SPATIAL PATTERNS OF THE ACCESSIBILITY OF THE POPULATION TO HEALTH CENTERS IN THE METROPOLITAN AREA OF GRAN RESISTENCIA-Chaco (Argentina)

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INTRODUCTION

The Ministry of Public Health of the Province of Chaco organizes all the health facilities through a Provincial System that provides health services to the people at central, zone and local levels. According to the Ministry, the Health System is structured on the basis of a zoning scheme that considers:

- Accessibility and coverage based on health needs.
- The circulation and reference natural population.
- Staggering Levels of Complexity of services.
- The provincial road network.

The present study aims to analyze the first of the assumptions outlined by the health agency most relevant to our territory. We limited our analysis to the Gran Resistencia or Great Metropolitan Area of Resistencia (AMGR) and it will show the location and distribution of health centers in relation to the population that uses them, **detecting the differential space-time accessibility.**

OBJECTIVES

The main goals we have set ourselves are:

- Show the areas presenting different situations in terms of access to health care: less served areas or less accessible to health services.
- Identifying the population at risk from the perspective of access to primary health care.
- Identify priority areas to accommodate new health facilities in the metropolitan area of Gran Resistencia health.

METHODOLOGY

This study is part of the postulates of the theory of location, and have tried to model the space-time accessibility of the population to Health Centers. We have worked in a relevant way using the spatial analysis functions that have Geographic Information Systems (GIS) in an envelope to address adequacy studies in urban space. Also used in

conjunction formats raster and vector data as they exploit their complementarity has enabled better analysis of spatial data.

THE AREA OF STUDY AND ANALYSIS OF THE VARIABLES

The Metropolitan Area of Gran Resistencia -AMGR- is made up of 4 municipalities: Resistencia, Puerto Barranqueras, Fontana and Puerto Vilelas, as shown in Figure 1 left. This cluster meeting in 2001 a population of 360.405 inhabitants living in 90.284 homes in the map on the left is represented population density by block or hectare.[1]

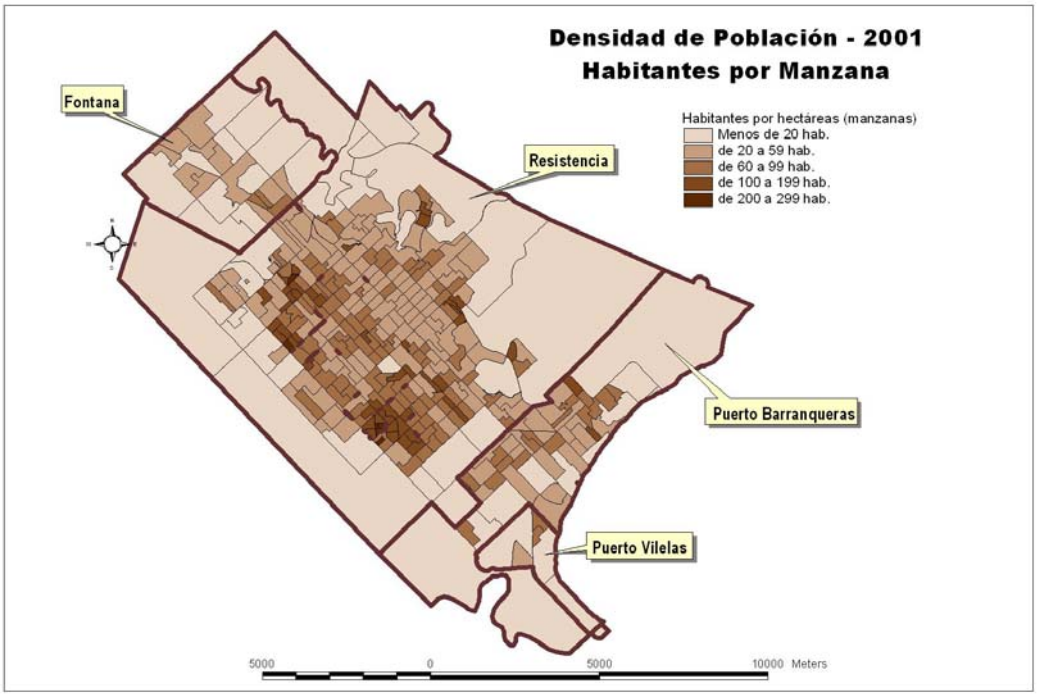

Figure 1

Of this amount approximately 196,147 persons, ie 54.42% did not have the benefits of a Coverage Work Plan or Medical Mutual, for this reason, this group is considered as the potential demand to be attended by public health facilities in the AMGR, that corresponds to the two public hospitals (Perrando and Pediatric Hospitals) and health centers that can be seen in the representations of figure 2 on the left displays the distribution of health centers and to the right area influence or health coverage defined by the Ministry for each of them.

