Analysis of geographical accessibility to rural health houses using the geospatial information system, a case study: Khuzestan Province, South-West Iran

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ANALYSIS OF GEOGRAPHICAL ACCESSIBILITY TO RURAL HEALTH HOUSES USING THE GEOSPATIAL INFORMATION SYSTEM, A CASE STUDY: KHUZESTAN PROVINCE, SOUTH-WEST IRAN

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ABSTRACT

Background: The use of rural health houses is one of the important approaches for delivering health services but, inappropriate infrastructures and limited resources make it difficult to design and implement plans to enhance and improve health services in rural areas. The aim of this study was to analyze the accessibility to rural health care services in the province of Khuzestan

Materials and methods: This applied research was conducted in Khuzestan Province, south-west Iran with a cross-sectional approach in 2014. The population of the study was the villages and rural health houses. All the villages and rural health houses were included in the study without sampling. Descriptive data collected with a checklist from the Statistical Centre of Iran, IT Department of the Management Deputy of the Governor's Office and Ahvaz Jundishapur and Dezful University of Medical Sciences and spatial data obtained from the national Cartographic Center. The validity of the checklist was confirmed by 5 Public Health experts and 3 senior experts of the GIS system. Data analyzed with Arc GIS 9.3 software.

Results: Khuzestan Province has 3461 villages with inhabitants. Based on the geographical distance to the nearest health house, 358 villages (10.34%) with inhabitants were outside the service provision area with a distance of more than 6 In order to measure the total petroleum hydrocarbon available in the soil, first, 1 gr of the pot soil was taken and 10 ml dichloromethane solvent added to it, then the mixture was stirred for 5 minutes, and the resulting mixture was centrifuged for 5 minutes at a speed of 3000 rpm. After being centrifuged, 1 ml of the centrifuged solution was transferred to vials that were weighed before, and the dichloromethane was permitted to evaporate in the air for 48 hours. Afterwards, the vials were weighed again, and the removal percentage of the petroleum hydrocarbons was calculated based on the weight difference between the vials (21).km. Based on the population covered by health houses, 11 villages with more than 1000 population had inappropriate access to health houses.

Conclusions: The results showed that geographical conditions and developmental infrastructures of the rural areas were some major challenges of access to health houses in Khuzestan Province, which requires the cooperation of several governmental sectors. Collection and storage of accurate, up-to-date, and complete information are very important steps in delivering primary healthcare services and enhancing the rural population health.

Key words: Geographic Information system, Accessibility, Rural Health Houses.

Introduction

Geographical dispersion, low socioeconomic status, inappropriate health conditions, and natural barriers cause numerous problems for the provision of health services in rural areas of different countries, especially developing countries[1]. Convenient and appropriate access to primary health care has a prominent role in enhancing the health status of the rural population; therefore, the use of rural health houses is one of the important approaches for delivering health services[2]. Birth control, screening, controlling communicable diseases, and maternal and child health care are some examples of the services delivered in rural health houses[3, 4].

However, inappropriate infrastructures and limited resources make it difficult to design and implement plans to enhance and improve health services in rural areas[5]. The Geospatial Information System is a suitable tool for analyzing, managing and determining optimum access to health services[6]. Nowadays, the GIS is used in different studies to analyze the

accessibility and determine the optimum model of accessibility to health services[7-9]. The GIS analyzes geographical features and phenomena on the earth and presents optimal models for analyzing the obtained decisions[10]. The analytical capabilities of the GIS provide a better interpretation of the distribution and management of the resources to deliver health services[11].

Another use of the GIS is the calculation of the indicators of geographical accessibility of the population to health services in different areas which provides the opportunity to meticulously evaluate the distribution of health care facilities in the society and its proportion to the population under coverage[12]. Equal geographical accessibility to health care services in the rural areas is one of the challenges of equity in health[13]. Distance, population density, transportation routes, and rural transportation services are among the determinants of accessibility to health services in rural areas[14, 15]. Available tools in the GIS provide the opportunity to analyze the distance and transportation routes to determine geographical access[16]. Since 1970s, different projects have been implemented in Iran to ensure the appropriate access of the rural population to primary health services including health houses and since mid 1990s, the health houses have been established according to the regulation of the health promotion and development office of deputy health network system, ministry of health and medical education[17]. The geographical location of the health houses, population and number of the villages under coverage, transportation routes, and distance to the health center are among these regulations. The aim of these regulations is to ensure the accessibility of the rural population to the services delivered in health houses[18].

