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The application of geographic information systems (ArcGIS) in selecting locations for installing banners and billboards in a health campaign

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Abstract

In recent years, the geographic information system (GIS) application has used the latest spatial data to help researchers make the right decisions in the shortest time. This study was conducted with the aim of using geographic information systems (ArcGIS) for selecting the best location for installing banners and billboards in a health campaign. This research was an analytical and applied research conducted in Sirjan city, Iran in 2018. In this research, GIS and fuzzy logic methods were used. In order to implement the fuzzy operator in the GIS environment, initially, the main influencing criteria in location selection were determined. Then the weighted layers were put on top of each other and, by considering the sub criteria, the most suitable places to install banners and billboards were identified in the final map. The final map showed the best places to install billboards and educational banners for the 'hookah is the enemy of health' campaign. The final number of these places was 30 according to the main criteria, and the number was reduced to 25 places, after considering the sub criteria. ArcGIS can be used in selecting the best locations for installing banners and billboards in a health campaign.

Introduction

Population growth and poor urban development have created many problems for providing educational services in the cities. One of the main challenges in urban planning is balancing the spatial distribution of facilities or services with its economic cost [1]. Equal access to educational services and organizing an appropriate situation for optimal use of these facilities is one of the fundamental components of sustainable development. Achieving a fair spatial distribution of educational resources and services at the city level is one of the main objectives of planning educational campaigns [2]. Geographic information systems (ArcGIS) is one of the technologies which can contribute to location selection [3]. Considering the increase in information and resources and the development of computer hardware and software, the use of GIS can be an efficient tool to ease and speed health services. GIS has already been used for spatial analysis in epidemiological studies [4].

Over the past decade, several research groups have investigated the role of GIS as a tool to analyse health data; and a number of techniques has been developed that allow the extraction of exploration-relevant spatial factors from datasets [5]. These spatial factors are ultimately condensed into a single

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prospective map. Most techniques used to construct prospective maps tend to agree, in general, as to which areas have the lowest and highest prospectivities, but disagree for regions of intermediate prospectivity. In such areas, the prospectivity map requires detailed interpretation, and the end-user must normally resort to analysis of the original datasets to determine which conjunction of factors results in each intermediate prospectivity value [6]. In order to alleviate this problem, a new technique, based on fuzzy logic principles, has been developed for the integration of spatial data. Fuzzy logic differs from existing methods in that it displays prospectivity as a continuous surface and allows a measure of confidence to be incorporated [7].

GIS have a high ability in storing, recalling, analysing and displaying data and can help decision-makers control illnesses or health crises [8]. GIS can help decentralize health system information, reduce budgets and number of employees and save time. GIS can also help change attitude and understanding of the distribution of problems or show critical points, and a clear picture about their dispersal over the country. In this software, the information is stored in different layers and their relations in these layers can be studied [3].

Most citizens prefer to have high access to public services. But it is not economically feasible to provide facilities everywhere. Hence, important decisions must be made for selecting the location of services and facilities from places which are responsive to local needs and demands. GIS can be used as a decision support tool in effective urban planning [9].

Urban planning is based on spatial information and requires a wide range of information in various aspects, such as social, economic, health, environmental, cultural, traffic, etc. GIS software can help planners by using a wide range of designs, descriptions, analyses and models [7]. Location selection theories describe the suitable locations for health, medical, industrial and commercial services and identify the best location by using general rules and factors effective in location selection [10]. GIS has been used in various health services. In the 1970s, the UK Department of Health and Social Care considered the strategic development of health services and started to conduct studies in this area [11]. These studies include the study of Moore *et al.* on the application of GIS in health and epidemiology of diseases [12]; Erdogan *et al.* on the application of GIS in the analysis of traffic accidents[13]; Luo and Wang on access to health care by using GIS in Chicago [14] and Sumathi *et al.* on the use of GIS in appropriate landfill management in India [15].

Several studies have shown the results of GIS are applicable. For example, the study of Kuo *et al.* about a decision support system for selecting convenience store locations in Taiwan [16]; Muttiah *et al.* about waste disposal site selection using GIS-based simulated annealing in the US [17]; McGrail *et al.* about appropriate access to basic health services in rural Australia [18]; Stern *et al.* about determining the appropriate location for founding a hospital [19]; Azizi *et al.* about using GIS for selecting the location of health services in Mahabad city, Iran [11] and Kalantari *et al.* about selecting the best places to establish health centers in Zahedan city, Iran [20].