[1] The data correspond to the last National Census of Population, Households and Dwellings 2001.

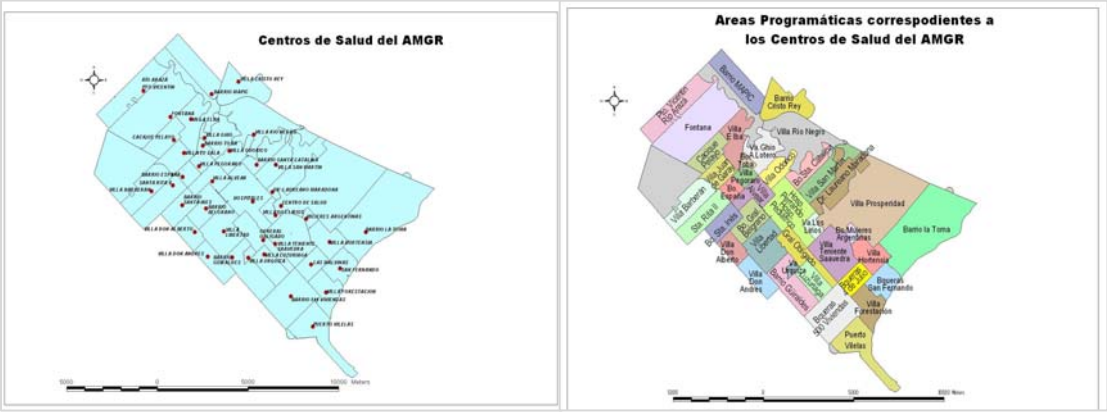

Figure 2

The **distribution of the population without social security** or potential demand for equipment that uses these models has been, from the information provided by the Department of Statistics of the Province of Chaco, radios in the 391 census shows the study area (Figure 3). The maps that follow reveal the pattern of population distribution that has no benefits regarding health care. The pattern shows that the people who inhabit the outer ring of the cluster are those which, for various reasons, have no social, health plan or fund by more than 50% and in many areas, this proportion rises to over 80 %. The map on the right, which shows deviations from the average, these areas are advised to refer recorded in some radios, more than twice the average population without coverage social work.

