Sustainable Urban & Regional Development Studies Quarterly

Volume 6, Issue 1 - Serial Number 19, Spring 2025 **Online ISSN: 2783-0764**
Journal Hompage https://www.srds.ir/
https://www.srds.ir/article_220893.html?lang=en

Analysis of the spatial distribution pattern and service coverage of pharmacies in the areas of Rasht using spatial analysis and spatial statistics capabilities in the ArcGIS environment

Seyed Aliasghar Tahami[1], Ata Ghafari Gilandeh[*2], Abolfazl Kouhi Heris[3], Mohammad Hasan Yazdani[4]
1. MSc of Geography and Urban Planning, Faculty of Social Sciences, University of Mohaghegh Ardabili, Ardabil
2. Professor, Department of Geography and Urban and Rural Planning, Faculty of Social Sciences, University of Mohaghegh Ardabili, Ardabil
3. MSc of Geography and Urban Planning, Faculty of Social Sciences, University of Mohaghegh Ardabili, Ardabil
4. Professor, Department of Geography and Urban and Rural Planning, Faculty of Social Sciences, University of Mohaghegh Ardabili, Ardabil

Received Date: 03 February 2025 **Accepted Date:** 15 may 2025

Abstract
Background and Objective: Optimal land use and physical organization of cities based on efficiency, environmental protection, social justice, and equitable access to services are among the primary goals of urban planning. Therefore, the location and spatial distribution pattern of urban land uses should be aligned with meeting the needs of all social groups, aiming to improve the welfare and comfort of citizens. In this context, qualitative and quantitative evaluation of land uses in the spatial structure of the city and examining their locational suitability across defined zones are of particular importance. Pharmacies are among the units that play a significant role in meeting the diverse needs of citizens in the fields of health, treatment, and wellness. Due to this role, their spatial distribution pattern greatly impacts the level of pharmaceutical service coverage. Given the inter-neighborhood nature of pharmacies, this study investigates their spatial distribution at the level of the municipal areas of Rasht city.
Methodology: To achieve the research objectives, various spatial analysis models within the ArcGIS environment were used, including hot spot analysis, frequency weighting, spatial autocorrelation analysis, population density in relation to the number of pharmacies, and Thiessen polygon analysis.
Findings and Conclusion: The results indicate a high frequency weight of pharmacies in areas 1-3, 3-2, and 2-2; a statistically significant condition in district 2-1 based on high Z-scores in hot spot analysis; a rate of 7.27 pharmacy units per 10,000 people in district 2-2; the representation of proximity-based pharmacy access through Thiessen polygon analysis; and finally, the outcome of spatial autocorrelation analysis showing a random distribution pattern of pharmacies across the areas of Rasht. Each of these findings reveals aspects of spatial distribution patterns across the city, which are discussed further in the full article.

Keywords: Spatial Analysis, Rasht City, Geographic Information System , pharmacy.

* **Correspong Author Email:** a_ghafarigilandeh@uma.ac.ir

Cite this article: Tahami, S. A. A., Ghafari Gilandeh, A., Kouhi Heris, A. and Yazdani, M. H. (2025). Analysis of the spatial distribution pattern and service coverage of pharmacies in the areas of Rasht using spatial analysis and spatial statistics capabilities in the ArcGIS environment. *Journal of Sustainable Urban & Regional Development Studies (JSURDS)*, *6*(1), 353-367.

Extended Abstract

Introduction:
Given the crucial role of pharmacies in providing public health services and ensuring citizens' access to medical care, the spatial distribution of these centers is a key indicator of spatial justice and urban quality of life. This study aims to analyze the distribution pattern and service coverage of pharmacies across the districts of Rasht using Geographic Information System (GIS) tools and spatial statistical methods.