Other applied studies have used GIS as well. Chang *et al.* used the hierarchical analysis method, susceptibility analysis and the improved Delphi method to determine the appropriate locations for Taiwan hospitals, by using indicators such as land, investment, labor and environmental and governmental factors [21].

Another study conducted in Semnan city (Iran) used GIS, hierarchical analysis and network analysis for determining the location for constructing three new hospitals. The radius of the optimal location for building health centers was determined in this study [22].

In another study, Mohammadi *et al.* determined the best location for health centers in Ramsar city, Iran. In this study, the fuzzy network analysis considered 12 criteria, and the most suitable location for constructing the health centers was determined according to the most effective indicators and their priority based on their calculated relative importance [3].

Tobacco smoking is a major health risk factors and is increasing especially among young

people [23]. Tobacco consumption is the fourth risk factor in the overall burden of diseases and has created huge health, social and economic burdens in the world [24]. Tobacco smoking resulted in one death from every six deaths globally in 1990, but according to predictions, it is anticipated that by 2020, tobacco will cause one out of every three deaths in adults [25]. By 2030, the rate of tobacco-related deaths will increase to over 8 million per year, in which more than 80% of these deaths will happen in low-income or developing countries [26].

The rate of hookah smoking is rising in Iran. It is one of the main health risk factors in recent years and is also a gateway to drug addiction. Finding and promoting protective behaviors can improve lifestyle and prevent diseases and health problems associated with hookah smoking [27]. Unfortunately, this phenomenon has now become a popular social phenomenon among young people and adolescents [28].

In order to control this harmful phenomenon, an appropriate educational curriculum based on the needs of the target group can be prepared and community interventions can be performed in the study population [29]. Community-based health promotion programs try to empower individuals, organizations and communities to promote behaviors and create a healthier environment. The main feature of community-based programs is that they target the entire community and require action at many levels [30]. One of the community-based educational strategies is running educational campaigns aimed at conveying convincing messages for causing a specific behavior in the audience. Health Campaigns invite people and authorities to public participation and pay attention to social interests and benefits [31].

One of the uses of ArcGIS is in educational campaigns, for delivering messages in specific locations by banners and billboards to the target group. If locations are defined well, people's exposure to the health message will increase [32].

Although health care services have been implemented in cities by using GIS, they have not been used for selecting the location of banner or billboard installation in health campaigns. However, conveying information in appropriate locations is an important issue in health campaigns [33]. Identifying the best location for banner or billboard installation according to the available facilities and budget plays an important role in conveying educational messages. Therefore, this study was conducted with the aim of using geographic information systems (ArcGIS) in selecting the best location for installing the banners and billboards of a Health Campaign in Sirjan city in 2018.

Materials and methods

This research is an analytical and applied research that was conducted in Sirjan City (Iran) in 2018. Sirjan city is one of the largest cities in Kerman province in the south-east of Iran. According to the 2016 census, the population of this city was 324 103, in which 32 826 people (16 722 male and 16 104 female) were persons under 24 years of age.

The target group of this study was youth and adolescents (aged 12–24 years) in Sirjan city. As young people stay outdoors for a long time, messages need to be delivered to them in different ways; and the installation of banners and billboards in places like schools and higher education centers is one of the best ways to expose them to these educational messages.

At first, the effective features were divided into main and secondary features. The main features were distance from the main city streets, distance from crowded centers and distance from educational centers (higher education centers and schools). The secondary features included appropriate visibility with minimal risk of accident for drivers, distance from recreational areas and parks and distance from commercial sites. These data were collected through a survey (Table I).

In the analytical section, based on the data collected for the main research features, a (1:5000) map was prepared for the city. Then fuzzification of digital layers was performed by using fuzzy logic techniques, and in ArcGIS, the integration of the designed layers was done.

Researchers have shown that GIS have the necessary reliability and validity for selecting the location

Table I. *The features used for determining the locations for installing banners and billboards about the 'Hookah is the Enemy of Health' campaign*

	Feature	Analysis method
Main	Distance from main entrance and avenues	ArcGIS
	Distance from crowded centers	
	Distance from educational centers (higher education centers and schools)	
Subsidiary	Appropriate visibility with minimal risk of accident for drivers	Experts' opinions in FGD
	Distance from recreational areas and parks	
	Distance from commercial sites	

of health services [34]. GIS is a quantitative technique that can be used for decision-making, determination of trends, selecting locations and different levels of planning. Modeling is one of the important capabilities of this system. Making models and using models is essential in geographic research [35]. One of the most important models is the model of overlapping indicators, in which, in addition to giving weights to information layers, the units in each information layer are given a certain weight based on their potential [11].