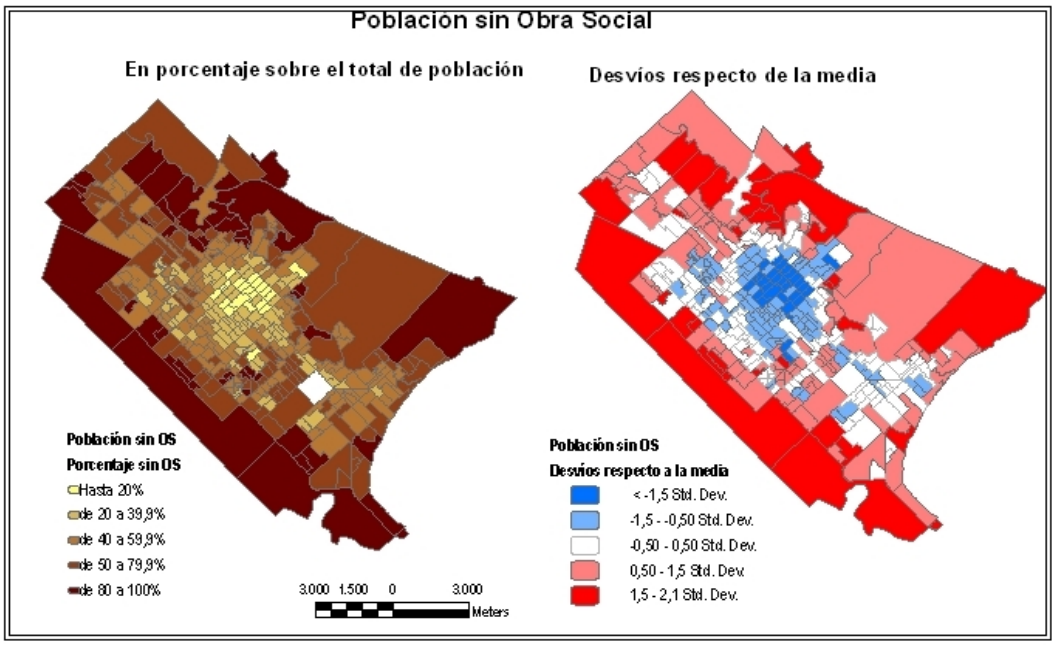

Figure 3

In addition to this first approximation of the general population has no social work security we considered it appropriate to include other variables from this first, that will allow us to get closer to the knowledge of the population that characterizes the AMGR. This is displayed on the page following the distribution of **children under 14 years who have no coverage social work** (Figure 4), represented by analogy with the previous case. It is remarkable how similar the two documents presented mapping, observing carefully, we can only warn the few differences that occur, like the representation that shows deflections reached a high similarity. Again AMGR of the outer ring is the most populous sector potentially becomes the applicant's public health facilities. Unlike in the central area children are, in large part, over 1.5 times more security social work in the periphery of the conglomerate.

Regarding **the adult population-more than 65 years and older** consider important to discriminate on gender and that both men and women can get different patterns in response to a possible condition of occupation pursued throughout his life. Thus we can see, in the following pages, a map showing the distribution of **the female population over 65 years with no social work** (Figure 5) this distribution shows a pattern similar to that described above, but with different less marked in respect of minimum and maximum percentage values. However, there is a deepening of the situation and who have registered more than 2.5 times the deviations from the average, this means that the peripheral ring is twice as many women without work in the social center of AMGR .