Objective

Khuzestan is one of the provinces with a large rural population[19]. The eight-year Iran-Iraq war and forced immigration of the people from the border villages, the growth of the petrochemical, oil, and steel industries, motivations to migrate from towns and villages to the cities, the occurrence of several droughts, and the dust storm are among the factors that have changes the population texture of the villages of Khuzestan. Therefore, considering the population and climate changes in the province, the aim of this study was to analyze the accessibility to rural health care services in the province of Khuzestan.

Materials and methods

Study Location

The Province of Khuzestan, with an area of 64.075 km², is located in the south west of Iran, near the Persian Gulf. Khuzestan borders the Province of Lorestan in the north, Isfahan Province and Chaharmahal Bakhtiari Province in the northeast and east, the Province of Ilam in the northwest, Kohgiluyeh and Boyer-Ahmad Province in the east and southeast, Bushehr Province and the Persian Gulf in the south, and Iraq in the west.

Figure 1: The study area. Khuzestsn province with the counties.

Khuzestan is located from 47.42°-50.39° E and 29.58°-32-58° N. It has a population of 4,531,720 (according to the most recent census in 2011) with 1,083,341 household including 793,289 urban and 290,052 rural households. The Province of Khuzestan has 24 counties (Fig. 1), 55 districts, and 132 rural agglomerations.

Study design

This applied research was conducted in Khuzestan Province in 2014 in a cross-sectional approach. The target population of the study was the villages and rural health houses of Khuzestan province in 2011. All the villages and rural health houses were included in the study without sampling.

Data collection

Descriptive data including the name of the village and county, longitude and latitude, population, village type (main or satellite), having a rural health house, population under the coverage of health houses, type of transportation route, residential status of the village (permanent, seasonal,

deserted), type of topography (jungle, plain, mountain), and infrastructures (water, electricity, gas, telephone), and the presence of educational and administrative units like The county seat, police station, school, city council, bank, and other governmental institutions. The data collection tool for this part was a checklist that was designed according to the objectives of the study and consultation with the experts of the health network system and the GIS system. The validity of the checklist was confirmed by 5 public health experts with the experience of working in the health networking system and 3 senior experts of the GIS system.

The basis of data collection was the 2011 national Census. The data of the village and county name, longitude and latitude, type of transportation route, residential status of the village (permanent, seasonal), and infrastructures (water, electricity, gas, telephone) were derived from the Statistical Centre of Iran. The Statistical Centre of Iran did not have the data of villages with fewer than five households. Therefore, these data were collected from the Statistics and IT Department of the Management Deputy of the Governor's Office. The data related to the health network system including the characteristics of the health houses, main and satellite villages, and under coverage population of the rural health houses and rural health centers were obtained from the Deputy for Health of Ahvaz Jundishapur and Dezful University of Medical Sciences.

Spatial data including topographic layers, counties, villages, and rural roads of Khuzestan Province (scale: 1:25000) were according to the latest administrative divisions of the country. The data were obtained from the national Cartographic Center, and Forrest, Range, and Watershed Organization and the Governor's Office of Khuzestan Province.

Geodatabase development

Descriptive data and topographic layers were entered into the GIS software and a database was created using the ArcGIS 9.3. The topographic layers were created to their application in the analysis of the current situation of the dispersion of the rural area and health houses. The layers included villages, population, rural health houses, transportation routes, distance to rural health centers, residential status, and topography. Then, the current situation of the geographic distribution of rural area was analyzed using the descriptive and loca-

tion data available in the geodatabase. In this stage, spatial distribution of the villages, transportation routes, population distribution, topography of the villages, and their residential status were determined in the GIS. In the next stage, the current situation of the rural health houses and their under coverage population were determined and the distribution of the health houses in GIS, operational radius of each health house, satellite villages of each health house, and the population and number of households covered by each health house were identified.