In this model, input maps are given weight based on their significance in the hypothesis. The easiest way to weigh indices is when the maps are dual and each map has a single weight factor. However, when multi-class maps are used, each class takes on a different score or weight from each map, and this makes the weighing system more flexible [36].

There are different ways to score the criteria. The fuzzy logic method of fusion techniques is one of them. The fuzzy logic was first introduced by Lotfizadeh, from the University of Berkeley. It was used for conditions of uncertainty. Fuzzy theory and logic is a scientific tool that enables dynamic simulation of a system without the need for detailed mathematical descriptions, and by using quantitative and quantitative data [37].

According to the fuzzy logic theory, membership in a group may not be complete, and each member has a membership ratio from zero to one, and in contrary to Boolean's logic, in fuzzy logic, there is no definite classification as perfectly suitable or perfectly inappropriate [38]. Fuzzy logic analysis also has different modes including intersection, unity and gamma. Gamma is in between the two modes of intersection and union. According to experience and research, the fuzzy multiplicative mode has a high accuracy and high sensitivity in location selection. In this case, all layers of information are multiplied, because of the nature of the membership degree in fuzzy unions numbers, which is between zero and one, when multiplied, the numbers get smaller and approach zero; and as a result, the low number of pixels are classified in the very good class [39].

After determining the main features, focus group discussion (FGD) was used to determine the secondary features. FGD is a good way to gather people views from similar backgrounds or experiences to discuss a specific topic of interest. FGD can be used to explore the meanings of survey findings that cannot be explained statistically, to gather a range of opinions on a topic of interest and to collect a wide variety of local information [40].

FGD is one of the ways to find out about the perceptions of a group of people about a specific topic in a non-threatening and purposeful manner, and aims at gathering information about a particular topic. The main characteristic of FGD is the information which is generated through the interaction of the participants. The open questions asked in FGD makes it possible to obtain deep, and rich information about the topic from participants [41].

In this study, FGD was conducted with the aim of excluding inappropriate places for installing banners and billboards. In this FGD, 10 experts (4 health experts, 3 municipal experts and 3 police officers) participated. The FGD was organized in a conference room with an oval table in the city's health center,

at a time and date convenient for the experts. The FGD was facilitated by a moderator and an assistant moderator. The moderator was the first author. The assistant moderator took notes from the participants' views and comments during the discussions.

FGD started with an introductory round in which the researchers and the participants presented themselves and the researchers explained the purpose of the study. Then, the facilitator began the discussion, and the instructor took notes and recorded the participants' voice. The findings of each focus group were summarized and categorized by the researchers.

'Appropriate visibility with minimal risk of accident for drivers', was determined by the municipality and police experts through field visits and expert opinion. The 'proper vision' factor was determined by checking these points, and then, the 'lowest risk of accident' was determined by conducting field surveys.

Results

Preparing fuzzy maps

The results of fuzzy maps were determined for three items including, distance from main entrance and avenues, distance from crowded centers and distance from educational centers (higher education centers and schools) and the final map of the combination of the above layers was prepared by using the gamma fuzzy operator. Then by using the secondary criteria, the map of final places for installing the banners and billboards were determined.

ArcGIS$_{10.5}$ was used to prepare the fuzzy maps. In order to use space changes to find the right location, the linear type of the membership function was used. The resulting layer is a layer that converts the values of the input layer to values between zero and one, so that regions with the membership score of 1 or close to 1 are more worthwhile than those with a membership score of zero or near to zero. This is done for all existing layers, and values are classified into four groups. The resulting layers were as follows:

The results of the 'proximity to the main avenues of the city' feature showed that the 1, 2, 3 and 4 areas had values of 0.37, 0.52, 0.61 and 0.85, respectively. The places with membership scores of 0.85 were the most valuable areas. In other words, these areas had the closest proximity to the main streets and main roads of the city, and were a good place to install banners and billboards to expose people to educational messages (Fig. 1).

The results of the 'proximity to centers with high population' feature showed that the 1, 2, 3 and 4 places had 0.19, 0.30, 0.38 and 0.81, values, respectively. Places with a membership degree of 0.81 were the most valuable places. In other words, these areas were the closest to areas with a high population density and were a good place to install banners and billboards because they could expose a bigger population to educational messages (Fig. 2).