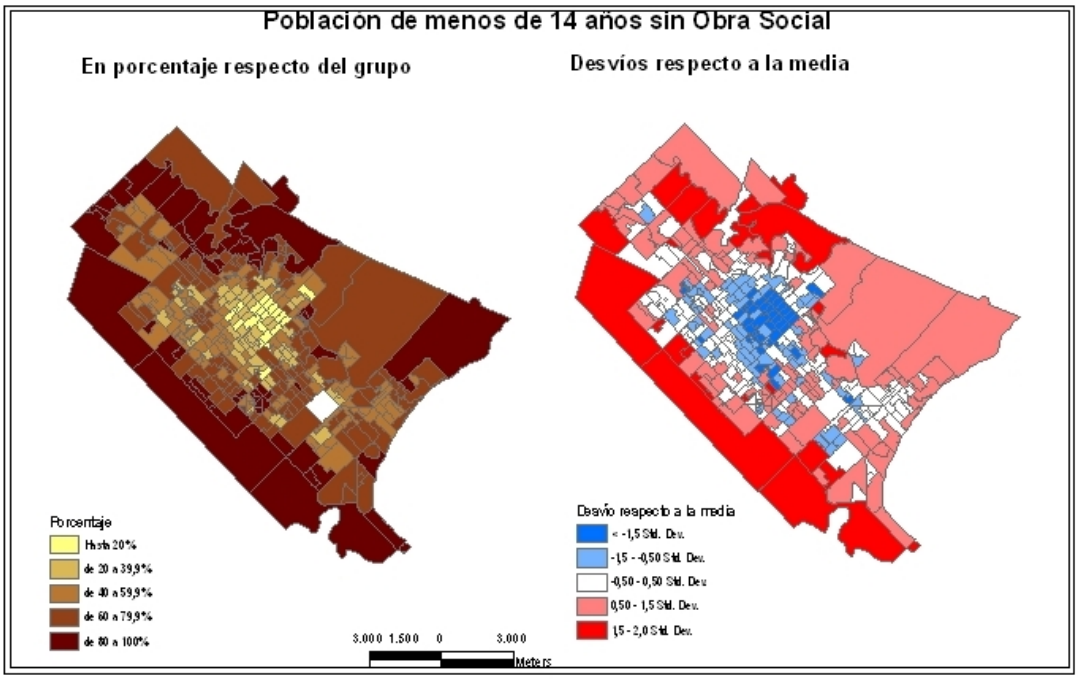

Figure 4

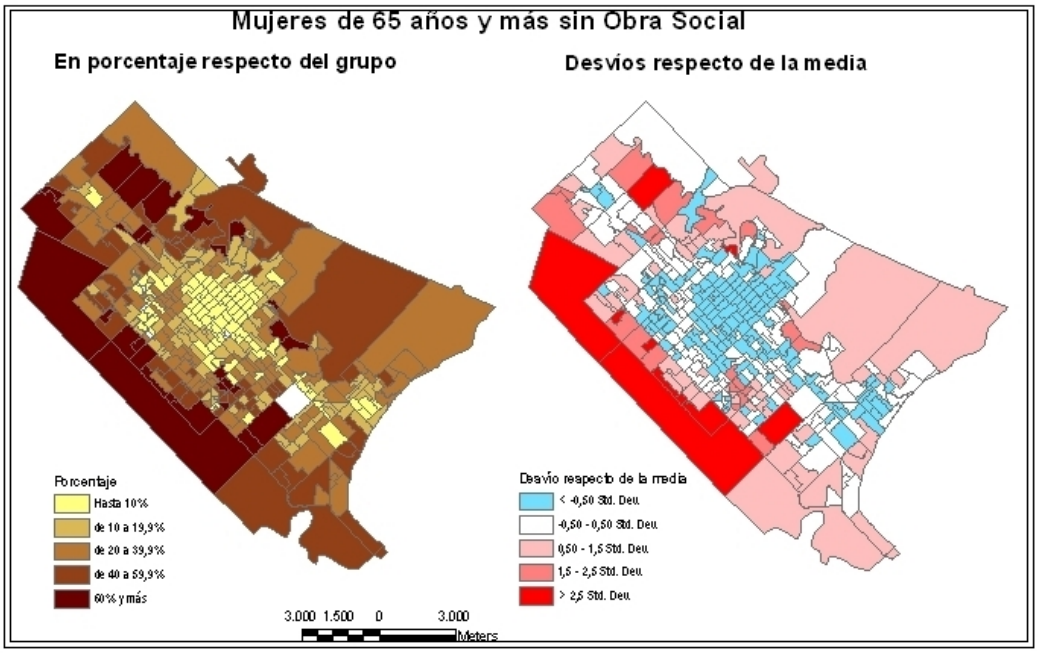

Figure 5

The male population over 65 years with no security social work whose map is shown below (Figure 6) has similar characteristics to that of the female population with regard to the percentage values, however the spatial distribution is dissimilar.

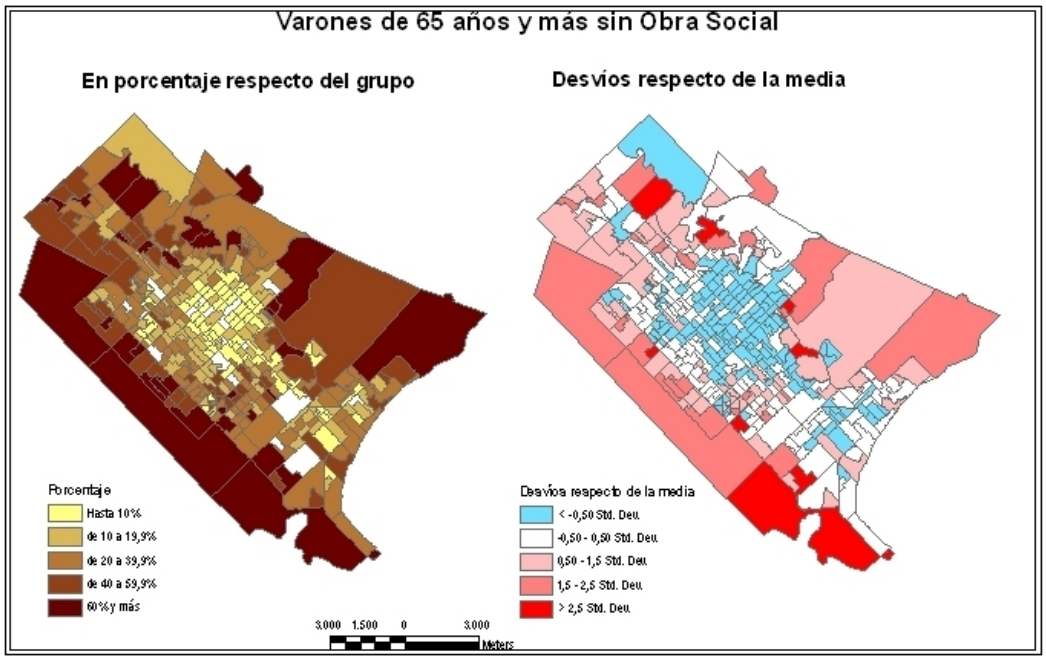

Figure 6

MODELING ACCESS TO HEALTH CENTERS

In Argentina, as in most countries, people, for various reasons do not have security social work, health plan or fund is the potential users of the public facilities, for this reason knowledge of successful access to these facilities is essential to put the equity in access.