Methodology:
In this study, a descriptive–analytical research method was employed, and data collection was carried out through both documentary and field-based approaches. Initially, information regarding active pharmacies in the city of Rasht was obtained from the Food and Drug Administration of Guilan University of Medical Sciences. To verify the accuracy of the data and determine the precise geographic locations, field surveys were conducted across the city. The locations of pharmacies were marked using Google Maps, then transferred to Google Earth and saved in KML format. Subsequently, the file was imported into ArcGIS software and converted into Shapefile (SHP) format for spatial analysis. The statistical population of the study consisted of all active pharmacies within the legal boundaries of Rasht. After final validation and filtering, a total of 176 pharmacy units were identified and included in the analysis. Considering the inter-district nature of pharmacy services and their role in public health provision, the analysis was conducted at the district level based on the municipal zoning of Rasht. Furthermore, given the focus of the research on the distribution, spatial dispersion, and locational suitability of pharmacies, various spatial analysis tools were used, including: Spatial Autocorrelation (Moran's I) to examine the overall distribution pattern (clustered, random, or dispersed); Hot Spot Analysis to identify districts with high concentrations of pharmacies using Z-Score and Gi_Bin; Pharmacy-to-population ratio analysis to calculate the number of pharmacies per 10,000 residents in each district; Thiessen Polygon Analysis to determine each pharmacy's spatial influence zone and assess accessibility; Frequency Weighting Analysis to evaluate the relative density of pharmacies in different districts of the city.

Results and Discussion:
In terms of the number of pharmacy units, District 1-3, with 44 pharmacies, is considered the main concentration hub of pharmacies in Rasht. In contrast, districts 2-2 and 5-3 each have only one pharmacy unit. The results obtained from the hot spot analysis related to the spatial distribution of pharmacies in the districts of Rasht show high Z-scores in District 2-1 and low Z-scores in District 3-5. Additionally, based on the Gi_Bin index, District 1-2 is identified as a hot spot at the 99% confidence level, while the other districts do not fall within the statistical confidence ranges listed in the map legend. The result of the spatial autocorrelation analysis (Moran's I) regarding the distribution of pharmacies in the districts of Rasht indicated a value of -0.180979. Since this number is not close to +1 or -1, it suggests that the distribution pattern of pharmacies across the city's districts is random. In the present analysis, Thiessen polygons were generated in ArcGIS to assess spatial accessibility to pharmacies. These polygons divide the city in such a way that each point within a polygon is closest to the pharmacy at its center. Smaller and more compact Thiessen polygons in certain parts of the city indicate a higher density of pharmacies and better spatial accessibility. In contrast, larger and elongated polygons reflect the absence of pharmacies in those areas and suggest that residents must travel longer distances to access the nearest pharmacy. Moreover, the analysis of the pharmacy-to-population ratio by district (based on the number of pharmacies per

10,000 residents) revealed that District 2-2 has the highest ratio, with 7.27 pharmacies per 10,000 people, followed by District 2-3 with a ratio of 6.31. The lowest ratio belongs to District 2-4 with just 0.41 pharmacies per 10,000 people. The remaining districts fall within this range.

Conclusion:
The current distribution pattern of pharmacies in Rasht reveals high service concentration in some districts and relative deprivation in others. This spatial imbalance reduces spatial equity, places pressure on high-density service areas, and limits access in underserved districts. The results highlight the urgent need for targeted urban planning interventions to redistribute pharmacy services and ensure equitable access throughout the city.

Declarations

•**Funding**: There is no funding support for this study.

•**Authors' Contributions**: All authors contributed equally to the conceptualization and writing of the article. The authors approved the manuscript's content and agreed on all aspects of the work.

•**Conflict of Interest:** The authors declare no conflict of interest.

•**Acknowledgments**: The authors extend their gratitude to all scientific consultants who provided invaluable insights during this research.

