Using a geographic information system to identify the number and location of new health centres needed in the city of Kermanshah, Islamic Republic of Iran

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Abstract

Background: Inappropriate distribution of health centres can increase inequities in health care. A geographic information system (GIS) is a useful tool to help plan, monitor and evaluate health systems by analysing and visualizing geospatial data.

Aims: This study aimed to propose an optimal model for establishing new health centres in the city of Kermanshah, Islamic Republic of Iran using GIS.

Methods: In this descriptive analytical study, the number and location of health centres and people's access to them across Kermanshah were evaluated using the GIS system, ArcGIS 10.3, for the years 1997, 2007 and 2012. To determine the best locations for establishing health centres, five principles were considered: access, distance, service delivery radius, proximity to areas of compatible and incompatible land-use, and population density.

Results: In spite of an increase in the number of health centres in Kermanshah between 1997 and 2012, the population without access to such centres also increased, and this varied by age group. Based on the final map of all the land in Kermanshah, 6% of the land was considered unsuitable or very unsuitable, 16% medium suitability, and 78% good or very good for the location of health centres in Kermanshah city.

Conclusion: The spatial distribution of health centres (in terms of the radius of access) and compatibility of the land-use were not properly considered over the 15-year period. To provide health coverage for the current population in the city of Kermanshah, 13 new health centres are needed in suitable locations.

Keywords: health centres, access, geographic information system, Islamic Republic of Iran

Introduction

Over the past 50 years, urban populations have risen but the services provided have not been expanded enough to meet the needs of the people. This has led to undesirable and spatial inequity in urban health services and a waste of human and material resources (1). Today, preventing inequities in the health sector is a main concern of the health policy-makers, especially in developing countries (2). However, a lack of financial and human resources and the growing complexity of health dimensions (physical, mental, emotional, spiritual, and social) are challenges for health policy-makers (3).

Health care services provide health care, maintain and promote health, and restore health at times of illness (4). One of the factors that can both cause inefficiency in the delivery of health services and increase inequality in health services is the inappropriate distribution of health centres (2). The theory of healthy and ecological cities (5) promotes good access to health centres and the placement of urban services at consistent and optimal distances. Factors that can support the proper distribution of health services include good and transparent

management, and the required knowledge and tools (6). Managers are important because they are responsible for planning, organizing, directing, innovating, motivating, coordinating and budgeting health services.

Today, the technological developments in the field of health information (7) have increased the importance of using new tools in health management, such as the geographic information systems (GIS) (8,9). GIS is a valuable tool to help ensure that vulnerable and deprived populations have access to primary health care services (10) and hospitals (11). GIS can also be used to plan, monitor and evaluate health systems by gathering, storing, processing, analysing and visualizing geospatial data (3,10–16). Thus, GIS can help reduce inequalities in the distribution of services and identify inequalities in groups, sectors and urban areas.

As mentioned above, identifying and ranking the criteria of a desirable model for location of health centres are important in health services management. Kermanshah is one of the most deprived (17) and underdeveloped (18) provinces of the Islamic Republic of Iran in terms of access to health services. Moreover, Kermanshah has faced many health challenges, including

high rates of disease such as gastrointestinal cancer and AIDS *(19,20)* and inequity in access to health centres *(2)*.

The United Nations Sustainable Development Goals aim to ensure healthy lives and promote well-being for all at all ages, reduce inequality, and support sustainable cities and communities *(21)*. In view of these goals and the above-mentioned situation in Kermanshah, allocating resources and health centres in this area is a priority. We therefore aimed to develop an optimal model for establishing new health centres in Kermanshah city using GIS with the aim of supporting our health managers and policy-makers on this issue.

Methods

This descriptive, analytical study was done over a 15-year period (1993–2012). The number of health centres was our target. People's access to these centres and land-use compatibility status across Kermanshah city were evaluated using ArcGIS 10.3, and its index overlay model and network analyzer *(22)*. Land-use compatibility describes an existing or committed land use or activity that can co-exist with neighbouring use(s)/activity(ies), without either creating or experiencing off-site adverse effects. In the first step we used the ArcGIS intersect and symmetrical difference tools. In this study, the effective layers for locating health centres include proximity to green space (C1), proximity to the centre of the neighbourhood (C2), proximity to fire-fighting services (C3), proximity to communication networks (C4), proximity to population density (C5), proximity to residential areas (C6), the slope of the land (C7), distance from existing health centres (C8), distance from industrial workshops (C9), distance from urban facilities (C10), distance from places of education (C11), distance from cultural services (C12), and distance from sports facilities (C13).

In the second step, the proposed map of suitable locations for establishing health centres was extracted using the index overlay model, ArcGIS network analyzer, the fuzzy analytic hierarchy process (AHP) (fuzzy AHP SoLver software, 2015) and GIS. Moreover, to determine the best locations for establishing health centres, five principles were considered *(23)*.

- Access principle: One of the main criteria in locating such critical centres is easy access. In other words, easy access denotes the ability of urban residents to have the access to health centres they wish.

- Distance principle: Use of the distance principle in locating centres is based on the sphere of influence, that is, the standard range covered by each of the health centres.

- Service radius: This is the radius of each of the health centres in terms of delivering services and its distance from the radius of other centres. For example, the standard coverage is a radius of 750 m which may become shorter because of overlap with other centres.

