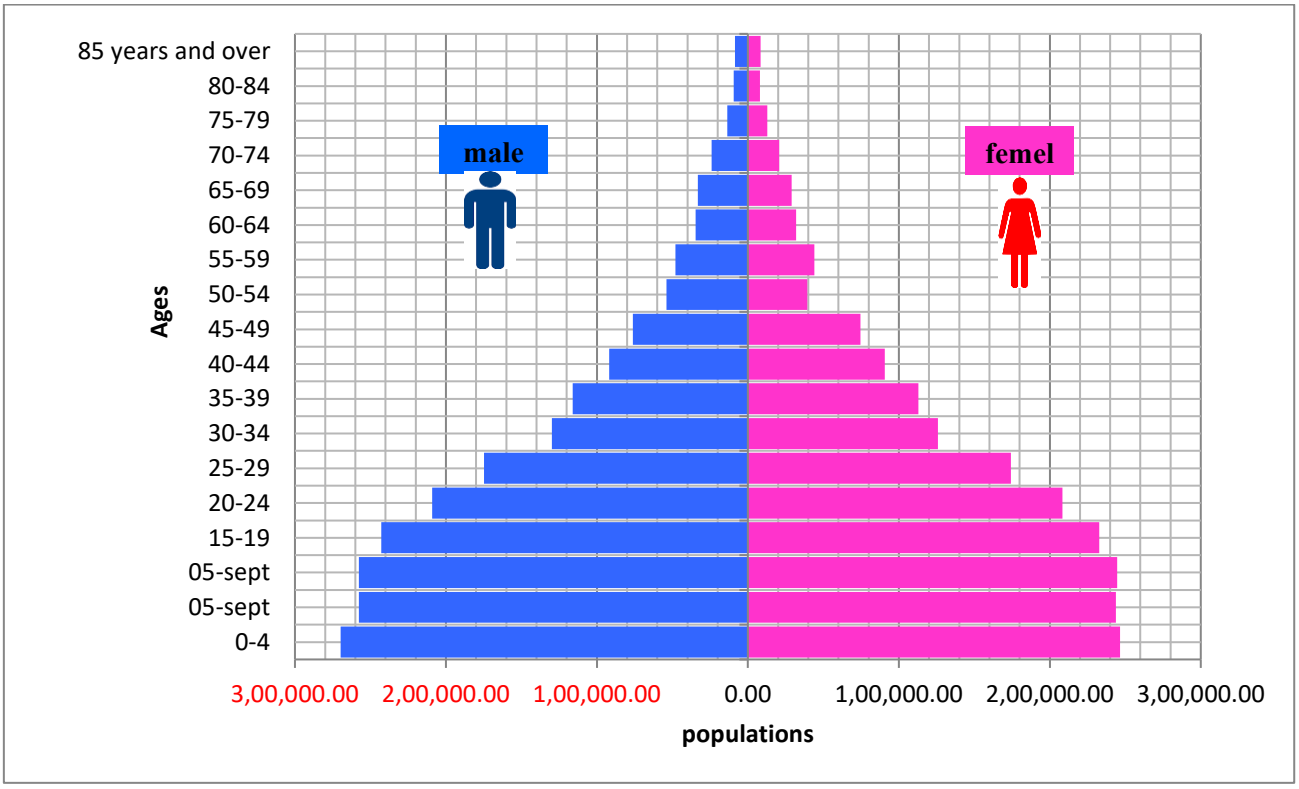

Fig. 5 Population pyramid of the highest plateaus region of central Algeria in 2024
Source: prepared by the researcher and based on population data for the year 2024

3.2 Population and Space: Urbanization and Ruralization, Concentration and Population Density

The increasing percentage of urban population in the Central High Plateaus region is a reality shared with all Algerian regions, where the number of urban residents exceeds the number of rural residents. The pace of urbanization in the study area recorded its lowest value during the period 1977-1987 at 3.63%, followed by the period 1998-2008 at 4.55%, then the period 2008-2024 at 11.61%, which are rates higher than the national average for the same periods, which are 3.19%, 3.35%, and 9.17% respectively (DPAT, 2024). The waves of migration resulting from rural exodus have affected the cities of the study area with a kind of urban glut or excess. The first signs of this excess were evident in the increase in population from about 900,000 people in the second population and housing census in 1977 to more than 2,540,000 people in the fifth census in 2008, where the net migration share contributed to increasing the urbanization rate by 58.3% during the period 1926-1931, 43.70% during the period 1977-1987, and 44.3% between 1998-2008 (ONS, 2008). This led to a significant, sudden, and rapid acceleration in the urbanization process as a result of improved social and economic conditions within cities, and the emergence of industrial and service centers around major cities. These factors, combined with other factors, including security conditions, had a significant impact on attracting residents from various population-expelling administrative units to population-attracting agglomerations. There is no doubt that regional disparities between the administrative units of the study area are one of the main factors of internal migration, where the attraction factors in cities, especially the availability of job opportunities and services, helped the rural population to migrate to urban centers.
By calculating the Eldridge index(1) for the study area, it is observed that it takes an upward trend during the period 1987-2024, where its value reached 10.32% between 1998 and 2008, and then began to rise to reach 11.61 for the period

2008-2024. Thus, it can be said that the phenomenon of urbanization in the study area during the various censuses took an upward trend, estimated at about 1% per year.

Eldridge index = UT-U0*100

where: (1) Eldridge index = UT-U0*100, where: **U0**: percentage of urban population relative to the total population in the previous census, **Ut**: percentage of urban population compared to the total population during the census.