Assessment of access to rural health houses

Type of criterion	Attribute
Geographical Location	The units should be located on the routine transportation routes. Emphasis on this criterion may sometimes cause that from 2 or more villages that are covered by one unit, one village be selected for the establishment of the designated unit which is not necessarily the most populated one. The presence of one or more of the following factors indicates that a village is on the routine transportation route: 1. Being located on the main roadway of neighboring villages 2. Having administrative units like the county seat, police station, court of justice, bank, and other governmental institutions. 3. Frequent trading like weekly or regular markets 4. Having schools, high schools, public baths, etc. that can be used by neighboring villages.
The number of population and villages under coverage	Although an unvarying pattern cannot be determined for the population covered by each unit according to the regulations and the location of the village, the mean population covered by each unit can be estimated using the calculations related to the activities and duties of each service delivering unit and the staff of the unit: 5. About 1500 persons for each health house- however, health houses can be established for more or less populated villages depending on the situation with modifications in their staff and personnel
Geographic dispersion	If the population is dispersed in different villages, the villages are in the functional domain of a health house if their distance to the health house does not exceed 6 km (1 hour walk).
Transportation Route	The transportation route between the village where the health house is located and the location of the health center should be at least Jeep trail and preferably through all year long.
Distance to rural health center	The distance between the health house and the health center should not preferably exceed 20km except for special situation when a distance of maximum 40km is acceptable depending on the type of the transportation route and Climate condition

Table 1: Regulations and criteria of the Health Promotion and Development Office of Deputy Health Network System for the establishment of health houses[18].

The final stage was the identification of the residents of the villages with convenient access to health houses in each country separately. The criteria for convenient access to health houses were according to the regulations of the health promotion and development office of deputy health network system for the allocation of rural health houses. The criteria are presented in Table 1.

Inappropriate access of the residents of the villages to health houses was analyzed through an overlay of the layers of villages, population, rural health houses, transportation routes, proximity to rural health centers, residential status (permanent, seasonal), topography, and the operational radius of the health houses. The operational radius of health houses was considered 6 km according to the regulations of the health network system.

Finally, according to the regulations of the health network system, the villages that had inhabitants but lacked convenient and appropriate access were identified.

Results

Based on the national census in 2011, Khuzestan Province has 4547 villages. Izeh and Hendijan had the largest and smallest number of villages (539 and 40 villages, respectively). Andika and Hendijan had the highest and lowest number of villages according to their area, respectively. Regarding the residential status, 3315 villages (72.9%) had permanent residents, 146 villages (3.2%) had seasonal residents, and 985 villages (23.9%) were deserted.

lages for each health house (Figure 2).

Furthermore, 2223 villages (48.9%) and 753 villages with health houses had access to asphalt roadways (Table 3). Overlap of the layers and determination of the operational radius of rural health houses showed that there were 358 villages with inhabitants outside the service provision area of rural health houses with a distance of more than 6km to the nearest health house (Figure 3 and 4).

Moreover, evaluation of the population of the villages with residents that lacked health houses showed that 11 villages with more than 1000 population had inappropriate access to health houses (Table 4).

County Name	Area (Sq. km)	Number of villages	The number of health houses	Population	The average population per health center	County Name	Area (Sq. km)	Number of villages	The number of health houses	population	The average population per health center
Abadan	2538	75	40	55744	1360	Ramhormoz	1818	177	38	41019	1079
Ahvaz	6835	313	80	162453	1593	Ramshir	1620	132	23	24273	1055
Bavi	1377	87	22			Gotvand	973	52	19	26003	1369
Andimeshk	3116	169	32	33603	1050	Shadegan	3598	183	60	95206	1587
Izeh	3789	539	80	86521	1082	Shush	3630	182	56	112813	2015
Omidiyeh	2330	71	22	27754	1261	Shushtar	2433	164	55	95206	1587
Bagh-e Malek	2251	313	55	70528	1282	Lali	1400	220	26	20847	802
Behbahan	2999	189	49	54121	1105	Andika	2369	500	40	41623	1041
Mahshahr	1908	49	12	19420	1765	Masjed Soleyman	2176	209	23	4652	437
Khorramshahr	2298	102	21	39099	1862	Hoveyzeh	2757	106	20	14635	732
Dezful	4646	530	59	121523	2060	Haftkel	1436	54	11	7054	641
Dasht-e Azadegan	1972	91	37	47671	1288	Hendijan	3780	40	16	9691	606

Table 2: Distribution of villages, home health and population in the Khuzestan province, according to County.