Proximity principle (compatibility and incompatibility): The presence of some land-use, such

as industrial centres in the vicinity of and adjacent to health centres, is known as incompatible land-use, which reduces the efficiency of these health centres. In this regard, we classified land-use into two categories, compatible and incompatible land-use. Items C8 to C13 were considered incompatible land-use. This is because this land-use causes problems such as crowding, noise pollution and atmospheric pollution, and avoiding noise and environmental pollution are among the most important considerations when locating health centres. C7 was considered both compatible and incompatible, and the other items (C1 to C6) were considered compatible land-use *(24)*.

Population criterion: This is one of the main factors in the establishment of health centres. In other words, there should be more health centres in areas with higher population densities.

We marked the health centres based on statistical blocks of Kermanshah in the environment of ArcGIS maps, and then the urban roads were created. The urban communication network and health centres in Kermanshah city were extracted using the ArcGIS network analyzer. The topology and spatial relationships between the roads were developed in ArcGIS catalog, and the rules and restrictions were imposed through the ArcGIS network analyzer.

In the third step, given that normal walking speed ranges between 0.75 and 1.25 m/s *(24)* and the standard 750 m catchment radius for health centres *(25)*, a person's speed was set at 1 m/s. In addition, a walking time of 12.5 minutes was set for the distance of each person's house from the nearest health centre. Then, using the ArcGIS network analyzer, some limits were considered for areas with health centres in terms of people's access to these areas in real time through real roads. The above-mentioned items, including the access principle, the distance principle and the service radius, were considered in this step.

In the fourth step (the proximity principle), a minimum distance of 1000 m was considered *(26)*, and the number of people with and without access to health centres was calculated based on age and gender, and also the area of compatible and incompatible land-use within a radius of 1 km. The ArcGIS intersect and symmetrical difference tools were used for these calculations. The information of layers in terms of compatible and incompatible land-use were as follows.

Incompatible layers: These layers include industrial workshops, urban facilities, educational, cultural, sports facilities, and health centres. The appropriate distance from these land-uses should be considered in locating health centres because of challenges such as air and noise pollution for health centres as well as the optimal and equitable access to health centres and their appropriate distribution in cities. Therefore, the further these land-uses are from the health centres, the higher the score (a score of 10 being highest) would be and vice versa. In this model, a distance of 0–100 m from the incompatible

land-use has the lowest score (a score of 1), and a distance of more than 750 m has the highest score (a score of 10). The minimum distance of health centres from the incompatible land-use is 1000 m, and this value was considered as the base analysis of the land-use.

Compatible layers: These include residential areas, green spaces, fire-fighting services, population density, centre of the neighbourhood and communication networks. The shorter the distance of these land-uses from the health centres, the higher the score would be and vice versa. In this regard, quick and timely access to health centres is seen as one of the basic needs of households. Accordingly, the proximity and access to urban streets is one of the best options for the location of health centres. Thus, if the distance from the main streets is reduced, the score will be higher and vice versa. Moreover, proximity to the centre of the neighbourhood is another factor that should be considered for residents, and equitable distribution of health centres is one of the objectives and criteria of locating such land-use. Therefore, the shorter the distance of health centres from the centre of the neighbourhood, the higher the score will be and vice versa.

It should be noted that areas with a slope of the land value of 0–5% will have a higher score (the compatible section) and areas with a slope of 20–100% will have a lower score (the incompatible section) *(26–30)*.

In the fifth step, to examine the population criterion, a population density of more than 150 population/km²was considered *(31)*.

Modelling is important in geographical studies and the model of overlapping indexes is one of the most important models *(32)*. In this modelling, units in each information layer are given weights based on their capability, in addition to the weights of the information layers, and the input maps are given weights according to their importance *(33)*. The simplest type of index weighting is when maps are binary (consisting of pixels that can have one of only two colours, usually black and white) *(34)* and each map has a single weighting factor.

We used AHP to assign weights to criteria *(35)*. This method is based on pairwise comparisons and determining the priority of elements over other criteria. It is used to solve multicriteria problems and prioritization of alternatives using the intended criteria *(36)*. In our modelling, the final map was extracted for the decision-making of health managers by reviewing the literature and interviews with experts in connection with the significance of each layer and their combinations using the fuzzy AHP *(23,37)*.