The results of the 'proximity to educational centers' feature showed that the 1, 2, 3 and 4 areas had values of 0.28, 0.39, 0.56 and 0.77, respectively. The areas with a 0.77 membership score were the most valuable places. In other words, these areas were the closest to educational areas (schools and universities) and were a good place to install banners and billboards for young people (Fig. 3).

In Fig. 4, the final map of the combination of the above layers was obtained by using the gamma fuzzy operator. The results of combining these layers showed that the 1, 2, 3 and 4 areas had values of 0.18, 0.27, 0.62 and 0.88, respectively. The areas with a 0.88 membership score were the most valuable and the best areas for installing banners and billboards (Fig. 4).

The final map was obtained after considering the sub criteria, including appropriate visibility with minimal risk of accident for drivers, distance from recreational areas and parks and distance from commercial sites. In other words, after considering the main and secondary criteria of these areas, the best areas for installing banners and billboards that could effectively expose the target group to the message were determined (Fig. 5).

The results of a survey about the places that the billboards and educational banners of the 'hookah is the enemy of health' campaign were installed, showed that 76.5% of the participants believed that the installation site was good and only 6.4% of the participants thought that the installation site was inappropriate (Table II).

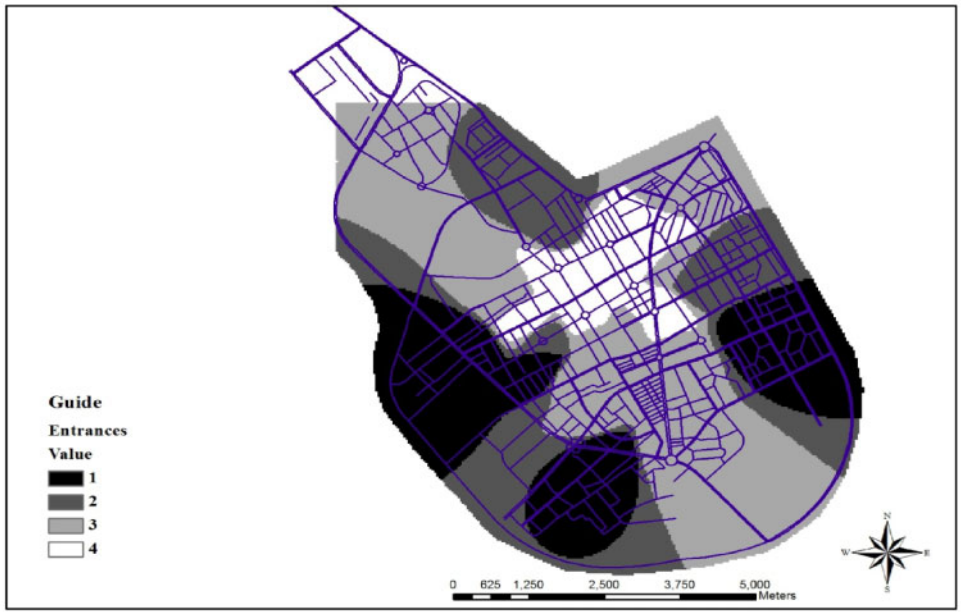

Fig. 1. The fuzzy map about proximity to the main entrance and avenues of the city.

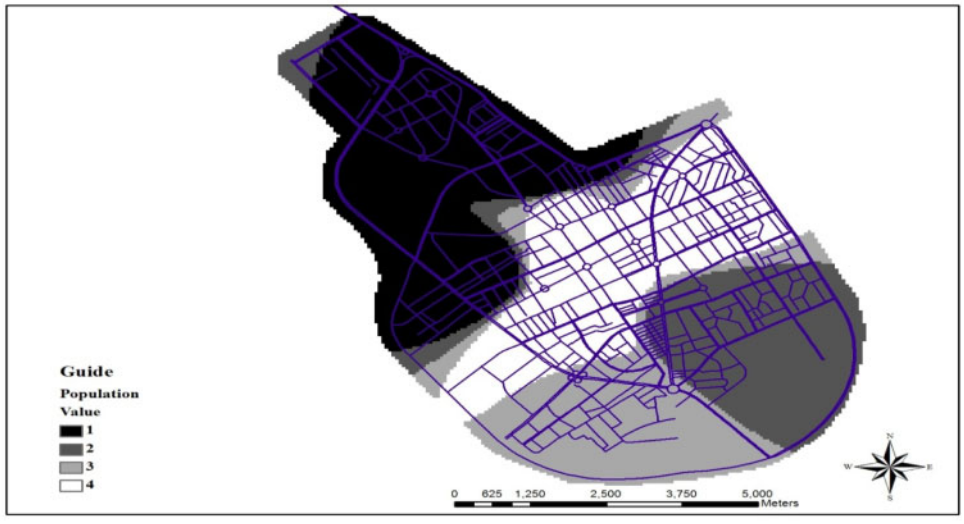

Fig. 2. Fuzzy map about proximity to centers with high population.