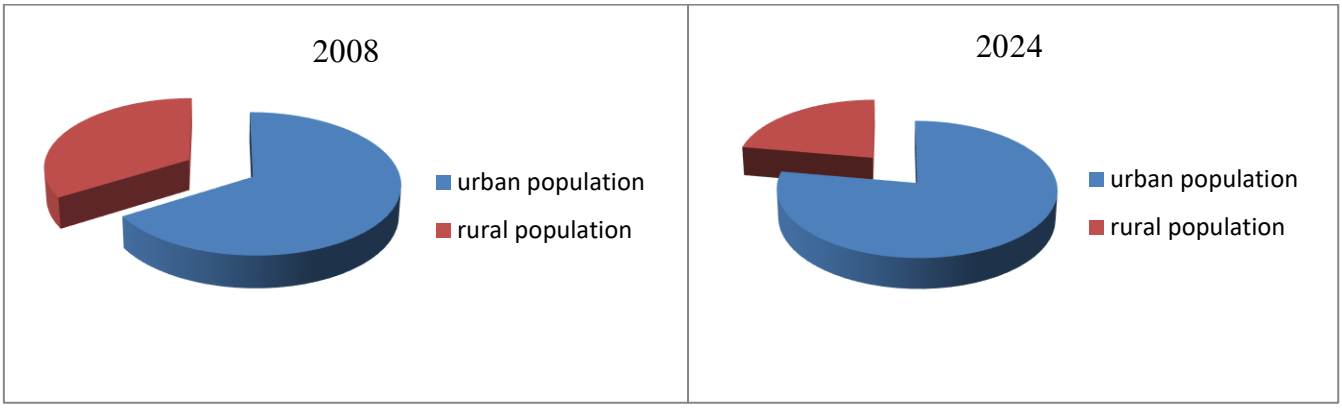

Fig. 6 Urban and rural population distribution of the Central High plateaus region (2008-2024)
Source: National Bureau of Statistics 2008 and Directorates of Planning and Budget Follow-up 20024

Demographic data indicate that the Central High Plateaus region in Algeria has moved from the seventh position in terms of population size in the 1977 census, with approximately 900,000 people, to the fifth position in the 2008 census with a population size of 2,537,037 people (ONES, 2008), and then 3,932,833 people in 2024. When the population variable is linked to the area variable, the average population density also changed from 24.02 people/km² in 1987 to 33.64 people/km² in 2008 and 52.10 in 2024, considering that the area variable is constant and equals 75,463.41 km². This population density data places the study area in a middle position, between the northern region, which has the highest densities, and the desert region, which is at the bottom of the population density scale.

This pattern of spatial distribution of population density across the study area, which is accurately reflected by the data in the subsequent map, indicates the extent to which natural factors dominate in drawing the road map for population distributions on the one hand, and the weakness of the effectiveness of human indicators that are translated on the ground by reaping the fruits of development efforts. This has kept the population distribution in its natural and historical framework, far from any planned and visible changes. To support the foregoing, we use the calculation of the population concentration index(1), which aims to show the extent of spatial equity in the distribution of the population across the various administrative units in the study area, regardless of the difference in area and population. By applying the aforementioned law, it is noted that the population concentration index of the study area has taken an upward trend, moving from a value of 0.75 in 2008 to 1.28 in 2008. It is also noted that the two mentioned values deviate from the ideal value in the equal spatial distribution of the population, which is the value of absolute zero. This is explained by the existence of population concentration in the study area in certain poles (municipalities) at the expense of other municipalities, which are estimated in number - as we mentioned - at more than a third of the administrative units in both censuses. This naturally requires a balanced development policy that aims to redistribute and spread the population across the study area regularly, which we will support by calculating the so-called redistribution index (2).

The first inferential interpretation of the distribution of cities to the gradient scale of urban center sizes in terms of urban services. Central places, according to Christaller's theory (Walther Christaller), are linked to their regions by economic relations that increase or decrease according to the level of services provided by each. On this basis, the dominance or priority measure is the simplest measure of concentration, as it relates the population of the largest city to the total urban population of the next three cities in population size.

By applying the Christaller theory scale to the administrative units of the study area, by dividing the population of the city that ranks first in terms of population size by the total population of the three cities that follow it, according to the figures carried by the 2024 population projections, it was noted that there is an average index equal to (67.74%), which indicates the dominance of the capital municipality of Djelfa over the rest of the three urban centers that follow it, namely: Laghouat, M'sila, and Bousaada. This indicates in all cases the possibility of other municipalities competing with the aforementioned municipalities in urban dominance, but the capital municipalities of the three provinces remain the first municipalities in attracting population numbers, and their population is much larger than the population of the municipalities that come in the first three places.

(1) The population concentration index is measured by dividing the number one hundred (100) by the total number of administrative units (municipalities) in the study area. Since the number of municipalities is 107, then: concentration index = (100/107) = 0.93%. Thus, the average for each municipality is 0.93%, then we subtract this average from the

relative share of the population at the level of each municipality, then the result is summed for the negative or positive sign, and the result of the sum is the index to be extracted.

(2) The redistribution index is calculated by subtracting the percentage of the population of each administrative unit (municipality) in the first census from the percentage of the population in each administrative unit in the second census, then the absolute differences are summed, and the result is divided by two.