Figure 1 Study processes
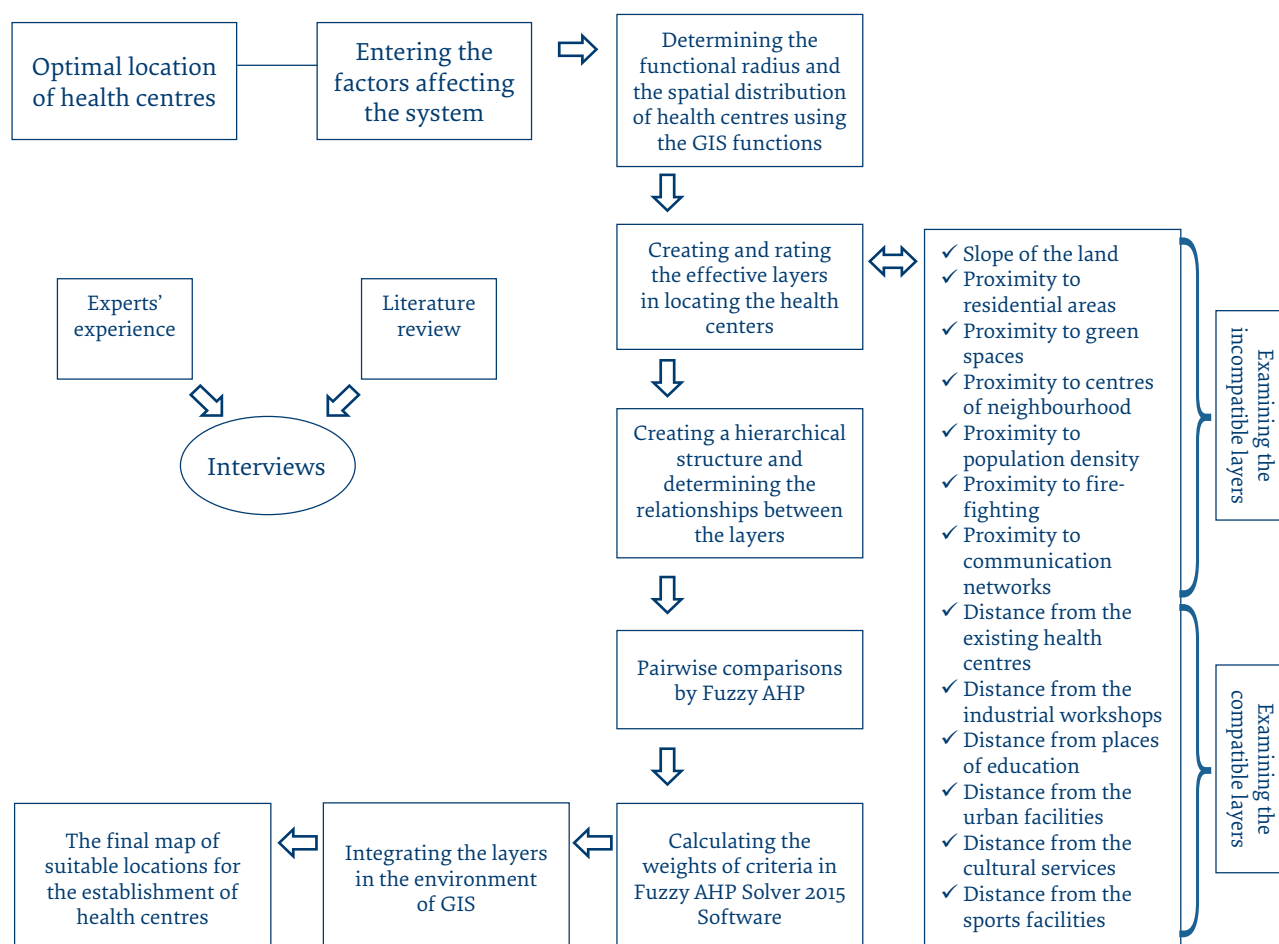
The research framework and processes of our study are shown in Figure 1.

Results

The distribution of health centres in Kermanshah city was not uniform. Given the assigned walking time of 12.5 minutes for each person from his/her home to a health centre during the three periods under study (1997, 2007 and 2012), the percentage of the population with access to health centres fell while the percentage of the population without access increased.

The population of Kermanshah city was 693 157 in 1997, 794 863 in 2007 and 851 405 in 2012. The deprived population increased from 47.28% in 1997 to 55.65% in 2007 and 58.39% in 2012, while the number of health centres increased from 29 in 2007 to 33 in 2007 and to 34 in 2012 based on ArcGIS network analyzer (Figure 2). In 1997, 38.57% of those aged 0–14 years did not have access to health centres compared with 22.97% in 2007 and 20.44% in 2012. As regards older ages, 56.62% of those aged 15–65 years did not have access to health centres in 1997 compared with 70.50% in 2007 and 74.76% in 2012. However, 4.81% of the age group 65 years and older did not have access to health centres in 1997 as opposed to 6.53% in 2007 and 4.79% in 2012 (Table 1). In 2012, 354 236 people (41.61%) had access to health centres, of which 114 859 people (32.42%) had access to two or three health centres.

Kermanshah city had eight fire-fighting services in the compatible layers, of which two were out of the range (radius of 1 km). With regard to proximity to the centres of neighbourhoods, we identified 121 centres of neighbourhoods, of which 40 (33%) were out of the range (radius of 1 km). This finding suggests that many areas have been deprived of the services provided by these centres. Moreover, all health centres were constructed along the street. In other words, the layer of proximity to streets had been considered in the establishment of health centres. The slope of the land fit into both groups: compatible (areas with a slope of 0–5% will have a higher score) and incompatible (areas with a slope of 20–100% will have a lower score). According to our findings, most of the central areas of Kermanshah city had a 5% slope and the surrounding areas had slopes ranging between 20% and 100%. Moreover, 92.42% of compatible land-use and 84.79% of incompatible use were within the range covered by health centres (radius of 1 km) (Table 2 and Figure 3).

In Figure 4, the information layers were scored in both compatible and incompatible groups. We created the hierarchical structure, determined the relationships between layers (C1–C13), and made pairwise comparisons by reviewing literature and interviews with experts *(26–28)*. Additionally, the weights of the information layers were determined by fuzzy AHP (fuzzy (AHP SoLver, 2015) (Table 3). The layers and their weights are shown in Table 4.