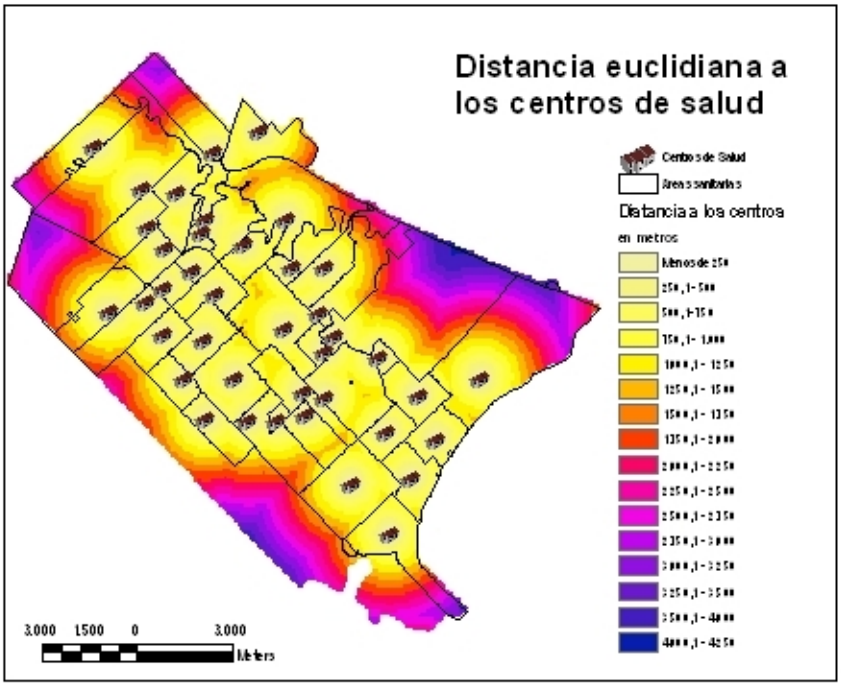

Figure 7

In this sense to warn that what happens now with the potential demand for access to health centers that provide primary health care, we made two types of analysis, first calculating the Euclidean distance from the center to any AMGR defining point of the previous image (Figure 7). This calculation, the simplest of all that can be made through any Geographic Information System allows us to warn of a very rough-and visually-coincidence between the areas where people live work and increased social distances to health centers, a situation that he should not, precisely because the public health facilities would have to approach groups of people who are its most vulnerable potential demand. The analysis allows us to know that the maximum distance between a point of supply (health center) and point of demand (population) is 4230.66 meters, while the average distance of 1234.78 meters and the minimum is of 0 meters and the system finds that any provision of any claim.

The same information that appears in the image above has been designed in 3D (Figure 8), there are areas where improved accessibility to coincide with the location of health

facilities in the form of depressions and less accessible areas, the periphery, coinciding with the sectors that contain a greater proportion of people without security social work.