The mean population of the villages was 282 (range: 9-12321 inhabitants). Villages with fewer than 250 inhabitants had the highest frequency. Moreover, the highest population density was observed in Ahvaz. There was a total of 896 rural health houses in Khuzestan Province. Izeh and Ahvaz had the highest and Haftgol had the lowest number of health houses (80 and 11 health houses, respectively) (Table 2).

On average, each rural health house covered 1248 persons (range: 437-2060). Range between the numbers of health houses to the number of villages in different counties varied between 2-12 vil-

Discussion

Appropriate and convenient access of the rural population to health services and homogeneous distribution of the services are among the objectives of the Health Network System development project in Iran[17, 18] and one of the key indices of development[20]. The results of the study showed differences between the distribution of health services and some indices of rural development. The ratio of the distribution of health houses to the villages and the mean population under the coverage are examples of these differences. Range between

the number of health houses to the number of villages in different counties varied between 2-12 villages for each health house and the mean population under the coverage was 437-2060. The difference may not have resulted from inequity in the distribution of health services but could indicate the difference in rural development. Different studies have shown differences in rural development between different counties or different villages of a
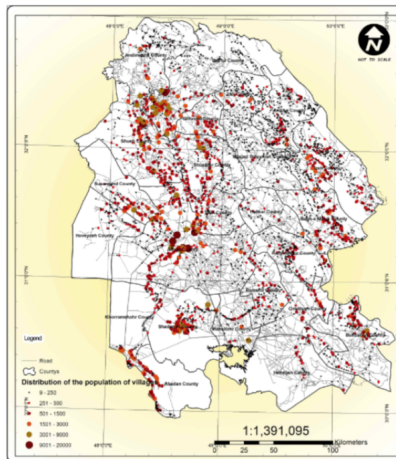
county[21]. A study by Ghasemi et al in the counties of Zanjan Province showed differences in the number of health houses in different villages[22]. Moreover, the results of a study by Kiadaliri et al showed significant differences in the distribution of health services in different parts of Iran[23].
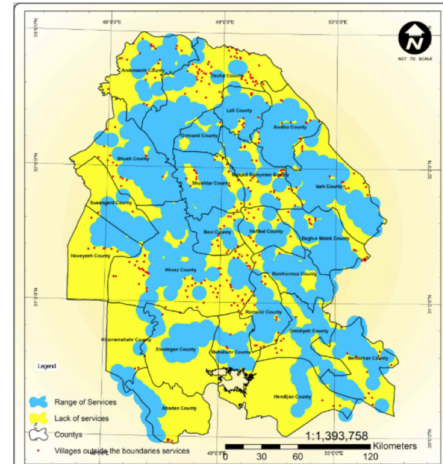

Figure 2: The spatial distribution of inhabited villages in Khuzestan province.

cases	paved	Paved & waterway	Paved & railroad	Gravel road	Gravel & railroad	Marlow & waterway	Dirt road	Dirt road & railroad	Dirt road & railroad	Marlow	Marlow & railroad	Unknown
The total number of villages	2199	15	9	320	3	7	1131	4	7	846	2	2
The number of villages with permanent residents	2034	15	8	259	3	3	697	4	5	270	1	-
The number of villages have health home	743	6	4	46	1		79	-	4	12	1	-

Table 3: Status of rural roads in Khuzestan province by type of roadway.

Figure 3: Spatial distribution of health centers services in rural areas (Radius of 6 kilometers) in Khuzestan province.

Figure 4: Spatial distribution of villages with inhabited, outside the radius of rural health centers services (6 kilometers).