After ranking and combining layers with overlapping indexes in GIS software, the output layer was developed, whereby suitable lands were identified for establishing health centres. Land with higher scores had better conditions for the establishment of health centres. The final map indicated five belts for new sites for health centre as in Kermanshah city (Figure 5). The outer areas, shown in red, with a total area of 3 015 988 m2 had the lowest value (very unsuitable sites); these areas are located in the northern and southern parts of Kermanshah city. The orange belts with an area of 3 684 334 m2 and the yellow belts with an area of 18 590 936 m2 were ranked

Figure 2 Functional radius and spatial distribution of health centres and areas with and without health centre coverage in 1997, 2007 and 2012
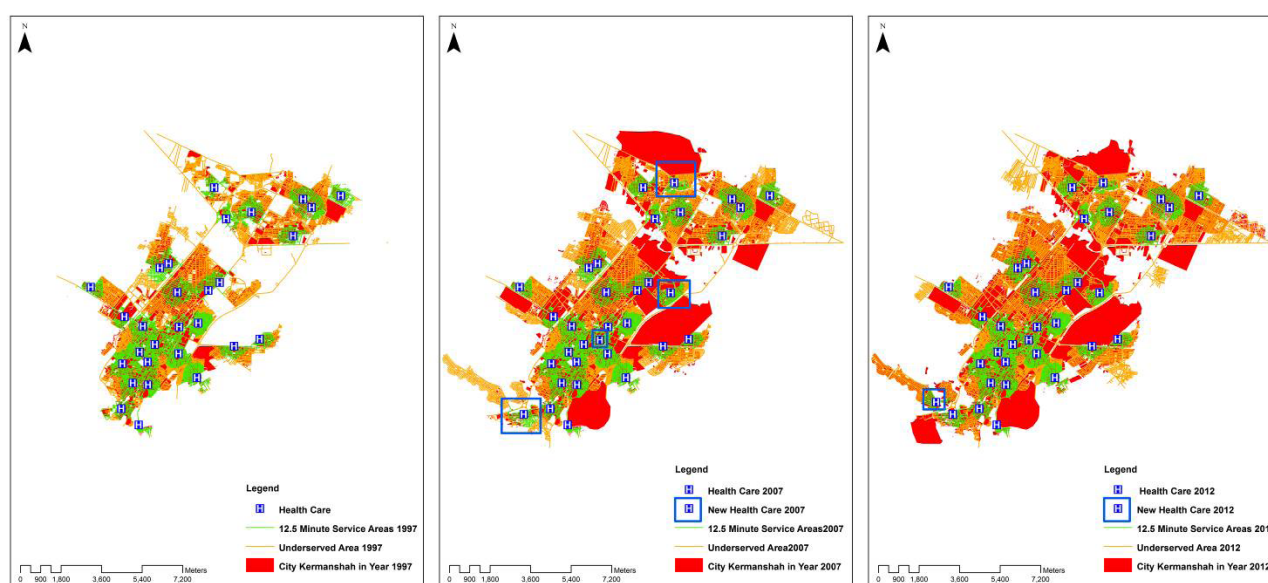
Table 1 Population without access to health centers based on age and sex over a period of 15 years, Kermanshah, 1993–2012

Year/Sex	Age groups (years)							
	Total		0–14		15–65		≥ 65	
	No.	%	No.	%	No.	%	N	%
1997								
Female	160 959	49.12	61 580	38.26	92 310	57.35	7 069	4.39
Male	166 753	50.88	64 820	38.87	93 244	55.92	8 689	5.21
Total	327 712	100	126 400	38.57	185 554	56.62	15 758	4.81
2007								
Female	215 101	48.62	50 418	23.44	154 551	71.85	10132	4.71
Male	227 286	51.38	51 201	22.53	157 339	69.23	18 746	8.25
Total	442 387	100	101 619	22.97	311 890	70.50	28 878	6.53
2012								
Female	247 769	49.83	49 038	19.79	186 908	75.44	11 823	4.77
Male	249 400	50.17	52 591	21.09	184 800	74.10	12 009	4.82
Total	497 169	100	101 629	20.44	371 708	74.76	23 832	4.79

unsuitable and medium suitability sites, respectively. The turquoise belts with an area of 35 423 271 m2 and the blue belts with an area of 51 641 924 m2 were ranked good and very good sites, respectively. In general, given the existing conditions and based on our data, we suggest 13 new health centres should be built in Kermanshah city (Figure 5).