Discussion

Location selection theories have helped in selecting the best locations for service centers since the 1970s. Optimal location selection has great importance in urban planning and determining the location of schools, health centers, fire stations, refineries, etc. [10]. Proper location selection can help in providing well-being and comfort to urban populations and

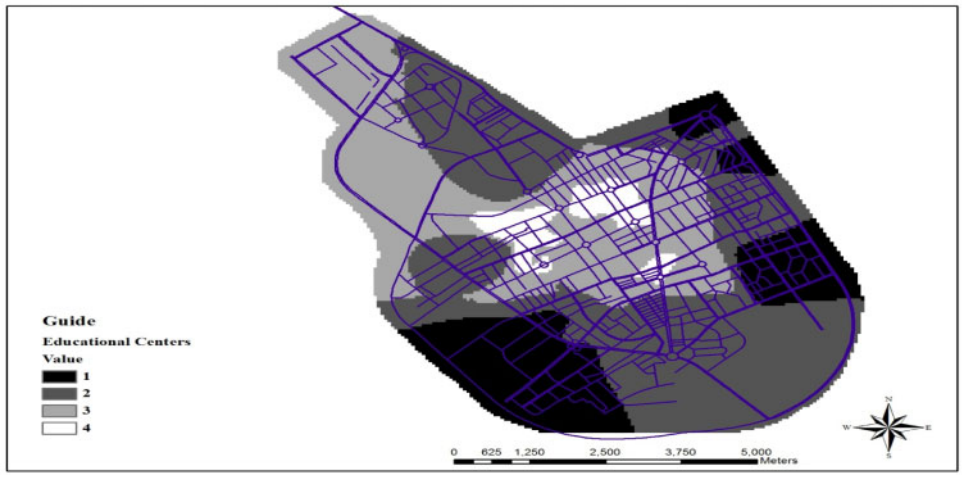

Fig. 3. Fuzzy map of closeness to educational centers.

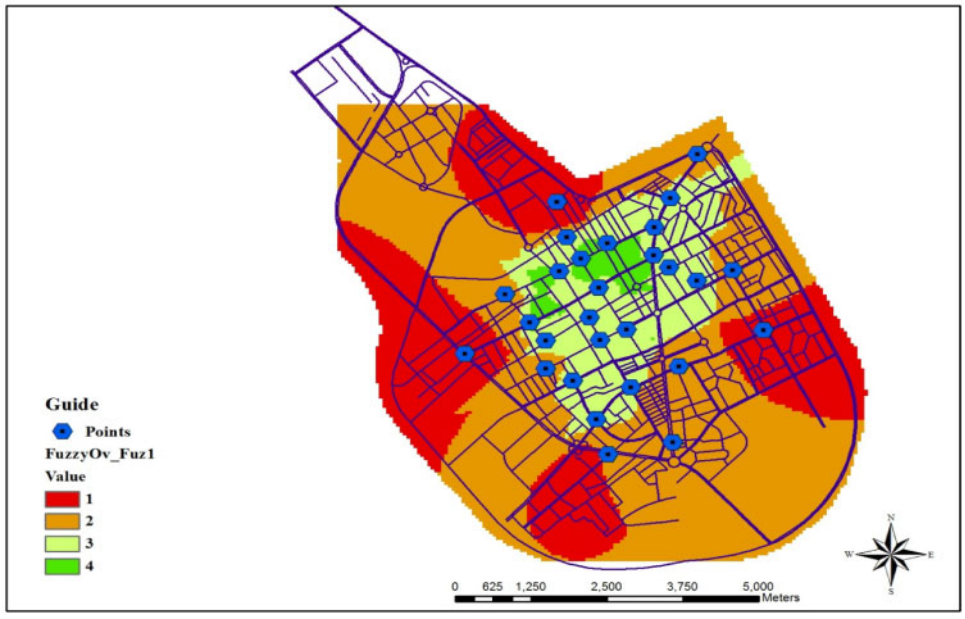

Fig. 4. The final map resulting from combining layers by using the gamma fuzzy operator.

contribute to social justice and health promotion of the community. This study aimed at using ArcGIS in selecting the best location for installing the banners and billboards of an educational campaign in Sirjan city.