County name	Improper accessibility by distance	Improper accessibility by population	County name	Improper accessibility by distance	Improper accessibility by population
Abadan	5		Ramhormoz	3	1
Ahvaz	68	4	Ramshir	16	
Bavi	15		Gotvand	1	
Andimeshk	24		Shadegan	2	
Izeh	16		Shush	16	1
Omidiyeh	6		Shushtar	18	1
Bagh-e Malek	15	1	Lali	11	
Behbahan	12		Andika	17	
Mahshahr	4		Masjed Soleyman	27	
Khorramshahr	3	1	Hoveyzeh	10	
Dezful	52	2	Haftkel	11	
Dasht-e Azadegan	2		Hendijan	3	

Table 4: Villages with population, whit improper accessibility to rural health home in each county.

Spatial distribution of rural areas is another challenge in the distribution of health houses. The distribution was more in Dezful, Andika, and Izeh counties. Moreover, the distance between the rural health house and the rural health center was more than 60 km in some counties which hinders the supervision of health centers upon health houses.

Bagheri et al analyzed the geographical accessibility of the rural areas of Otago to health services from the nearest primary health care provider according to the regulations of New Zealand Ministry of Health and reported that accessibility in outlying rural areas was not according to the regulations[24]. Spatial distribution of rural areas is one of the main challenges of the governments for delivering health care services[4].

Some studies have also shown that dispersion of the rural areas hinders policy making for the distribution of health services[25].

The presence of 1292 villages with less than 250 populations was another challenge for the distribution of rural health services.

Bahrami evaluated the status of rural development in Kurdistan Province and reported the large number of villages with less than 300 population as one of the main challenges[26]. Izadi and Hayayee performed a study to analyze the status of rural health houses and rural health insurance from the viewpoint of rural development and found that geographical distance, rural and population dispersion were the major threats to delivering health services in rural health houses. They also reported that establishing a healthcare center in one village to cover some neighboring villages regardless of the distance, geographic factors, and transportation route causes many problems in access to these centers and establishment of health houses or enhancing their equipment is not sometimes cost effective due to the limited population of the villages[27].

Rural roadways play a major role in the development of rural areas or the access of the rural population to health care services[28]. About 40% of the inhabited villages lack asphalt roadways. A study by Mohammadi and Kiani showed a direct relationship between rural roadways and the rural development[29]. The experience of some developing countries also shows that developing rural roadways enhances the access of the rural population to health care services[30].

One hundred and forty six villages in Khuzestan Province had seasonal inhabitants. These villages are empty of residents for half of the year and lack communication and welfare infrastructures, which hinder planning for the provision of health care services. Moreover, there were 985 deserted villages in Khuzestan that had health houses as main villages because they were inhabited when the health houses were established; their populations were calculated in the total population for the allocation of health houses. Migration of the rural population to the urban areas and the resulting of deserted and abandoned villages are a challenge for rural planning[31].

Determination of the services boundaries of the rural health houses in Khuzestan Province showed that 358 villages with permanent inhabitants lacked convenient and appropriate access and had a distance of more than 6km (1 hour walk) to the nearest health house.

Munoz and Kallestal used GIS to evaluate the geographical access of the rural areas of the western regions of Rwanda to primary health care services using three scenarios (walking, walking and bicycling, walking and public transportation). In the first scenario that was walking for 1 hour, only 26.6% of the population had access to primary health care centers[32]. Gibson et al also used the GIS system to evaluate the access of the rural households to the nearest health care center in Shaanxi, China. Their results showed that about 47% of the rural households were at a distance of at least 5km from the nearest health care center. They stated that the long distance increased the costs of transportation and decreased the usage of health facilities[28]. Some other studies have also reported a direct relationship between the distance to the health facilities and the use of the services as increasing the distance decreases the usage[1, 33, 34].

Conclusion

The results of the study showed that geographical conditions and developmental infrastructures of the rural areas were some major challenges of access to health houses in Khuzestan Province, which requires the cooperation of several governmental sectors like the Ministry of Interior and the Ministry of Roads and Urban Development with the Ministry of Health to overcome.