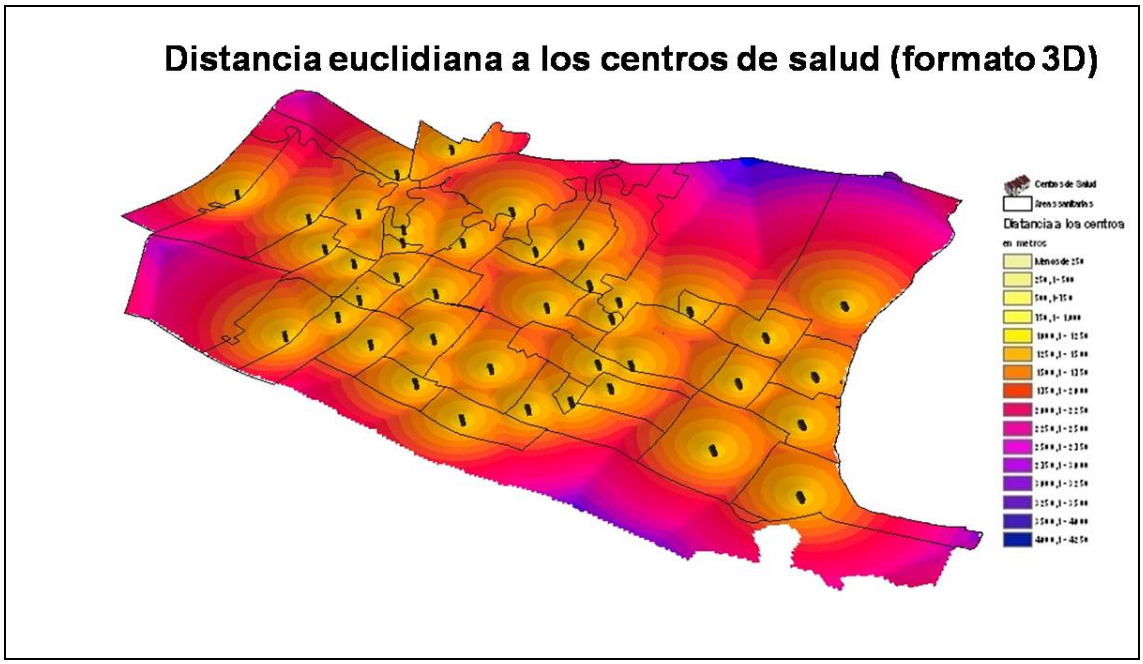

Figure 8

Another best way to see how it now shows the accessibility of the population to health centers, is to analyze, first, the distance across the road which, inevitably, to model the mobility of people and Furthermore, the time it takes to travel the roads to the point of supply. We employ AMGR[2] of the road network that is generated from the fragmentation of the territory occupied by the four municipalities. As we see in Figure 9 this division exceeds the area occupied by the radio census had been used so far, use has its origins in the radios have attributed the population data.

Notwithstanding the differences in area under the spatial correspondence of any spatial analysis is possible. This road network, basically, is made up of streets and avenues and consider, in addition to the length / distance are essentially arcs / segments that conform to the movement of people from their places of residence to the health centers are makes walking on foot for the purpose of assessing the time they occur.

[2] In the case of Resistencia and Puerto Barranqueras road that we used was provided by the respective municipalities. In the case of Puerto Vilelas, Fontana and staff of the Laboratory of Geographic Information Technologies has developed the corresponding networks.

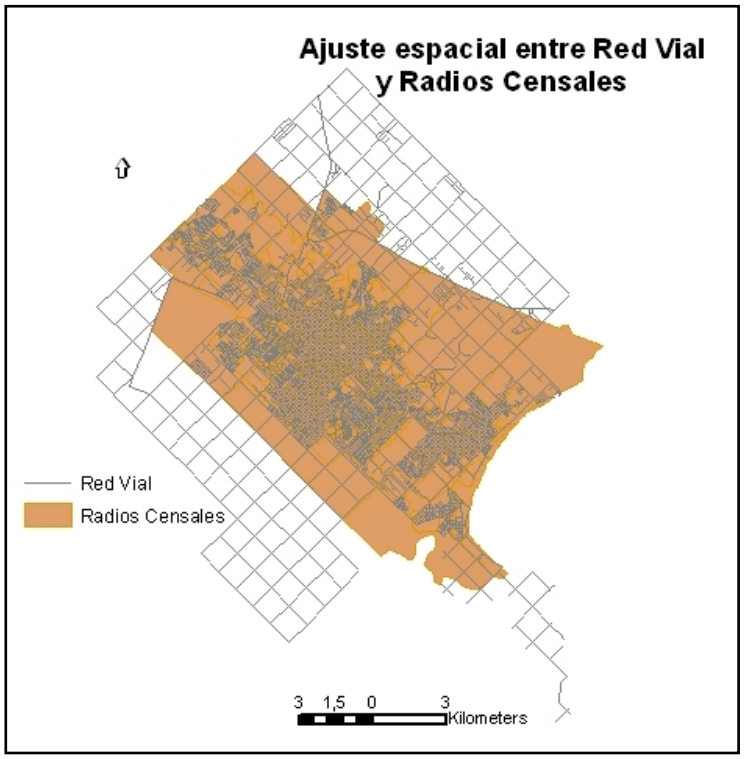

Figure 9

In this sense it was seen crossing a street about one hundred meters of the transfer time, friction or impedance, would be 1.17 minutes, while making the same journey through an avenue would be 1.50 minutes[3] and is considered more waiting time at the side. These options allow us to define the time from anywhere through the segments / arcs that make up the network to the point of supply and the nearest health center. As a result we will see two shows for each scenario because when we analyzed the distances or travel time implies that the road network, we can simultaneously learn about the service areas of health facilities, which include areas that are seen in the table the left.

[3] Other possible scenarios that are being discussed are: the transfer of pubic transport, including waiting times, and different scenarios for different actors: children under 14 years accompanied by an adult or older with a higher. Due to space restrictions only present a possible scenario of all.