Appropriate urban planning can be done according to people's needs by using different GIS models and according to information from cities. GIS models in addition to showing the current situation of the city can also suggest the best possible

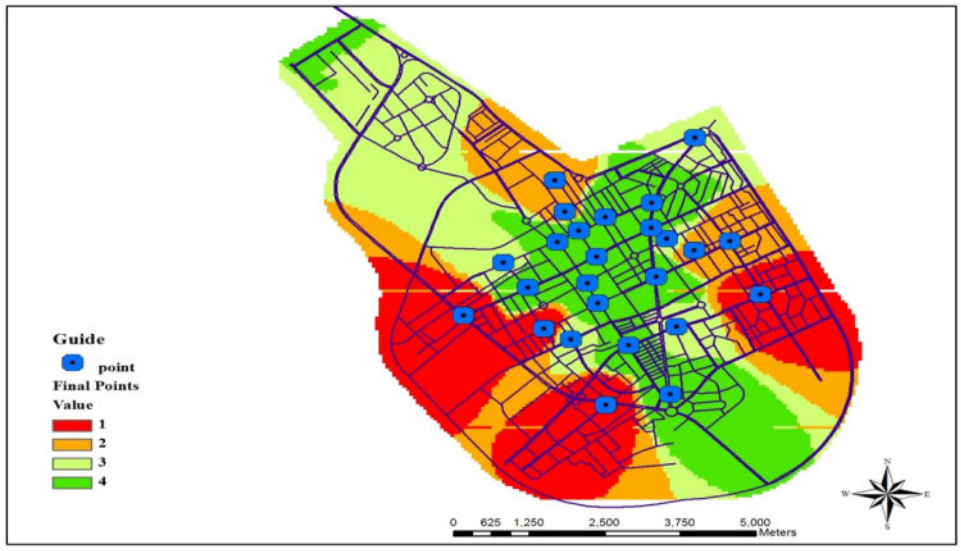

Fig. 5. The final map of suitable places after considering the subsidiary criteria.

Table II. *Participants' opinion about the location of the banner and billboard installation in the 'Hookah smoking is the enemy of health' campaign*

Satisfaction participants		*n* (%)	Good	Medium	Weak
Gender	Male	131 (46.7)	105 (80.1)	19 (14.5)	7 (5.4)
	Female	149 (53.3)	109 (73.1)	29 (19.5)	11 (7.4)
Total		280 (100)	214 (76.5)	48 (17.1)	18 (6.4)

initiatives to planners and executives by locating the effective factors in the city [42].

One of the most important uses of GIS is helping to plan for the implementation of health education programs. In this research, the final map indicated the best points to install the billboards and educational banners of the 'Hookahs is the Enemy of Health' campaign. These areas had the closest proximity to the main areas of the city, the centers with high population and educational areas (such as higher education centers and schools). These areas also had good visibility and were close to amusement parks, green spaces and commercial sites. Choosing these areas helped in saving money and human resources during the educational campaign. The results of Kuo *et al*. showed that if time and funding is limited, some factors with lower evaluation weights can be eliminated and this will not influence the prediction accuracy significantly [16]. In another study, Muttiah *et al*. showed that 'the simulated annealing algorithm' achieved an order of magnitude reduction in execution time over that of an exhaustive search method; and gave policy makers the option of selecting the final site based on social factors that were not considered in the numerical model [17].

The final map was designed after a FGD with the presence of 10 experts and by concentrating on secondary factors. The secondary factors included proper visibility with minimal risk of accident for drivers, distance from recreational spaces and parks and distance from commercial sites. The numbers of these points were 30 and after considering the secondary criteria, it decreased to 25 points.

In this study, it should be noted that other areas with less membership scores (0.62–0.88) were the next priority. This means that these areas may have had specific ready established advertising sites that could be used. Of course, planning for these places is in the next priority and is subject to funding.

A survey was conducted to assess the appropriateness of the identified places by asking teenagers and young people. The findings showed that 80.1% of men and 73.1% of women (with an average of 76.5%) commented that these sites were very good. This shows that the locations were selected appropriately.

One of the limitations of this study was the lack of access to some information and statistics, such as demographic information from different parts of the city and blocks, demographic density, school information and number of students, etc. In some cases, officials refused to give this information, which was resolved by the help of the governor of Sirjan city.

Another limitation of this study was not using other methods such as the simulated annealing algorithm and artificial neural network. It is suggested that other researchers use these methods in future research.