Discussion

Our study shows that even with an increase in the number of health centres in Kermanshah city, the percentage of the population without access to health centres was on the rise, 47.28% in 1997, 55.65% in 2007 and 58.39% in 2012. Kermanshah city has increased in population from 693 000 in 1997 to 851 000 in 2012. The inappropriate spatial distribution of health centres is another challenge
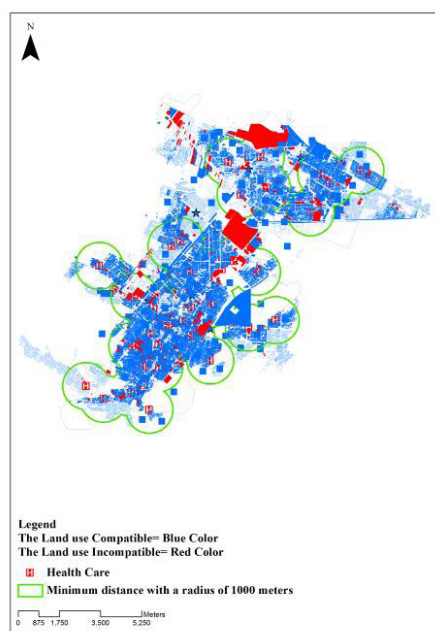
that Kermanshah city has, which is due reduced optimal access to health centres and the irrational accumulation of these centres in certain places. Some of the consequences of this issue are the lack of equal opportunity for people, injustice *(2)*, negative changes in the ecological, human and natural structure of healthy cities, and inefficiency of the urban health management system in using funds *(25)*.

Health centres were not distributed appropriately across Kermanshah city. Over the period 1997–2007, four new health centres were established, three of which were appropriately located. However, one centre was established in a part of the city that was already covered by other centres and there was no need for it. Similarly, from 2007 to 2012, a new health centre was established which overlapped with a neighbouring centre. Based on our data, the interference of the function radius was very

Table 2 Areas of the land use within and outside the range covered by the health centres (radius of 1 km) in Kermanshah city

Type of land use	Total area	Land use within the range covered by health centres		Land use outside the range covered by health centres	
		Area	%	Area	%
Compatible					
Residential	17 764 003	15 871 617	89.35	1 892 386	10.65
Green space	4 656 665	3 802 101	81.65	854 564	18.35
Blocks with high population density	21 020 679	20 474 774	97.40	545 905	2.60
Total	43 441 347	40 148 492	92.42	3 292 855	7.58
Incompatible					
Industrial workshops	2 162 608	1 676 362	77.52	486 246	22.48
Educational centres	2 791 985	2 474 194	88.62	317 791	11.38
Urban facilities	559 975	503 979	90.00	55 996	10
Cultural services	124 581	98 133	78.77	26 448	21.23
Sports facilities	365 020	338 175	92.65	26 845	7.35
Total	6 004 169	509 0843	84.79	913 326	15.21

Figure 3 Compatible and incompatible land-use within a radius of 1 km of the health centres

Legend
The Land use Compatible= Blue Color
The Land use Incompatible= Red Color
Health Care
Minimum distance with a radius of 1000 meters

high, so that 32.43% of people had access to two or three health centres, thereby resulting in a waste of resources in terms of the optimal use of facilities in these health centres. Our findings on the lack of appropriate and uniform access to health centres across Kermanshah city are consistent with the results of other studies (25,26,29,38–40). Based on our results, if more detailed need assessments and planning had been done in Kermanshah city over 1997–2007, it would have been possible for the areas in need of health centres to be better covered instead of establishing new centres in areas already covered. This situation would have resulted in higher productivity, better public satisfaction, less duplication of previous programmes and time-saving compared with the current circumstances. The results of studies in other countries have shown that adopting inappropriate management strategies results in the loss of resources (6).

In addition, our results show that the population without access to health centres in the age group 0–14 years had decreased from 38.57% to 20.44%. Population growth has decreased in the Islamic Republic of Iran and this decrease may explain the declining trend in the population of children without access to health centres. In those aged 15–65 years, the percentage of the population without access to health centres was on the rise (from 56.62% in 1997 to 74.76% in 2012). For the group over 65 years, the percentage without access increased from 1997 to 2007 and then decreased from 2007 to 2012 (from 6.53%

to 4.79%). Given the reconstruction and renovation plan in recent years in central areas of Kermanshah city, the number of migrants to the peripheral suburbs has risen. Also, because of the accumulation of health centres and the large population of elderly people in Kermanshah (before migration and renovation/renewal policies), these factors may be a reason for the decline in the population without access to health centres in 2012. In general, this lack of responsiveness to the needs of residents without proper access to health centres and the lack of social justice cause damage in community groups, especially vulnerable groups. In cities such as Kermanshah where ethnic segregation exists between residents of different neighbourhoods (25,41), the accumulation of services in particular places across the city is unjustifiable and disturbs the human, natural and ecological structure of cities.

The analysis of the compatibility and incompatibility of land-use across Kermanshah city showed that about 92% of the compatible and 85% of incompatible lands were in the range of 1000 m from the health centres. The large amount of compatible and incompatible land-use around health centres indicates that these centres were established without planning, which is one of the main reasons for the failure of urban health projects in the country (42).

As for compatible land-use, residential area (89%), green spaces (81%), densely populated blocks (97%), fire-fighting services (75%) and centres of the neighbourhoods (67%) were within a radius of 1 km of the health centres. The presence of such compatible land-use in the vicinity of health centres is an advantage. However, the existence of incompatible land-use (e.g. sports facilities (92%), urban facilities (90%), places of education (89%), cultural services (78%) and industrial workshops (77%) within a radius of 1 km of the health centres) is a disadvantage. Our finding on the lack of appropriate planning for the distribution of land-use concur with the results of other studies (42). The lack of planning in the urban land-use has led to the wide distribution of incompatible land-use throughout Kermanshah city.