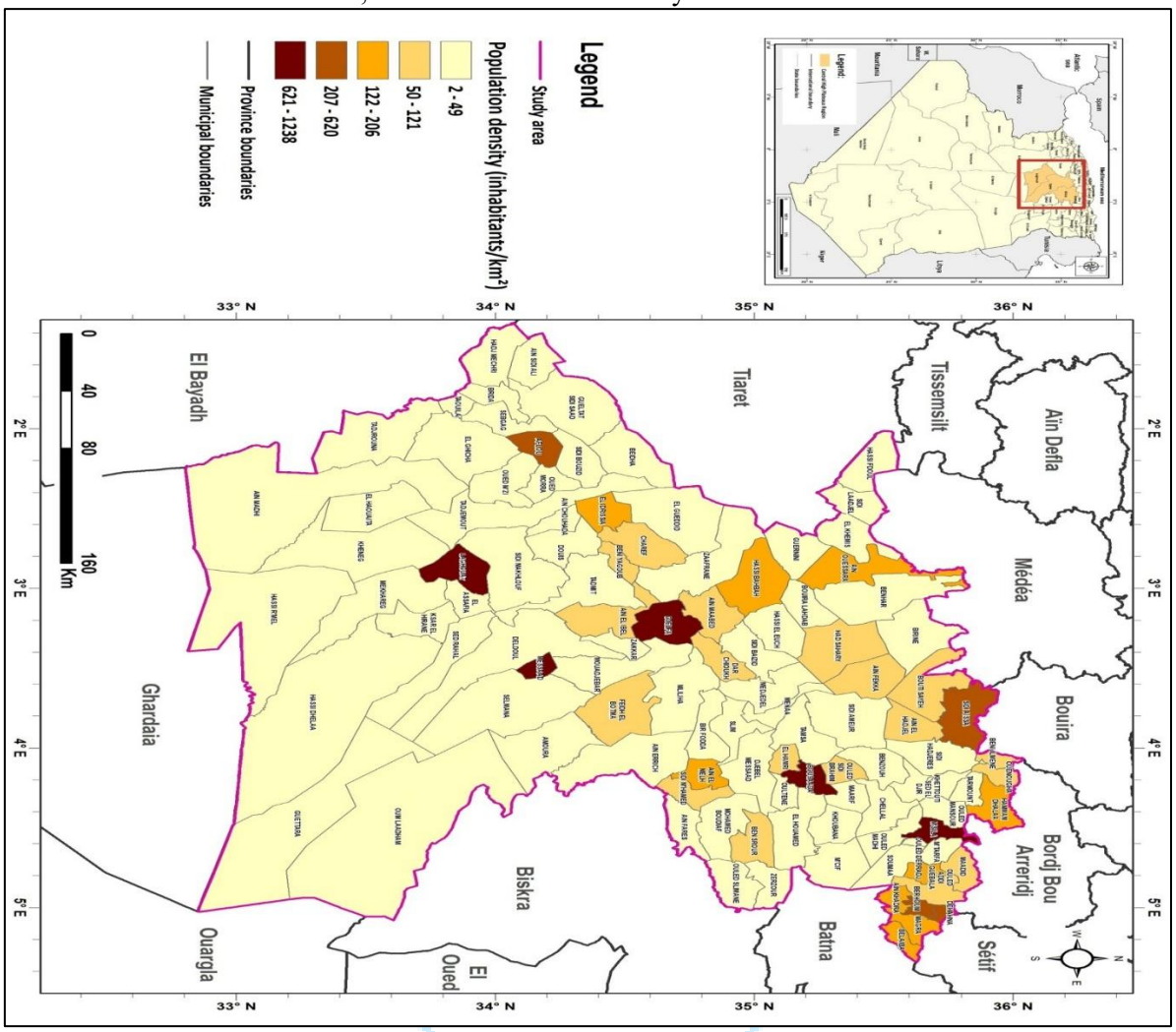

Fig. 7 Population density in the Central High plateaus region in 2024

When adopting the rural stability equation(1), this index (0.077) indicates a very low density, meaning that 0.077 municipalities appear per 100 km², which explains the wide dispersion and spread of rural municipalities. If the neighboring municipalities were clustered together to provide essential services, the rural settlement density would undoubtedly drop much lower. To illustrate this, calculating the dispersion coefficient(2) will provide a numerical example that reflects this reality. This coefficient is very small (0.0067), clearly indicating the vast area of rural municipalities and their small population sizes.

(1) Rural settlement density equation = (Number of rural municipalities in the study area / Area of the study area) x 100

(2) Dispersion coefficient = (Number of rural municipalities in the study area / Population of the study area) x 100

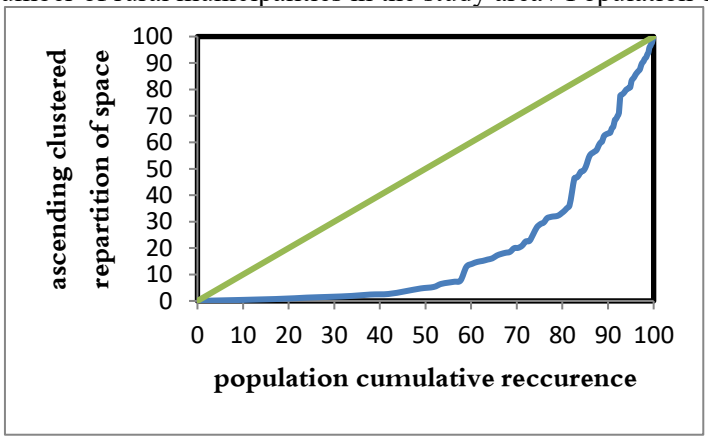

Fig. 8 Lorenz curve for the study area 2024

Population projections for 2024

In general, it is clear to us from contemplating the folds of the previous data that the burdens borne by urban agglomerations, represented in competition for services, job opportunities, and others, increase with increasing urbanization rates. The more the urban population in a certain geographical area exceeds the required limit, the greater the pressure on the urban agglomeration, and vice versa. Urban attraction centers constitute a dominance that includes most administrative, economic, social, and service activities at the expense of other agglomerations that orbit them. The continued growth of these centers in this manner can be described as cancerous growth that tends to hinder development of all kinds in the study area as a whole.