Establishing and providing various services, including health centers, are one of the most important items in city development and population health. It is recommended that databases about health-related services be prepared, so that GIS can be used in healthcare management and planning programs.

Conclusion

GIS can help decision-makers make the right decision without wasting time and energy by using prior data. In this study, ArcGIS helped in finding appropriate locations for banners and educational boards for the first time.

HUMAN SUBJECTS APPROVAL STATEMENT

This study was approved by the Ethics Committee of Shahid Sadoughi University of Medical Sciences (Ethics Code: IR.SSU.SDH.REC.1396.134). The aim of the study was clarified for the participants and informed consent was inquired from all participants and their parents.

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References

1. Abdi A, Jahanshiri H, Alavi M. Built CNG fuel stations using geographic information system GIS and multi-criteria evaluation method of AHP Case Study: Rasht. Ninth International, Congress on Civil Engineering, Isfahan University of Technology, 2012.
2. McKenzie JF, Neiger BL, Thackeray R. *Planning, Implementing, and Evaluating Health Promotion Programs: A Primer*. San Francisco: Pearson/Benjamin Cummings, 2005.
3. Mohammadi Zanjirani D, Shahbandarzadeh H, Ghorbanpour A *et al*. The application of fuzzy analytical network process (FANP) approach for appropriate location selection of health centers: case study in Ramsar cite. *ISMJ* 2012; **15**: 127–36.
4. Nikurai M. Consideration of urban waste management with emphasis on medical wastes in metropolises. Case Study: Tabriz City. *Thesis*. Marand, Iran: Azad Islamic University of Marand Center, 2007.
5. Kyoomarsi F, Khosravi H, Eslami E, Dehkordi PK *et al*. Optimizing text summarization based on fuzzy logic. In: *Seventh IEEE/ACIS International Conference on Computer and Information Science (ICIS 2008)*, 347–52. IEEE, 2008.
6. Knox-Robinson C. Vectorial fuzzy logic: a novel technique for enhanced mineral prospectivity mapping, with reference to the orogenic gold mineralisation potential of the Kalgoorlie Terrane, Western Australia. *Aust J Earth Sci* 2000; **47**: 929–41.
7. Wheatley D, Gillings M. *Spatial Technology and Archaeology: The Archaeological Applications of GIS*. London: CRC Press, 2013.
8. Bagheri N, Benwell GL, Holt A. Measuring spatial accessibility to primary health care. 17th Annual Colloquium of the Spatial Information Research Centre, University of Otago, New Zealand, 2005.
9. Birkin M, Clarke G, Clarke M, Wilson A. *Intelligent GIS: Location Decisions and Strategic Planning*. Cambridge: Geoinformation International, 1996.