Given that a large proportion of the population did not have proper access to health centres, and this situation was related to the location and insufficient number of health centres, we conclude that 13 new health centres should be established on suitable land across Kermanshah city. The use of GIS software by health managers in their planning and decision-making is recommended. By doing so, health policies and management decisions in Kermanshah city will be enhanced.

Figure 4 Scoring the effective layers by distance for compatible and incompatible groups
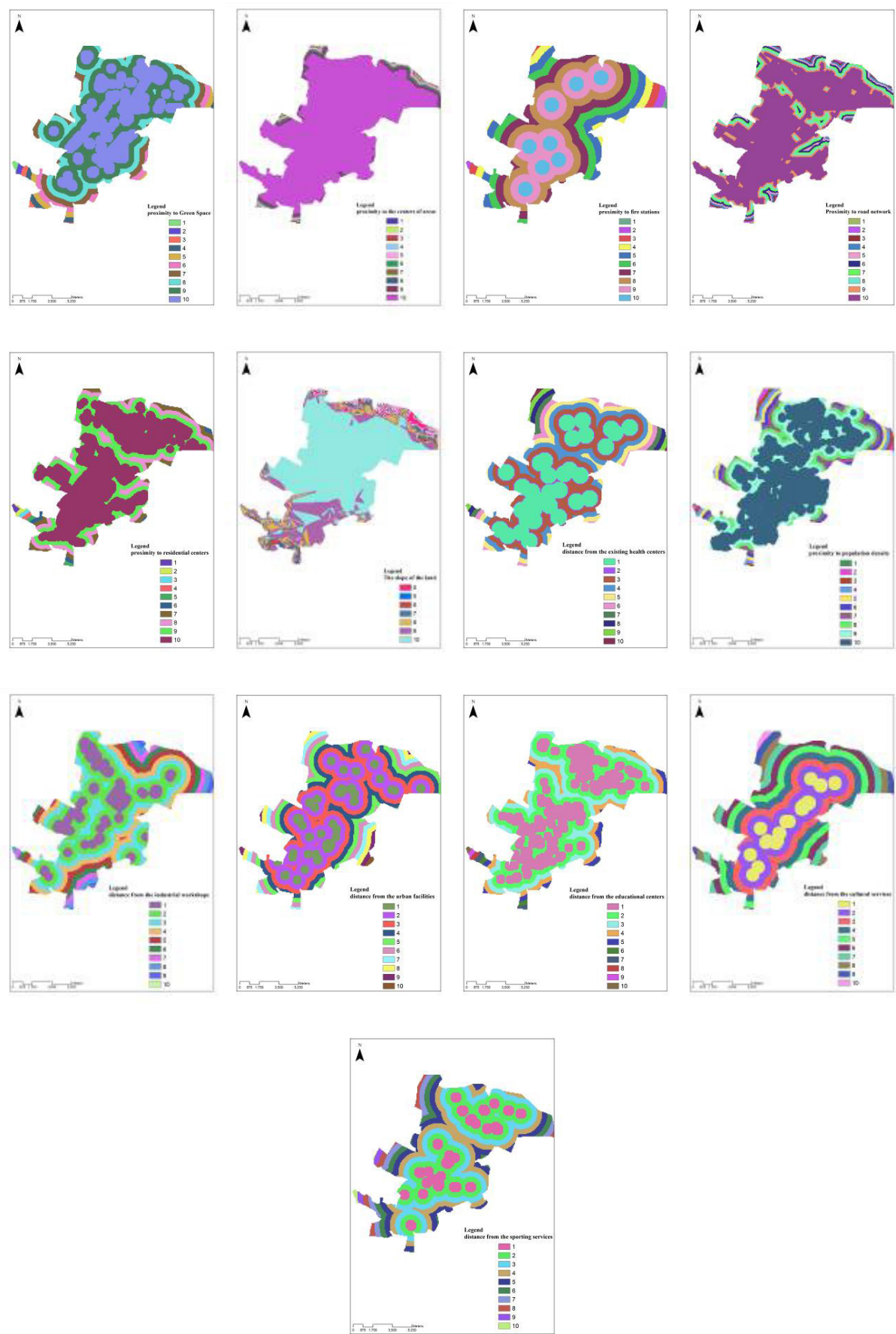
Table 3 Pairwise comparisons of the effective layers in locating health centres: comparisons metrics using fuzzy analytic hierarchy process (fuzzy AHP SoLver software, 2015)