3.3 Geographical Distribution of Health Structures and Human Resources (1998-2024)

The health system currently bears four main components that are highly intertwined and intersecting: space, population, structures, and human resources. The intersection of these components leads to the development of the health sector to levels befitting the aspirations of human development for the population. Health services have gone through several stages until they reached the form we see today. For the purpose of studying the efficiency of health institutions and human resources in the study area, it is necessary to analyze their geographical distribution between 1998 and 2024, as follows:

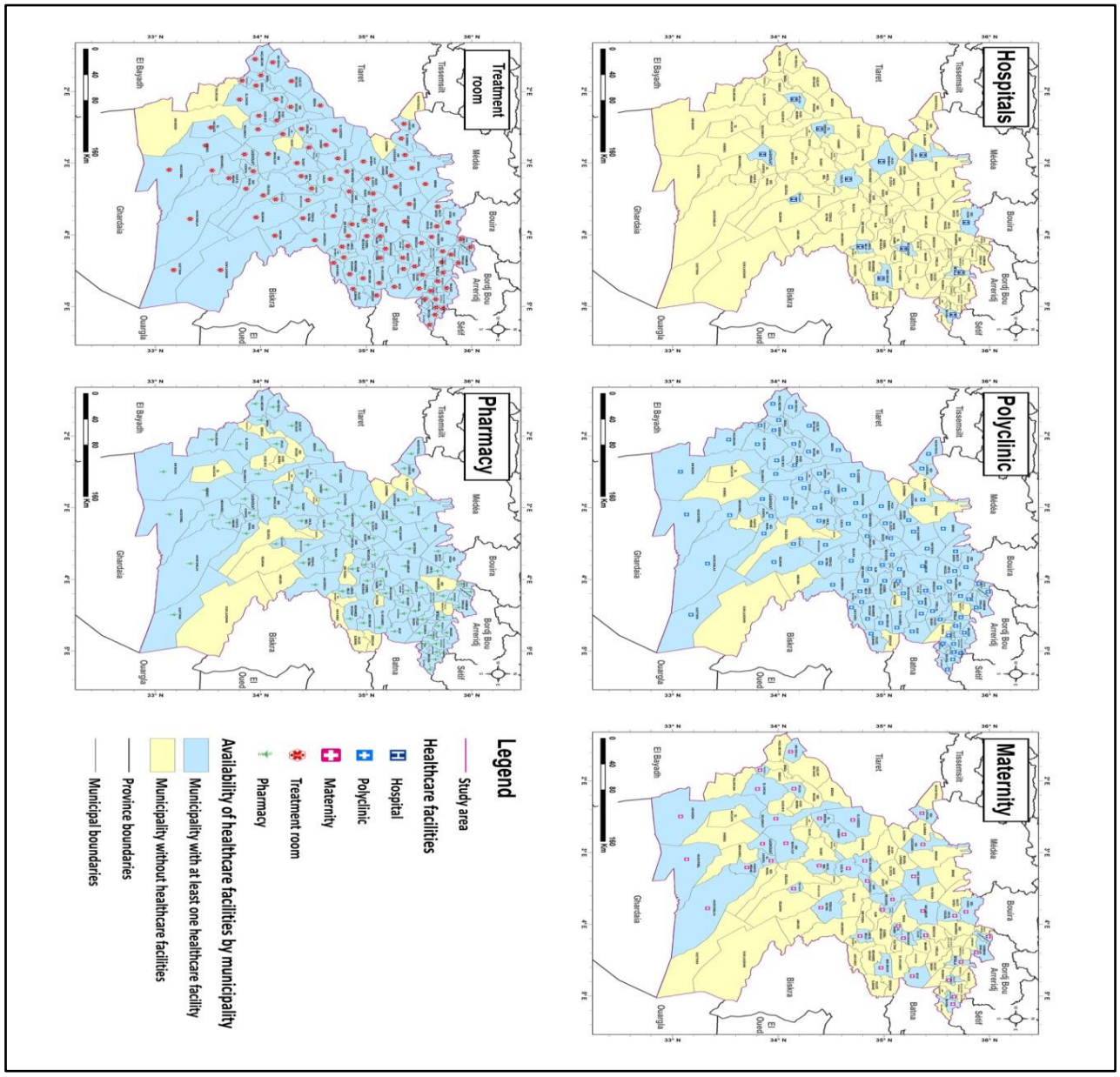

Fig. 9 Distribution of health facilities in the Central High plateaus region in 2024

Source: Prepared by the researcher Depending on the planning and budget follow-up directorates of the study area

3.3.1 Health Structures

Hospitals: The World Health Organization defines a hospital as: "an essential part of a social and health system whose function is to provide complete health care to the population. This care includes preventive and curative services and outpatient services that extend to families in their home environment. The hospital also provides the inpatient with shelter where they receive medical and nursing care and is considered a center for training health workers and conducting

medical and social research." The study area in 1998 contained 11 hospitals, spatially concentrated in ten (10) administrative units represented by the municipalities of: Laghouat, Aflou, Djelfa, Hassi Bahbah, Messaad, Ain Oussera, M'sila, Sidi Aissa, Bousaada, Ain El Melh. It has a total number of beds of approximately 2543 beds. Figure 9 shows the geographical distribution of health institutions in 2024. Compared to the data from the previous period, especially the distribution of hospitals, it is clear that their number has doubled, reaching 24 hospitals, distributed between old hospitals (11 hospitals) and the establishment of new hospitals (13 new hospitals), with a total bed capacity of approximately 4177 beds, at a rate close to one bed per 1000 citizens, while the global average achieved 3.30 beds/1000 people.As shown in Figure 10, the spatial distribution of hospitals in 2024 is a mirror image of what it was in 1998, although there are some slight differences that included only three administrative units, namely the municipalities of El Idrissia, Magra, and Ben Srour. In addition to these health facilities, the new hospitals category includes the Eye Hospital of the Cuban-Algerian Friendship in the municipality of Djelfa, which provides its services to all residents of the national territory. As a result of what has been explained in this element, the geographical distribution of hospitals in the Central High Plateaus region during the period 1998-2024 was limited to approximately 13% of the total 107 administrative units.