Discrepancies in the data of the villages in different organizations and institutions were one of the limitations of this study; however, we rather overcame this limitation through obtaining information from formal resources like the Governor's Office. Collection and storage of accurate, up-to-date, and complete information on the status of the population, distribution of health houses, and their accessibility are very important steps in delivering primary healthcare services and enhancing the rural population health. In this regard, the GIS system is a very practical tool that can assist policy makers in devising better plans.

References

1)   Tanser F, Gijsbertsen B, Herbst K. Modelling and understanding primary health care accessibility and utilization in rural South Africa: an exploration using a geographical information system. Social Science & Medicine. 2006; 63(3): 691-705. Pubmed Central PMCID: 16574290

2) Murawski L, Church RL. Improving accessibility to rural health services: The maximal covering network improvement problem. Socio-Economic Planning Sciences. 2009;43(2):102-10.DOI: 10.1016/j.seps.2008.02.012

3) Salehi-Isfahani D, Abbasi-Shavazi MJ, Hosseini-Chavoshi M. Family planning and fertility decline in rural Iran: the impact of rural health clinics. Health Economics. 2010; 19(S1): 159-80. Pubmed Central PMCID: 20552711.

4) Mehryar AH, Aghajanian A, Ahmad-Nia S, Mirzae M, Naghavi M. Health Indicators, and Rural Poverty Reduction: The experience of Iran. The xxv general population conference of the international Union for the Scientific Study of Population (IUSSP); 18-23 July 2005; Tours, France.

5) Wilson N, Couper I, De Vries E, Reid S, Fish T, Marais B. A critical review of interventions to redress the inequitable distribution of healthcare professionals to rural and remote areas. Rural Remote Health. 2009; 9(2): 1060. Pubmed Central PMCID: 19530891.

6) Fisher RP, Myers BA. Free and simple GIS as appropriate for health mapping in a low resource setting: a case study in eastern Indonesia. Int J Health Geogr. 2011; 10(11): 10.1186. Pubmed Central PMCID: PMC3051879.

7) Evans B, Sabel CE. Open-Source web-based geographical information system for health exposure assessment. International journal of health geographics. 2012; 11(1): 2. Pubmed Central PMCID: PMC3286384.

8) Lokhman MT, Rasam A, Rauf A, Noor AMM, editors. Reforming health care facility using geographical information system. Control and System Graduate Research Colloquium (ICSGRC), 2012 IEEE; 16-17 July 2012; Shah Alam, Selangor, Malaysia: IEEE.

9) Yao J, Murray AT, Agadjanian V. A geographical perspective on access to sexual and reproductive health care for women in rural Africa. Social Science & Medicine. 2013; 96: 60-8. Pubmed Central PMCID: 24034952.

10) Griffith D. Geographic information systems. Encyclopedia of statistical sciences: John Wiley & Sons, Inc; 2004. DOI: 10.1002/0471667196.ess 4068.pub2

11) Jarup L. Health and environment information systems for exposure and disease mapping, and risk assessment. Environmental Health Perspectives. 2004: 995-7. Pubmed Central PMCID: PMC1247192.

12) McLafferty SL. GIS and health care. Annual review of public health. 2003;24(1):25-42. PMID:12668754

13) Balarajan Y, Selvaraj S, Subramanian S. Health care and equity in India. The Lancet. 2011; 377(9764): 505-15. Pubmed Central PMCID: PMC3093249.

14) Tanser F. The application of GIS technology to equitably distribute fieldworker workload in a large, rural South African health survey. Tropical Medicine & International Health. 2002; 7(1): 80-90. PMID: 11851958.In order to measure the total petroleum hydrocarbon available in the soil, first, 1 gr of the pot soil was taken and 10 ml dichloromethane solvent added to it, then the mixture was stirred for 5 minutes, and the resulting mixture was centrifuged for 5 minutes at a speed of 3000 rpm. After being centrifuged, 1 ml of the centrifuged solution was transferred to vials that were weighed before, and the dichloromethane was permitted to evaporate in the air for 48 hours.

Afterwards, the vials were weighed again, and the removal percentage of the petroleum hydrocarbons was calculated based on the weight difference between the vials (21).