Service Area	Area in Km2
Hasta 500 metros	10,94
De 500,1 a 1000 metros	29,37
De 1000,1 a 1500 metros	23,29
De 1500,1 a 2000 metros	15,42
De 2000,1 a 5000 metros	72,33
Más de 5000 metros	86,11

Table 1

The analysis of accessibility to health facilities, taking into account the network distance throws the representations contained in Figure 10. To the left there are the arches that make up the network assigned to the nearest health center, while to the right displays the service areas 500, 1000, 1500, 2000, 5000 and more than 5000 meters area of which was shown in Table 1. Note that the network distance has been calculated at 11,649.37 meters (remember that was the maximum Euclidean distance of 4230.66 meters, warned that net nearly triples the distance).

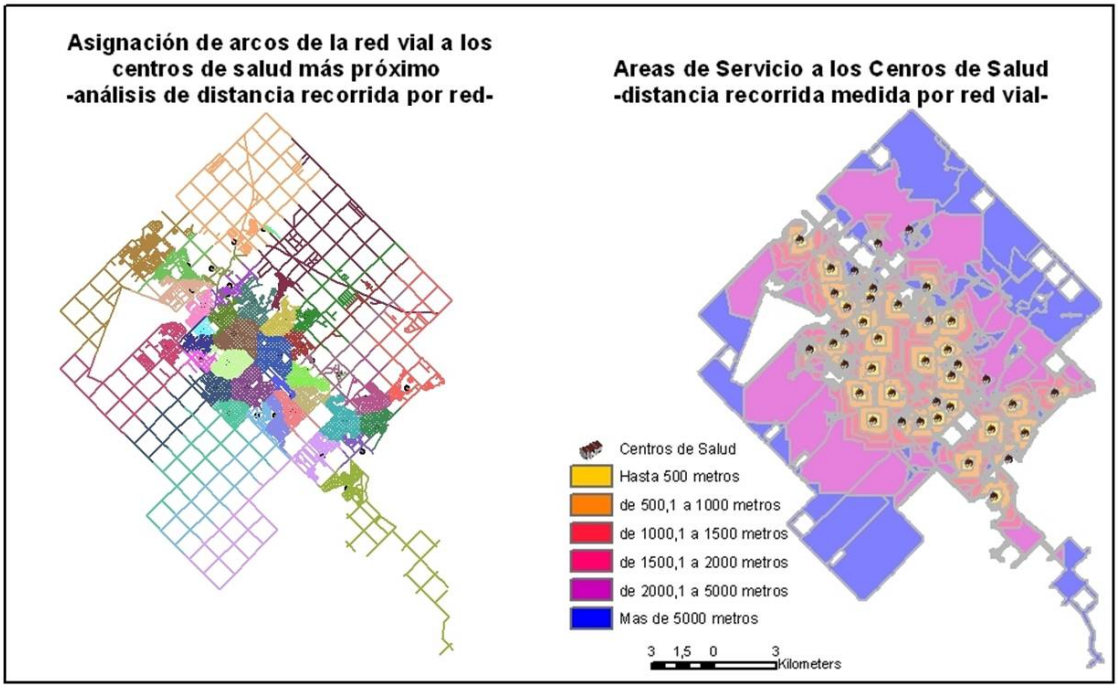

Figure 10

If instead the distance by network, analyzing the transfer time, we can say that as long as detection is 145.53 minutes, which represents more than two hours away from the most distant point of demand to health centers nearer. In terms of service areas have been generated in the areas the following times: 15, 30, 45, 60, and more than 60 minutes to transfer, remember that this is a scenario where the walking tour is on foot.

Service Area	Area in Km2
Hasta 15 minutos	**51,97**
De 15,1 a 30 minutos	**34,73**
De de 30,1 a 45 minutos	**32,94**
De 45,1 a 60 minutos	**29,51**
Más de 60 minutos	**88,73**

Table 2

Modeling described can be seen in Figure 11 (left arcs of the network allocated to each school and to the right service areas). The area covering the areas identified are those that are included in Table 2.