Multi-Service Clinics: Other health facilities, represented by multi-service clinics, contribute, along with hospitals, to providing health care services to the population. This type of service appeared in the Central High Plateaus region during the period 1998-2024 as shown in Figure 9 as follows:

- There is a clear variation in the distribution of multi-service clinics across the administrative units in the study area. In 1998, a total of 28 clinics were concentrated in 24 administrative units, approximately a quarter (22.43%) of the total clinics in the region. When comparing their number to what it was in 2024, the increase in the number of clinics is noticeable. Their number increased from 28 clinics to 138 clinics, an increase of 79.86%, and an annual increase of approximately 3.33 clinics per year, compared to an increase in their spatial spread to 93 administrative units, noting that the spatial coverage rate reached more than three-quarters (86.92%) of the study area.
- The correlation coefficient between the population number and the number of multi-service clinics witnessed a gradual increase during the period 1998-2014, increasing from 0.48 in 1998 to 0.77 in 2024. This increase reflects the significant development in the degree of correlation between the population number and the number of multi-service clinics, which contributes to improving the health status of the population and implementing many programs and activities that would promote sustainable health development for the residents of the Central High Plateaus region.

Health Centers: Health centers are among the most widespread health institutions across the administrative units of the study area, as they are institutions that provide primary medical services and refer difficult cases to hospitals, as they do not have beds and operating rooms, and medical staffing is less. The importance of health centers is evident through the health care they provide to all residents without exception, but the concentration of doctors and health centers in the headquarters of administrative units forces many residents to travel long distances to obtain that service. Quantitatively, if we look at Figure 9, we find that the number of health centers in the study area witnessed a noticeable decrease during the period 1998-2024 by about half, from 91 centers in 1998 to 46 centers in 2024. This does not mean that the number of health centers has decreased, but rather that they have been converted into multi-service clinics, as the number of the latter increased from 28 clinics in 1998 to 138 in 2024. It is worth noting that the spatial coverage of the study area with health centers was approximately 68.22% in 1998 compared to 37.38% in 2024, a decrease of 30.84% in 26 years, considering the aforementioned reasons. Regarding the correlation coefficient between population numbers and health center numbers, it reached its highest level in 2024, where the coefficient approached the value of 0.52. This is explained by the fact that the geographical distribution of health centers is moderately correlated with the population number. In 1998, its value decreased to 0.35, which means that the degree of correlation between the spatial distribution of health center numbers and the population numbers is a weak correlation controlled by other factors such as administrative division.

Treatment Rooms: One of the positive developments in the field of health at the level of the study area is the increase in the number of treatment rooms from 195 rooms, with a spatial coverage rate of 79.44% of the total administrative units in 1998, to 500 rooms, with a spatial coverage rate of 97.20% of the total municipalities. Data indicate that the number of municipalities that do not have this facility is at a minimum of five (03) units, or 02.80% of the total administrative units in 2024, and these are the municipalities of: Ouled Sliman, Hassi Fedoul, and Oued Mzi. Regarding the correlation between the number of treatment rooms and the population number, the results indicate that the coefficient values range between 0.86 and 0.94. Similarly, the correlation between the number of treatment rooms and urbanization rates by municipality decreased from 0.58 in 1998 to 0.47 in 2014. The correlation of treatment rooms with population densities was also strong, at 0.82 and 0.93, respectively. This direct correlation in the correlation coefficient values is a positive indicator of a kind of governance in the geographical distribution of treatment rooms, which increases the opportunity to serve the population according to population size and density.

Maternity Clinics: Reviewing the geographical distribution of maternity clinics in the study area during the period (1998-2024), it is noted that their total number increased by about five times, from 24 maternity clinics in 2008 to 118 maternity clinics in 2024. This led to an expansion in the number of administrative units covered by this service from 24 administrative units in 2008 to 32 administrative units in 2024. However, this increase, as shown, led to an increase in the spatial coverage rate from 22.43% to more than 29.91%. This is worrying, as the continuation of this weakness in the spatial coverage rate to low levels will threaten the health of pregnant women and increase the difficulties and reduce the alternatives available to address them for the population. To prevent the situation from worsening and getting out of control, reaching a degree where it is difficult to solve, it is necessary to work urgently and seriously to address this crisis. Perhaps the biggest challenge that requires the greatest attention in the coming stages is to reduce the area served by maternity clinics and continuously develop it to acceptable rates that reach below the current average of one clinic per 2353.13 km².

Pharmacies: Regarding the number of pharmacies in the study area, in terms of geographical distribution, Figure 9 shows the difference in numerical and spatial distribution during the period 1998-2024. According to 1998 data, it is clear that the spatial coverage rate in 1998 was concentrated in less than half of the administrative units (43.92%), with a total of 47 administrative units, and that the largest percentage (72.52%) of the total 273 pharmacies was concentrated in only 09 municipalities, which represents 08.41% of the total administrative units, namely: Laghouat, Aflou, Djelfa, Hassi Bahbah, Ain Oussera, Messaad, M'sila, Sidi Aissa, and Bousaada. As shown in Figure 9, the number of pharmacies increased to approximately 604 pharmacies in 2024, an increase of approximately 54.80% compared to 1998. Returning to the same data, the spatial coverage with the number of pharmacies has also increased to 95.32%, covering 102 administrative units in that year. On the other hand, calculating the correlation coefficient between the distribution of the number of pharmacies and a set of variables during the same period showed that the correlation was strong with the population number across the administrative units, reaching 0.74 and 0.95 respectively.