10. Shin E-K. Using geographic information system (GIS) to improve fourth graders' geographic content knowledge and map skills. *J Geogr* 2006; **105**: 109–20.
11. Azizi M. Application of geographic information system (GIS) in location, spatial distribution and network analysis in health services case study: city of Mahabad. *Thesis*. Tabriz, Iran: University of Tabriz, 2004.
12. Moore DA, Carpenter TE. Spatial analytical methods and geographic information systems: use in health research and epidemiology. *Epidemiol Rev* 1999; **21**: 143–61.
13. Erdogan S, Yilmaz I, Baybura T *et al*. Geographical information systems aided traffic accident analysis system case study: city of Afyonkarahisar. *Accident Anal Prev* 2008; **40**: 174–81.
14. Luo W, Wang F. Measures of spatial accessibility to health care in a GIS environment: synthesis and a case study in the Chicago region. *Environ Plann B* 2003; **30**: 865–84.
15. Sumathi V, Natesan U, Sarkar C. GIS-based approach for optimized siting of municipal solid waste landfill. *Waste Manage* 2008; **28**: 2146–60.
16. Kuo RJ, Chi S-C, Kao S-S. A decision support system for selecting convenience store location through integration of fuzzy AHP and artificial neural network. *Comput Ind* 2002; **47**: 199–214.
17. Muttiah R, Engel B, Jones D. Waste disposal site selection using GIS-based simulated annealing. *Comput Geosci* 1996; **22**: 1013–17.
18. McGrail MR, Humphreys JS. Measuring spatial accessibility to primary health care services: utilising dynamic catchment sizes. *Appl Geogr* 2014; **54**: 182–8.
19. Sinuany-Stern Z, Mehrez A, Tal A-G, Shemuel B. The location of a hospital in a rural region: the case of the Negev. *Locat Sci* 1995; **3**: 255–66.
20. Kalantari H, Rezazadeh MH, Miri GR. Finding the best health center location in Zahedan, Iran by using FAHP. *Eur Online J Nat Soc Sci* 2016; **4**: 680–90.
21. Chang C-W, Wu C-R, Lin C-T, Lin H-L. Evaluating digital video recorder systems using analytic hierarchy and analytic network processes. *Inf Sci* 2007; **177**: 3383–96.
22. Ziyari A, Khatibzadeh F. Integrated AHP model and network analysis model for user location, medical (hospital) case study: semnan. *Urban manag* 2012; **2**: 247–58.
23. Mazloomy Mahmoodabad SS, Sadeghi R, Fallahzadeh H *et al*. Validity and reliability of the preventing hookah smoking (PHS) questionnaire in adolescents based on the protection motivation theory. *Int J Pediat* 2018; **6**: 8327–37.
24. Rahimi MA, Hefazi M, Amin EM *et al*. Lifetime prevalence of tobacco use among high school students in Iran: a systematic review. *Payesh* 2012; **11**: 337–49.
25. Haenle MM, Brockmann SO, Kron M *et al*. Overweight, physical activity, tobacco and alcohol consumption in a cross-sectional random sample of German adults. *BMC Public Health* 2006; **6**: 233.
26. Öberg M, Jaakkola MS, Woodward A *et al*. Worldwide burden of disease from exposure to second-hand smoke: a retrospective analysis of data from 192 countries. *The Lancet* 2011; **377**: 139–46.
27. Sadeghi R, Mazloomy Mahmoodabad SS, Fallahzadeh H *et al*. Readability and suitability assessment of adolescent education material in preventing hookah smoking. *Int J High Risk Beh Addic* 2019; **8**: e83117.
28. Hadidi KA, Mohammed FI. Nicotine content in tobacco used in hubble-bubble smoking. *Saudi Med J* 2004; **25**: 912–7.
29. Hashemi M, Sadeghi R, Shamsi M. An investigation of educational intervention impact on pregnant women for promote preventive behaviors of influenza H1N1: using health belief model. *Koomesh* 2017; **19**: 603–10.
30. Laverack G. *Health Promotion Practice: Building Empowered Communities*. England, UK: McGraw-Hill Education, 2007.
31. Cohen EL, Shumate MD, Gold A. Anti-smoking media campaign messages: theory and practice. *Heal Commun* 2007; **22**: 91–102.
32. Gooley CG, Lattin JM. *Dynamic Customization of Marketing Messages in Interactive Media*. Graduate School of Business, Stanford University, 2000.
33. Sadeghi R, Mazloomy Mahmoodabad SS, Khanjani N *et al*. The association between health literacy and smoking (Hookah and Cigarette) among the young men in Sirjan, Iran. *J Subst Use* 2019; **24**: 1–4.
34. Baseri MA, Malekabadi RM, Gandomkar A. Site selection of public parking in Isfahan City, using AHP Model. *World Acad Sci Eng Technol* 2012; **64**: 621–4.
35. Haryng L, Lvnzyry F, Fraser J. *An Introduction to Scientific Research in Geography*. Mvlazadh MA Trans. Ahvaz: University of Ahvaz, 1999.
36. Delavar MR, Naghibi F. Oil and gas pipeline route planning using geo-spatial information system analysis. In: *Advances in Spatial Analysis and Decision Making: Proceedings of the ISPRS Workshop on Spatial Analysis and Decision Making: Hong Kong, 3–5 December 2003*, 211. CRC Press, 2003.
37. Phillis YA, Andriantiatsaholiniaina LA. Sustainability: an ill-defined concept and its assessment using fuzzy logic. *Ecol Econom* 2001; **37**: 435–56.
38. Wu C-R, Lin C-T, Chen H-C. Integrated environmental assessment of the location selection with fuzzy analytical network process. *Qual Quan* 2009; **43**: 351–80.
39. Alavi SA, Moazezbarabadi M, Divsalar A *et al*. Location CNG fuel stations by using fusion techniques of fuzzy operators and GIS spatial analysis, case study: Mashhad District 7. *BJUER* 2016; **7**: 9–18.
40. Connelly LM. Focus groups. *Medsurg Nurs* 2015; **24**: 369–71.
41. Khosravi S. Focus group, a data gathering method. *Iran J Nur* 2011; **23**: 19–30.
42. Bugs G, Granell C, Fonts O *et al*. An assessment of Public Participation GIS and Web 2.0 technologies in urban planning practice in Canela, Brazil. *Cities* 2010; **27**: 172–81.