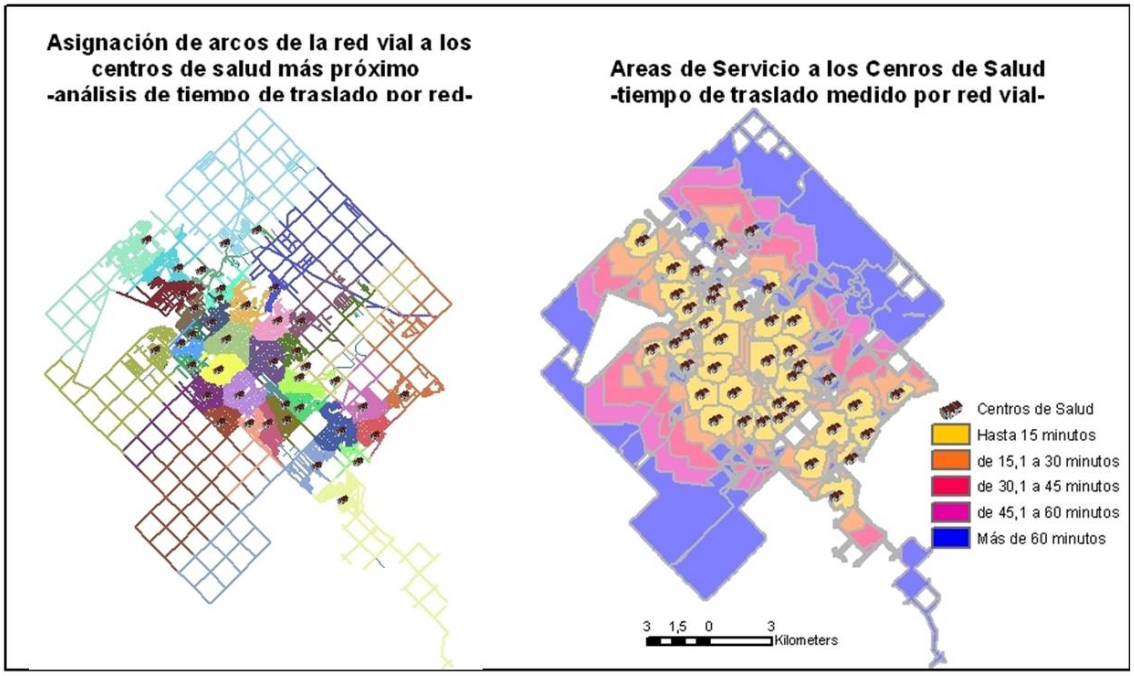

Figure 11

In short, both in the analysis of the Euclidean distance to health centers, and in consideration of distance or time of access by road to the centers of primary health care in AMGR, are revealed less favored areas, less access to these facilities and it will be able to define the area allocated to each facility and its corresponding surface.We can also visualize the collective population that is more distant from such facilities, that has to go, sometimes more than 5 kilometers (with extreme distances over 11 kilometers) and times that exceed 2 hours of travel to receive care.

These early approaches have allowed us to move forward in the definitions of sectors that should in future be equipped with new health centers, which, for reasons of length of labor, are not included in this contribution, but we will propose optimal sites that could harbor facilities and thereby reduce the extreme differences or inequities in this space are aware that exacerbate social differences of the population, and that justice is one of the spatial dimensions of social justice.

BY WAY OF CONCLUSION

The joint analysis of access-geographic space and time, by GIS in an urban area, with the emergence of several alternative scenarios, aid, land use planning process, to identify areas that have serious difficulties in accessing to workplaces, services or equipment of both governance and private management. Certainly the task of equally distributing the services or public facilities will be of interest to the government if it seeks to make the people enjoy equal access to all of them regardless of their place of residence. Added to this, the quantitative results which emerge from the analysis using GIS, we can detect the amount of people or people who are disadvantaged and in need of more rapid according to their needs.

Studies designed to shed light on issues that relate to accessibility and mobility with spatial parameters and generate genuine measures that are not considered in either conventional surveys of information, ie which are quantifications of the studies themselves land that are held in certain areas, with population groups defined on the basis of assumptions that researchers want to verify or refute. From our perspective, taking into account the experiences of working in this direction, we believe that the results are important in making decisions on improving the population's access to services and facilities, on the one hand, and the delimitation of areas or areas not easily accessible or inaccessible, on the other, would help significantly in land use.

The province of Chaco and inside the metropolitan area of Gran Resistencia (AMGR) should be studied, and it is being in some respects, in terms of differential levels of accessibility (spatial, temporal, economic) to the different services and equipment, as well as to dissimilar spatial mobility that makes the population. From these studies and analysis should occur the optimal distribution and redistribution of services for the population to fully satisfy their needs. We believe that the methodologies and

procedures that can be carried out through GIS can help make decisions more equitable and just.

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