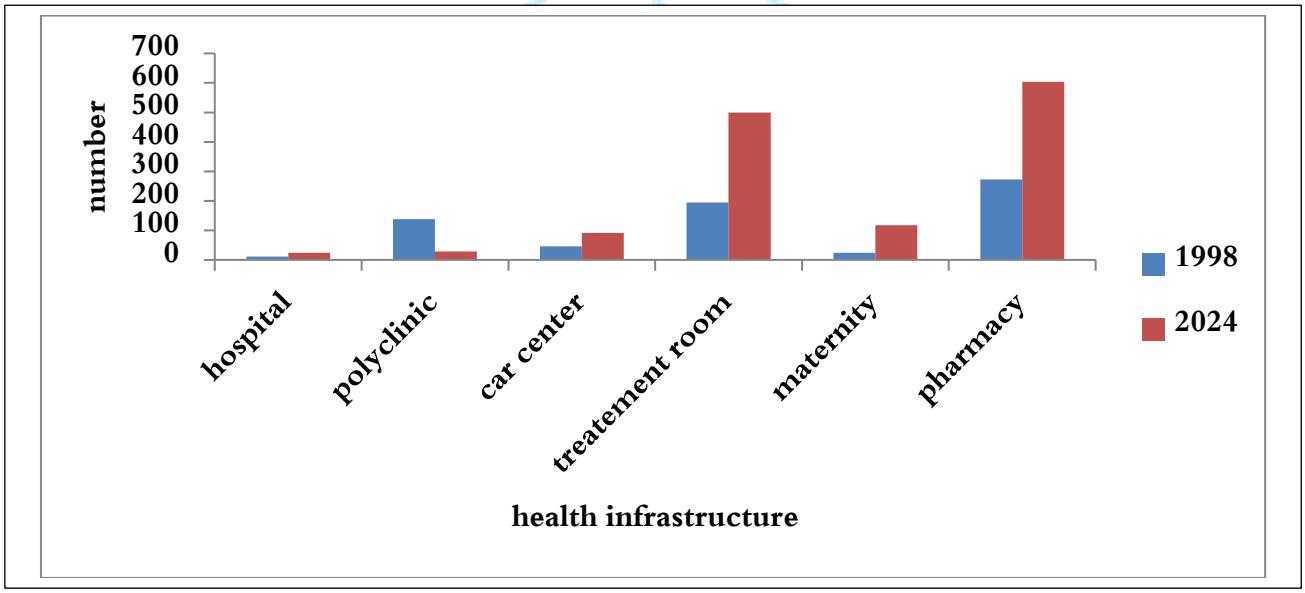

Fig. 10 Evolution of Infrastructure in the Central Highlands (1998-2024)
Source: Planning and Budget Monitoring Directorate

3.3.2 Human Health Resources

Based on the slogan adopted by the World Health Organization in its 2024 report "Health for All and All for Health," and in line with Goal 3 in the Arab Sustainable Development Report for 2024 "Ensuring healthy lives and promoting well-being for all at all ages" (UN, 2024), it has become necessary to eliminate health problems in the study area in a sustainable manner by taking measures in a wide range of areas, including reducing inequality, promoting the dissemination of comprehensive and sustainable health services, and access opportunities necessary to address diseases, in a manner that ensures that the population enjoys healthy lifestyles and well-being at all ages. Achieving this goal is closely related to the human capital working in the field of health.

3.3.2.1 General Practitioners: After reviewing the data and statistics and dividing the population by the total number of general practitioners, estimated at 2273 general practitioners in 2024, it became clear that this relationship is approximately 1.13 doctors per 1000 people, which is a very acceptable rate compared to the national and global averages, which are estimated at 0.98 doctors per 1000 people and 1.72 doctors per 1000 people in 2020, respectively, according to the World Bank Group data (BI, 2020). We note here that the calculation of doctor density includes both specialists and general practitioners per 1000 people. On the spatial level, the region has achieved a noticeable improvement in the geographical distribution of general practitioners across municipalities, with the latest value reaching

100%, compared to what was recorded in 1998, where the rate was approximately 71.76% of the total administrative units, an increase of 28.24%. This aims to enhance access to health care and ultimately strive for health equity.