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
C1	1, 1, 1	1, 2, 4	1, 2, 4	1, 2, 4	1, 3, 5	1, 3, 5	1, 3, 5	2, 4, 6	3, 5, 7	4, 6, 8	5, 7, 9	6, 8, 10	7, 9, 11
C2	0.25, 0.5, 1	1, 1, 1	1, 2, 4	1, 2, 4	1, 2, 4	1, 3, 5	1, 3, 5	1, 3, 5	2, 4, 6	3, 5, 7	4, 6, 8	5, 7, 9	6, 8, 10
C3	0.25, 0.5, 1	0.25, 0.5, 1	1, 1, 1	1, 2, 4	1, 2, 4	1, 2, 4	1, 3, 5	1, 3, 5	1, 3, 5	2, 4, 6	3, 5, 7	4, 6, 8	5, 7, 9
C4	0.25, 0.5, 1	0.25, 0.5, 1	0.25, 0.5, 1	1, 1, 1	1, 2, 4	1, 2, 4	1, 2, 4	1, 3, 5	1, 3, 5	1, 3, 5	2, 4, 6	3, 5, 7	4, 6, 8
C5	0.2, 0.33333, 1	0.25, 0.5, 1	0.25, 0.5, 1	0.25, 0.5, 1	1, 1, 1	1, 2, 4	1, 2, 4	1, 3, 5	1, 3, 5	1, 3, 5	1, 3, 5	2, 4, 6	3, 5, 7
C6	0.2, 0.33333, 1	0.2, 0.33333, 1	0.25, 0.5, 1	0.25, 0.5, 1	0.25, 0.5, 1	1, 1, 1	1, 2, 4	1, 2, 4	1, 2, 4	1, 3, 5	1, 3, 5	1, 3, 5	2, 4, 6
C7	0.2, 0.33333, 1	0.2, 0.33333, 1	0.2, 0.33333, 1	0.25, 0.5, 1	0.25, 0.5, 1	0.25, 0.5, 1	1, 1, 1	1, 2, 4	1, 2, 4	1, 2, 4	1, 2, 4	1, 3, 5	1, 3, 5
C8	0.16667, 0.25, 0.5	0.2, 0.33333, 1	0.2, 0.33333, 1	0.2, 0.33333, 1	0.25, 0.5, 1	0.25, 0.5, 1	0.25, 0.5, 1	1, 1, 1	1, 2, 4	1, 2, 4	1, 2, 4	1, 3, 5	1, 3, 5
C9	0.14286, 0.2, 0.33333	0.16667, 0.25, 0.5	0.2, 0.33333, 1	0.2, 0.33333, 1	0.2, 0.33333, 1	0.25, 0.5, 1	0.25, 0.5, 1	0.25, 0.5, 1	1, 1, 1	1, 2, 4	1, 2, 4	1, 2, 4	1, 3, 5
C10	0.125, 0.16667, 0.25	0.14286, 0.2, 0.33333	0.16667, 0.25, 0.5	0.2, 0.33333, 1	0.2, 0.33333, 1	0.25, 0.5, 1	0.25, 0.5, 1	0.25, 0.5, 1	0.25, 0.5, 1	1, 1, 1	1, 2, 4	1, 2, 4	1, 2, 4
C11	0.1111, 0.14286, 0.2	0.125, 0.16667, 0.25	0.14286, 0.2, 0.33333	0.16667, 0.25, 0.5	0.16667, 0.25, 0.5	0.2, 0.33333, 1	0.2, 0.33333, 1	0.25, 0.5, 1	0.25, 0.5, 1	0.25, 0.5, 1	1, 1, 1	1, 2, 4	1, 2, 4
C12	0.1, 0.125, 0.16667	0.1111, 0.14286, 0.2	0.125, 0.16667, 0.25	0.14286, 0.2, 0.33333	0.14286, 0.2, 0.33333	0.2, 0.33333, 1	0.2, 0.33333, 1	0.2, 0.33333, 1	0.25, 0.5, 1	0.25, 0.5, 1	0.25, 0.5, 1	1, 1, 1	1, 2, 4
C13	0.09091, 0.1111, 0.14286	0.1, 0.125, 0.16667	0.1111, 0.14286, 0.2	0.125, 0.16667, 0.25	0.14286, 0.2, 0.33333	0.16667, 0.25, 0.5	0.2, 0.33333, 1	0.2, 0.33333, 1	0.2, 0.33333, 1	0.25, 0.5, 1	0.25, 0.5, 1	0.25, 0.5, 1	1, 1, 1

Table 4 Weighted layers using fuzzy analytic hierarchy process (fuzzy AHP SoLver software, 2015)

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
0.15001	0.13885	0.1272	0.11523	0.10301	0.09107	0.07988	0.06889	0.05562	0.03956	0.02448	0.00619	0

Figure 5 Final ranking and proposed sites for the establishment of health centres
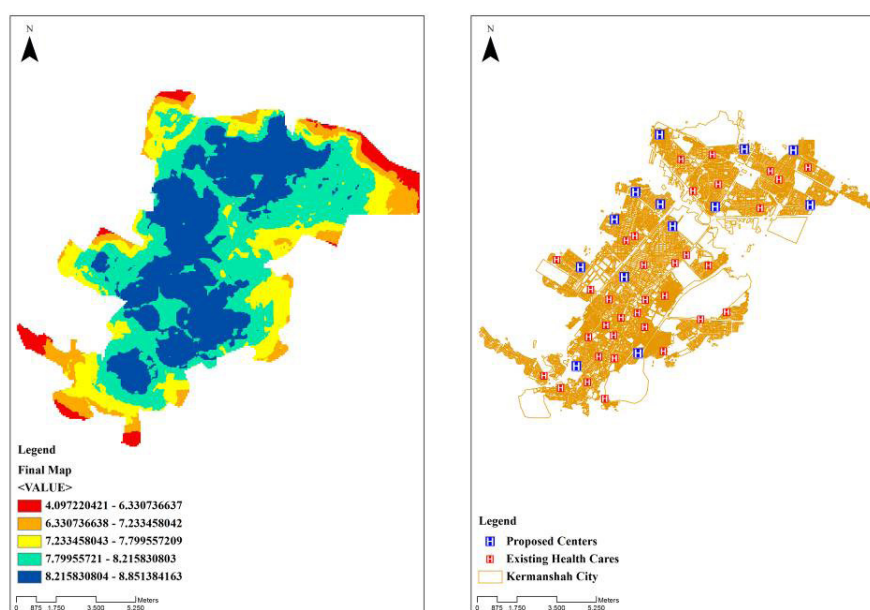
Utilisation d'un système d'information géographique pour déterminer le nombre de nouveaux centres de santé nécessaires dans la ville de Kermanshah, ainsi que leur emplacement (République islamique d'Iran)