References

Ahadi, Fazel, Nazmfar, Hussain, Masoumi, Mohamad Tagi, & ABRAVESH, AKBAR. (2020). spatial analysis of social poverty in ardabil city. BASIJ STRATEGIC RESEARCH QUARTERLY, 22(85), 151-179. SID. https://sid.ir/paper/387959/en (in persian)

aftab,ahmad,Soleimani,Alireza,hassanpour,negin. (2018).Analysis of the Spatial Distribution and Location of Pharmacies Under Nightly in the Past (Case Study the City of Urmia).Journal of healthcare management,9(1),33-45. https://sanad.iau.ir/fa/Article/806035?FullText=FullText (in persian)

Jafari, Zahra (2018), Introduction and Fundamentals of Pharmacy Technician, Including a Comprehensive List of Over-the-Counter (OTC) and Natural Medicines in the Country, Top Researcher Publications. https://bookpb.ir/ (in persian)

ZIARI, K.. (2002). URBAN LAND USE PLANNING (CASE STUDY: MINAB). GEOGRAPHICAL RESEARCH, 17(2-3 (65-66)), 0-0. SID. https://sid.ir/paper/361194/en (in persian)

Dolatyarian, K. , Yazdani, M. H. , Ghafari Gilandeh, A. and Dolatyarian, K. (2026). Geographical analysis of indicators and examples of a happy city with emphasis on Ray Oldenburg's third place theory (Case Study: Khorramabad city). *Journal of Sustainable Urban & Regional Development Studies (JSURDS)*, *7*(1), 44-72. https://www.srds.ir/article_219235.html (in persian)

Seraydar, N. , saeidirezvani, N. and ziari, K. (2023). Measurement of Spatial Justice in the Distribution of Health Care Services based on Justice-Oriented City Indicators the Case Study of Arak city. *Sustainable city*, *6*(1), 89-109. doi: https://10.22034/jsc.2021.250675.1324 (in persian)

salehian, S. and Nazmfar, H. (2024). Investigation and analysis of the spatial distribution of pharmacies in the neighborhoods of Ardabil city. *Geography and Human Relationships*, (), -. doi: https://10.22034/gahr.2024.472711.2233 (in persian)

Asgari, A. (2011). Spatial Statistics Analysis with ArcGIS, Publications of Tehran Municipality Information and Communication Technology Organization, First Edition. https://tmicto.tehran.ir (in persian)

ALIJANI, BOHLOUL. (2015). SPATIAL ANALYSIS IN GEOGRAPHY STUDIES. JOURNAL OF SPATIAL ANALYSIS ENVIRONMENTAL HAZARTS, 2(3), 1-14. SID. https://sid.ir/paper/264790/en (in persian)

Ghazanfarpour, H. , Mehrabi nejad, A. and Moslemizadeh, A. (2022). Locating Pharmacies and its Optimal Spatial Distribution in Sirjan City in Line with the Desired Access of Citizens. *Geography and Territorial Spatial Arrangement*, *12*(45), 79-106. doi: https://10.22111/gaij.2022.39011.2940 (in persian)

Ghafari Chandanagh, Navid. (1401). Analysis of the spatial-spatial distribution of dry cleaning and laundry units in the city of Ardabil using spatial analysis capabilities in the GIS environment, Master's thesis, Faculty of Social Sciences, University of Mohaghegh Ardabili. https://ganj.irandoc.ac.ir/#/articles/27ca579ed86cc3333ab962fd851a181a (in persian)

Jahani Dolatabad, E; Mohammadi, Ch. (1402). Explaining the Happy City from the Perspective of the Citizens of Ardabil City, Quarterly Journal of Welfare Planning and Social Development, 14 (54), pp. 317-348. (DOI): https://10.22054/qjsd.2022.64231.2261 (in persian)

Ghaffari Chanzanaqh, N. , Ghaffari Gilandeh, A. and Safarian Zengir, V. (2024). Investigating the Accessibility and Spatial Distribution of Urban Services Using Geographic Information System (GIS) in Ardabil Urban Neighborhoods (Case Example: Laundry and Dry-Cleaning Units). *Urban Economics and Planning*, *5*(1), 106-118. doi: https://10.22034/uep.2024.454750.1479 (in persian)