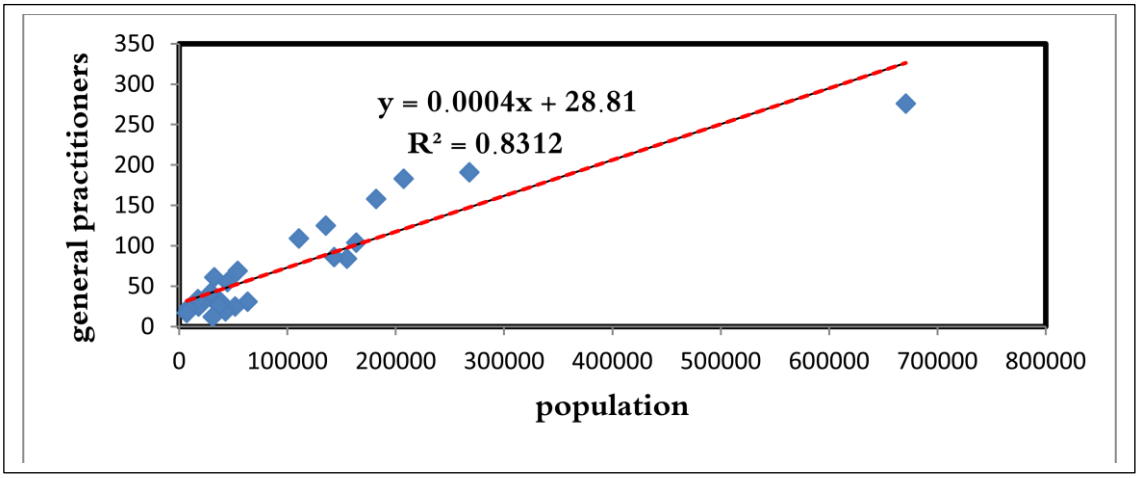

Fig. 11 Correlation coefficient between population and number of general practitioners
Population projections and data from the Planning Directorates and Budget Follow-up 2024

3.3.2.2 Specialists: What is worth noting through the analysis of the relationship between the number of specialists and the spatial distribution in the Central High Plateaus region is their intense concentration in some urban poles with high population density, and not others. To verify this relationship, it would be useful to calculate the correlation coefficient, which ultimately led to confirming the previous relationship with a very strong positive coefficient (0.99), whose result approached the ideal value of 1. The observer of the development of the spatial distribution of the number of specialists in the study area over 26 years notices a qualitative leap between 1998 and 2024 by approximately 10 times (9.97 times), moving from 110 specialists to 1207 specialists, with 30.69 specialists/100,000 people, a rate that matches the global average of 30 specialists/100,000 people. On the other hand, the evidence expressed by the correlation coefficient indicates that the concentration of specialists in 1998 was limited to nine (09) administrative units, with a percentage not exceeding 8.41% of the total number of administrative units for that year.

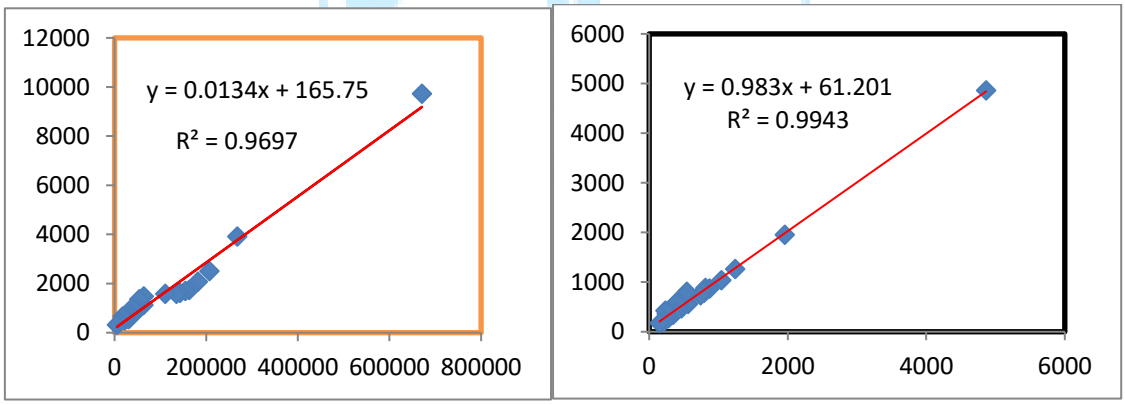

Fig. 12 Correlation coefficient between population, density and number of nurses
Population projections and data from the Planning Directorates and Budget Follow-up 2024

***3.3.2.3 Dentists*:** It is self-evident that there are multiple factors in the concentration of dentists in some administrative units, and thus their absence in others. However, these factors, despite their importance, were not the only ones in this context. Rather, a number of social factors in particular, and population densities in general, influenced the level of spatial distribution of dentists in the study area during the period 1998-2024. Needless to say, the number of dentists reached 155 in 1998, while it reached 782 dentists in 2024, at a rate of 1.98 dentists/10,000 people, which is therefore within the national average estimated according to the World Health Organization data in 2019 at 1.64, representing approximately 1/2 of the global average estimated in 2022 at 3.3 dentists/10,000 people. Note that the increase rate reached 33.70%. Regarding the geographical concentration of dentists during the same period, their absence in some administrative units would negatively affect the health development of the population.

***3.3.2.4 Paramedical Staff*:** There is no doubt that the category of paramedical staff has witnessed a significant expansion in number, which jumped from 3669 paramedical staff in 1998 to 10851 paramedical staff in 2024, which represents 27.59 staff/10,000 people, which is approximately 10 staff less than the global average (37.7 nurses/10,000 people). Note that the increase rate between the two mentioned years exceeded double, reaching 66.19%, at an average of 276 staff

annually. At the same time, the spatial coverage rate of paramedical staff across the administrative units of the study area was 100% during the period 1998-2024. There is also no doubt that the expansion in the distribution of paramedical staff was not to the same degree quantitatively, as a total of 2541 paramedical staff, or 69.29% of the total paramedical staff in 1998, were concentrated in nine (09) administrative units, which is 8.41% of the total number of administrative units. In parallel, the 2024 results reflected the concentration of paramedical staff by an amount greater than or equal to 100 paramedical staff in eleven (11) municipalities combined, forming a total of 7149 paramedical staff, or approximately 66% of the total number of paramedical staff in the same year.