Résumé

Contexte : Une répartition inappropriée des centres de santé peut aggraver les inégalités en matière de soins de santé. Un système d'information géographique (SIG) est un outil intéressant qui permet de planifier, de surveiller et d'évaluer les systèmes de santé en analysant et en visualisant des données géospatiales.

Objectifs : La présente étude visait à proposer un modèle optimal pour la création de nouveaux centres de santé dans la ville de Kermanshah (République islamique d'Iran) au moyen d'un SIG.

Méthodes : Dans cette étude analytique descriptive, le nombre de centres de santé, leur emplacement et l'accès de la population à ces centres dans l'ensemble de la ville de Kermanshah ont été évalués à l'aide du système d'information géographique ArcGIS 10.3, pour les années 1997, 2007 et 2012. Afin de déterminer les meilleurs emplacements pour établir des centres de santé, cinq principes ont été pris en compte : l'accès, la distance, la portée des services fournis, la proximité de zones d'aménagement compatibles et incompatibles et la densité de population.

Résultats : Malgré l'augmentation du nombre de centres de santé à Kermanshah dans la période comprise entre 1997 et 2012, la population n'ayant pas accès à ces centres s'est également accrue, et ce de manière variable selon les groupes d'âge. Sur la version finale du plan de l'ensemble des terrains de Kermanshah, 6 % des terrains ont été jugés inadaptés ou très inadaptés, 16 % moyennement adaptés et 78 % bien adaptés ou très adaptés à l'implantation de centres de santé dans la ville.

Conclusion : La distribution spatiale des centres de santé (vue sous l'angle du rayon d'accès) et la compatibilité des terrains n'ont pas été correctement prises en compte sur cette période de 15 ans. Pour assurer la couverture sanitaire de la population actuelle de la ville de Kermanshah, il faudrait créer 13 nouveaux centres de santé à des emplacements appropriés.

استخدام نظام المعلومات الجغرافية لتحديد عدد المراكز الصحية الجديدة وموقعها في مدينة كرمنشاه، جمهورية إيران الإسلامية

سُهيلا رشادات، شهرام سعيدي، علي رضا زنجنه

الخلاصة

الخلفية: يمكن أن يؤدي توزيع المراكز الصحية بصورة غير ملائمة إلى زيادة أوجه عدم الإنصاف في الرعاية الصحية. ويُعتبر نظام المعلومات الجغرافية من الأدوات المفيدة التي تساعد في تخطيط النُّظم الصحية، ورصدها، وتقييمها من خلال تحليل البيانات الجغرافية والمكانية وتصويرها بيانياً.

الأهداف: هدفت هذه الدراسة إلى اقتراح نموذج أمثل لإنشاء المراكز الصحية الجديدة باستخدام نظام المعلومات الجغرافية في مدينة كرمنشاه، جمهورية إيران الإسلامية.

طرق البحث: في هذه الدراسة التحليلية الوصفية، تم تقييم عدد المراكز الصحية وموقعها وإمكانية وصول الناس إليها في جميع أنحاء كرمنشاه، وذلك باستخدام نظام المعلومات الجغرافية ArcGIS 10.3، خلال السنوات 1997، و2007، و2012. وقد أُخذ بعين الاعتبار المبادئ الخمسة التالية لتحديد أفضل المواقع التي يمكن إنشاء المراكز الصحية بها، ألا وهي: إمكانية الوصول إليها، والمسافة، ومحيط تقديم الخدمات، ومدى قربها من مواقع الاستخدام المتوافق أو غير المتوافق للأراضي، والكثافة السكانية.

النتائج: على الرغم من زيادة عدد المراكز الصحية في مدينة كرمنشاه في الفترة بين عامي 1997 و2012، إلا أن عدد السكان الذين لا يستطيعون الوصول إلى هذه المراكز قد زاد أيضاً، ولكن بنسب متباينة حسب الفئة العُمرية. واستناداً إلى الخريطة النهائية لجميع الأراضي في كرمنشاه لتحديد المواقع التي تصلح للمراكز الصحية في المدينة، تبين أن 6٪ من الأراضي تُعتبر غير ملائمة أو غير ملائمة على الإطلاق، و16٪ منها ملائمة بدرجة متوسطة، بينما 78٪ ملائمة بدرجة جيدة أو جيدة جداً.

الاستنتاجات: لم يُدرَس جيداً التوزيع المكاني للمراكز الصحية (من حيث محيط الإتاحة، وإمكانية الوصول إليها) ومدى توافق استخدام الأراضي طوال فترة 15 عاماً (فترة الدراسة). ولتوفير التغطية الصحية لسكان مدينة كرمنشاه حالياً، يجب إنشاء 13 مركزاً صحياً جديداً في مواقع ملائمة.

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