Fatemi, Zohreh. (1402). Investigating the distribution and dispersion of bakery units in Ardabil city using spatial analysis capabilities in ArcGIS environment. Master's thesis, University of Mohaghegh Ardabili. https://ganj.irandoc.ac.ir/#/articles/65d73ede7b5034ccb2fc13ec57c982ab (in persian)

Fasihi, H. (2019). Analysis of the spatial distribution of pharmacies in District 20 of Tehran. Human Settlement Planning Studies, Volume 15, Issue 3, pp. 904-891. https://sanad.iau.ir/Journal/jshsp/Article/1031882 (in persian)

Ghahrudi Tali, M; Babaei Fini, U. (2015). An Introduction to Geographic Information Systems. Eighth Edition. Tehran: Payam Noor University Press. https://digibook.pnu.ac.ir/ (in persian)

MOLAEI HASHJIN, N., & Ghalambor Dezfouli, R. (2021). Settlement Pattern of Immigrant Population with Social Ecology Approach in Rasht City. , *12*(45), 117-136. doi: https://10.30495/jupm.2021.24039.3423 (in persian)

Yaghfouri, H., Fotouhi, S., & Beheshtifar, J. (2013). Application of GIS in The Analysis of The Spatial Distribution and Localization of Pharmacies (case study: pharmacies of Jahrom city). , *4*(14), 1-20. 20.1001.1.22285229.1392.4.14.1.7 (in persian)

Vaezi, H. (1403). An analysis of environmental risk reduction with emphasis on community-based crisis management components (Case study: Ardabil city). PhD thesis, Mohaghegh Ardabili University. https://ganj.irandoc.ac.ir/#/articles/0a4a8892f3ca48e1af85a6aa8184b410 (in persian)

Chen, X., & Suen, I. (2023). Analysis of spatial disparity of pharmacies in Virginia, USA. Journal of Urban & Regional Analysis, *15*(1). DOI:10.37043/JURA.2023.15.1.5

Esri ArcGIS 10.8.2 help. (n.d.). Environmental Systems Research Institute. *Retrieved from*, https://support.esri.com/en-us/knowledge-base/arcmap-continued-support-000029721?utm_source=chatgpt.com

Fernandes B. D., Foppa A., Almeida P., Lakhani A., Lima T.(2022). Application and utility of geographic information systems in pharmacy specific health research: A scoping review. Research in Social and Administrative Pharmacy, VOL.18;P.p:3263-3271. https://doi.org/10.1016/j.sapharm.2021.11.004

Sukamdi, D. P., Lazuardi, L., & Sumarni, S. (2015). ANALYSIS OF PHARMACY DISTRIBUTION WITH GEOGRAPHIC INFORMATION SYSTEM. JURNAL MANAJEMEN DAN PELAYANAN FARMASI (Journal of Management and Pharmacy Practice), *5*(1), 56-60. https://doi.org/10.22146/jmpf.29

SuperMap Software Co., Ltd. (2024). SuperMap iDesktop Tutorial. https://help.supermap.com/iDesktop/en/

Suri, N., Zakiah Oktarlina, R., Aulia Ramdini, D., Miswar, D., & Rahman, M. B. (2024). Mappingof Pharmaciesin Bandar Lampung Municipality: Nearest Neighbor Analysis and OverlayApproach. DOI:10.37090/jfl.v13i1.1356

Vilcea, C., & Avram, S. (2019). Using GIS methods to analyse the spatial distribution and public accessibility of pharmacies in Craiova city, Romania. *Bulletin of Geography. Socio-economic Series*, (45), 125-132. DOI:10.2478/bog-2019-0028

Wong, T.-C., & Yuen, B. (Eds.). (2011). Eco-city planning: Policies, practice and design. Springer. DOI:10.1007/978-94-007-0383-4