4. Conclusion

Improving health is vital for human well-being and a fundamental element for sustainable human development in the study area, thereby achieving the highest attainable level of health. This necessarily requires providing health services in sufficient quantity and quality to accommodate rapid population growth. Despite all the developments and transformations witnessed by the health sector, the available services are distributed unequally among and within the various administrative units. This has made access to health services difficult, primarily extending to both urban and non-urban areas, and is more pronounced among residents of remote settlements. At the same time, the calculation and analysis of various indicators for measuring the distribution of structures and human resources show that the health system in the study area does not cover 100% of the area, 100% of the structures, or 100% of the human health resources. Spatially, the situation is improving and is not far from comprehensive coverage during the comparison period, as most administrative units have made significant progress in reducing spatial disparities and inadequacy. Data indicate that the index of the population served by hospitals is continuously increasing, with the number decreasing to 170,973 residents per hospital in 2024, compared to 184,330 residents per hospital in 1998. Adding this index to the population's share of multi-service clinics makes the issue noteworthy, as the increase in the regional average above the national average between 1998 and 2024 brings this health structure closer to comprehensive coverage. It is also important to analyze the relationship between the population number and treatment rooms, which shows that the regional average exceeds the national average in many administrative units. The indices for the population number per pharmacy and maternity clinic have not changed significantly, but rather remained at the national averages. The average population per pharmacy ranged between 5,780 residents/pharmacy and 4,598 residents/pharmacy during the period 1998-2024, with a growth rate of 0.030%. The average population per maternity clinic was approximately 84,485 residents/clinic in 1998 and 81,934 residents/clinic in 2024, indicating that population growth continues to outpace the growth of these variables. Regarding human health resources, it is worth noting that the doctor-to-population ratios have shown acceptable improvement during the period 1998-2024 compared to the national average. This has helped improve spatial coverage, which reached 100% in 2024 compared to 1998. Measuring the rates of health professionals per population over the years shows a greater trend towards comprehensive coverage. The number of units that exceeded the World Health Organization standard decreased from 25 in 1998 to 8 in 2024. The dentist-to-population ratios are close to the national average but are half the global average. The doctor-to-bed ratios are almost identical to the World Health Organization standards, as are the national averages. The population-to-bed ratios were lower in 1998 than in 2024 for most administrative units, but within national and international standards, which is similar to the health professional-to-population ratio. The conclusion that can be drawn from the above is that the health data in the study area presents both quantitative and spatial challenges. However, it meets the aspirations for sustainable human development for the residents of the study area. The impact of successive development policies and programs is likely to bring about significant changes in the previous rates and health development trends for future generations

References

1. Assia, L. & Nahla, D. (2024). Impact of Private Real Estate Promotion on Urban Sprawl and Tourism Development in Skikda. Indonesian Journal of Social Science Research, 5(2), 533 – 544. doi: 10.11594/ijssr.05.02.14
2. Nedjla Gherabi, Assia Lifa. (2024) Tourism Development and Environmental Protection Facing the Threats of Urbanization -The Case of TAZA National Park- JIJEL Province, Algeria. International Journal of Innovative Technologies in Social Science. 2(42). doi: 10.31435/rsglobal_ijitss/30062024/8142
3. Bailey, S. R., O'Malley, J. P., Gold, R., et al. (2021). *Health disparities and telemedicine: Bridging the gap in rural healthcare access.* Health Affairs, 40(12), 1985-1992.
4. Development plan for the wilaya of Djelfa (D.P.W), phase 01, 2012.
5. Hassan ibn Ibrahim Al-Mohannadi. (2021), Indicators of Sustainable Social Development in the State of Qatar: Reality and Prospects, Population Studies Series, Permanent Population Committee, First Edition, Doha, Qatar.
6. Kruk, M. E., Gage, A. D., Arsenault, C., et al. (2018). *High-quality health systems in the Sustainable Development Goals era: Time for a revolution.* The Lancet Global Health, 6(11), e1196-e1252.
7. Mc Grail, M. R., & Humphreys, J. S. (2019). *Geographical accessibility of primary health care services and health outcomes in rural and remote areas: A systematic review.* International Journal for Equity in Health, 18(1), 27.

8. Ministry of Regional Planning and the Environment, regional (2007), plan for the development of the central highlands regional presentation and evaluation of public action, volume 01.
9. National Bureau of Statistics, General Census of Housing and Population 1966, 1966, 1977, 1987,1998,2022.
10. National Office of Statistics, Algerian demography 2020/2024 number 1030.
11. National Statistics Office (NSO), 5th General Population and Housing Census (GPHC) 2008, statistical collections no. 163/2011, series S (social statistics), urban framework, September 2011 .
12. Regional land use planning scheme (R.L.P.S) for the central highlands by 2025, volume 02.
13. Sabah Hassan Ali and Hussein Jaaz Nasser(2010), Health Service in Samawah City with the Participation of its Distinguished Partners, Al-Mashaheer Magazine, Issue 14.
14. United Nations (2024), ESCWA, Arab Sustainable Development Report: Prosperity of Countries, Dignity of Human Beings.
15. United Nations development program,(2024) human development report 2023/202 breaking the gridlock: reimagining cooperation in a polarized world
16. United Nations development program, ,(2015) human development report, works for human development, New York, USA.
17. United Nations Development Programme (UNDP). (2020). *Human Development Report 2020: The Next Frontier – Human Development and the Anthropocene.*
18. World Bank Group data for 2022 at https://data.worldbank.org/indicator/SH.MED.BEDS.ZS
19. World Health Organization data at https://data.who.int/ar/indicators/i/B54EB15/5C8435F.
20. World Health Organization (WHO). (2021). *World Health Report 2021: Universal Health Coverage and Equity in Access to Healthcare.*
21. World Bank. (2019). *Delivering Quality Health Services: A Global Imperative for Universal Health Coverage.*