15) Eskandari M, Abbaszadeh A, Borhani F. Social determinants of health care process in rural society of Iran from health care provider's experience. Journal of Qualitative Research in Health Sciences. 2012; 1(3): 159-69.(Persian)

16) Chang K-t. Introduction to geographic information systems: McGraw-Hill Higher Education Boston; 2006.

17) General Principles in structures of the health network system. Health Promotion and Development Office of Deputy Health Network. Tehran, Iran: Ministry of Health and Medical education; 2007. (Persian)

18) Pilehroodi S. County healthcare network. 3 ed. Tehran, Iran: Ministry of Health and Medical education Press; 2006. (Persian)

19) Dormiani A. The report of national healthcare unit's information, based on Health Network Information System (HNIS) software since 2008-2011. health Promotion and Development Office of Deputy Health Network. Tehran, Iran: Ministry of Health and Medical education 2012. (Persian)

20) Marmot M, Friel S, Bell R, Houweling TA, Taylor S, & Commission on Social Determinants of Health. (2008). Closing the gap in a generation: health equity through action on the social determinants of health. The Lancet. 2008; 372(9650): 1661-9. PMID: 18994664

21) Momeni M, Ghahari G. Investigating Development Status of Cities in Fars Province. Journal of Zonal Planning 2013; 3(9): 53-66. (Persian)

22) Tabrizi J, Ghasemi A, Moazzen S. Analysis of spatial inequality of economic services, social and cultural cities of Zanjan province. Research and Urban Planning. 2013; 4(13): 19-34. (Persian)

23) Kiadaliri AA, Najafi B, Haghparast-Bidgoli H. Geographic distribution of need and access to health care in rural population: an ecological study in Iran. International Journal for Equity in Health. 2011; 10(1): 39. Pubmed Central PMCID: PMC3196912

24) Bagheri N, Benwell GL, Holt A. Primary Health Care Accessibility for Rural Otago:'A Spatial Analysis'. HIC 2006 and HINZ 2006: Proceedings. Brunswick East, Vic.: Health Informatics Society of Australia, 2006: 365-376.

25) Dummer TJ, Cook IG. Exploring China's rural health crisis: processes and policy implications. Health Policy. 2007; 83(1): 1-16. PMID:17254663

26) Bahrami R. Main Challenges in rural development over Iran (Case study Kurdistan province). Geographical research. 2010; 25(3): 125-42. (Persian)

27) Izadi B, Hayati D, editors. The situation analysis of rural House health status and Villagers health insurance from the perspective of rural development. 1st national convenience on policies toward sustainable development; 10 March 2013; Tehran, Iran. (Persian)

28) Gibson J, Deng X, Boe-Gibson G, Rozelle S, Huang J. Which households are most distant from health centers in rural China? Evidence from a GIS network analysis. GeoJournal. 2011; 76(3):245-55.DOI: 10.1007/s10708-010-9337-y

29) Mohammadi J, Kian iS. Spatial analysis of relation between access to road and rural development based on accessibility to services. Journal of Village and Development. 2007; 10(4): 117-44. (Persian)

30) Banerjee R, Sachdeva A. Pathways to Preventive Health, Evidence from India's Rural Road Program, 2014. [cited 2015 5 May] Available from: http://dornsifecms.usc.edu/assets/sites/834/docs/PathtoHealth_Banerjee_Sachdeva_Nov2014.pdf.

31) Mahdavi-Hajilooi M, Ghadiri_Masum M, Mohammadi_Yegane B. The Role of Geographical natural factors on instability and migration of rural in Zanjan Province. Geographical Research. 2003; 36(49): 203-21.(Persian)

32) Munoz UH, Kallestal C. Geographical accessibility and spatial coverage modeling of the primary health care network in the Western Province of Rwanda. International Journal of Health Geographics, 2012; 11: 40. PMCID: PMC3517388

33) Jordan H, Roderick P, Martin D, Barnett S. Distance, rurality and the need for care: access to health services in South West England. International journal of health geographics. 2004; 3(1): 21. PMCID: PMC524184

34) Chan L, Hart LG, Goodman DC. Geographic access to health care for rural Medicare beneficiaries. The Journal of Rural Health. 2006; 22(2): 140-6. PMID:16606425

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