ISSN 1840-4855
e-ISSN 2233-0046

Original scientific article
http://dx.doi.org/10.70102/afts.2026.1835.571

SPATIAL DISTRIBUTION AND DETERMINANTS OF AUTISM SPECTRUM DISORDER AMONG CHILDREN IN BABYLON GOVERNORATE, IRAQ: A GIS-BASED EPIDEMIOLOGICAL STUDY

Maysaa Y. Al-Dujaili[1*], Jawad K. Al-Hasnawi[2], Arafat H. Al-Dujaili[3]

[1]Lecturer, Department of Geography, College of Education, University of Kufa, Najaf, Iraq. e-mail: maysaay.aldujaili@student.uokufa.edu.iq, orcid: https://orcid.org/0009-0003-6330-188X*
[2]Professor, Department of Geography, College of Education, University of Kufa, Najaf, Iraq. e-mail: jawadk.obaid@uokufa.edu.iq, orcid: https://orcid.org/0009-0003-7379-7620
[3]Professor, College of Medicine, University of Kufa, Najaf, Iraq. e-mail: arafat.aldujaili@uokufa.edu.iq, orcid: https://orcid.org/0000-0001-8986-5809

Received: January 20, 2026; Revised: March 03, 2026; Accepted: April 22, 2026; Published: May 29, 2026

SUMMARY

Autism Spectrum Disorder (ASD) is a major neurodevelopmental disorder with a growing global incidence, and needs to be better understood in terms of its spatial patterns and risk factors to inform health policy. This study conducted a spatial-statistical analysis to detect spatial patterns and factors of ASD in children under 15 years in Iraq's Babylon Governorate. A descriptive-analytical approach was used, combining Geographic Information Systems (GIS) and statistical techniques, including Z-score normalization, Pearson's correlation and regression. The results reveal a high spatial variation in ASD incidence (7.45-45.78 per 10,000 children) and a higher incidence in urban administrative units. Genetics (34.5%) and heredity (31.5%) were the two most important factors; followed by environmental (13.9%), neurological (10.4%) and psychological (9.7%) factors. But there were no significant correlations between ASD incidence and other factors (r from -0.059 to 0.058), suggesting that ASD likely results from a combination of factors, rather than by any one factor. This study shows the usefulness of integration of spatial epidemiology and statistical methods to identify spatial inequalities and hotspots. This study provides valuable insights for policy makers, by showing the need for enhanced diagnostic services, health care services and targeted interventions in the under-serviced areas. Moreover, the paper highlights the necessity of implementing integrated spatial-health strategies in order to comprehend the regional differences in developmental disorders better and evidence-based decision-making to improve the strategies of healthcare planning and early intervention.

Key words: *autism spectrum disorder, spatial epidemiology, geographic information systems (GIS), health geography, childhood disorders.*

INTRODUCTION

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental disorder with variable impacts on social, communication and behaviour skills in children which usually manifests in early childhood and persists into adulthood if not addressed by early intervention [5][8]. It's known to be a variable severity spectrum disorder with impact on cognition, adaptive functioning and long-term psychosocial outcomes [6]. ASD has received more attention in the last 20 years with a rise in prevalence and burden globally [7]. Recent epidemiological reports consistently show an increase in the diagnosis (which could be due to improved recognition and diagnosis but also potentially environmental and genetic causes), while global burden studies also confirm its increasing burden in different regions and populations of the world [12][19]

Like many other conditions, ASD has a multifaceted etiology, including genetic, neurobiological, environmental and psychosocial factors. Genetic factors are considered to be important and recent research has shown common and distinct genetic factors of ASD and other neurodevelopmental disorders [13]. Neurobiological studies also demonstrate structural and connectivity differences of the brain that influence behavior and cognition. Furthermore, environmental factors, including exposures during pregnancy, maternal illness and pollutants have been shown to affect genetic factors for ASD. Recent studies also highlight the importance of clinical evaluation, diagnosis, and treatment, which are continually evolving in contemporary psychiatry [15], and advances such as digital behavioral phenotyping in the early detection and treatment of ASD.

The prevalence of ASD varies globally, reflecting differences in health care, diagnostic procedures, and sociocultural factors [2][17]. Large epidemiological and burden-of-disease studies show variations in incidence and prevalence, which reflect differences in access to care and reporting systems [1][16]. This highlights the need for a multidisciplinary approach to understanding these conditions from epidemiological, clinical, and public health viewpoints. While the classification of mental disorders and the evolution of psychiatric diagnostics have had a profound impact on understanding neurodevelopmental and other behavioral disorders, current debates in psychiatry and diagnostics continue to shape the recognition and interpretation of such conditions. Other research in behavioral and developmental disorders also underscores the impact of impairment and diagnostic criteria in analyzing complex disorders [3], while studies of developmental trauma and other related presentations highlight co-existing and co-occurring issues of clinical populations [4].

Geographically, spatial epidemiology provides a description of spatial patterns of disease and environmental and socio-demographic factors of disease distribution. Spatial epidemiology has benefited from the application of Geographic Information Systems (GIS) to map clusters, measure spatial inequalities and health care access [11][9]. Although there are many studies on ASD epidemiology with spatial analysis in developed countries, there are very few in developing countries. Babylon Governorate in Iraq is an interesting region for investigation because of its diversity, urbanization and variations in health care services across administrative units [10]. A spatial analysis of ASD prevalence in this region can provide information about spatial risk factors and health care services [14].

Therefore, this study aims to investigate the spatial distribution of ASD in children in Babylon Governorate and to identify and prioritise the main risk factors causing ASD using a spatial and statistical integrated approach. By combining geographical and epidemiological analyses, the study will help to improve planning and intervention programs and better understand ASD in this area [18][20].

Research Problem

While the incidence of autism spectrum disorder (ASD) in children is increasing in Babylon Governorate, few studies have examined the geographical distributions of this disorder, as well as its risk factors. The absence of geographical and epidemiological studies hinders the capacity of health providers to plan for early diagnosis and treatment.

Research Objectives

The main objectives of this study are:

1. To detect geographical pattern of childhood autism spectrum disorder (ASD) in Babylon Governorate.
2. To identify the administrative areas that have high and low spatial distribution of autism.
3. To detect the correlation of autism prevalence with some variables.
4. To provide recommendations that could help in health policy and early diagnosis.

Research Hypothesis

H1: There is a significant spatial variation in the incidence of Autism Spectrum Disorder (ASD) across the administrative districts of Babylon Governorate.

H2: Genetic and hereditary factors have a significant influence on the incidence of ASD among children in the study area.

H3: Environmental, neurological, and psychosocial factors collectively contribute to the variation in ASD incidence across different administrative districts.

Paper Organization

This paper comprises seven sections. Section 1 presents the background, problem statement and aims of the study. Section 2 discusses the study area of this research. Section 3 describes the data and methods, including spatial analysis using geographic information systems (GIS) and statistical analysis. Section 4 outlines the main causes of autism spectrum disorder, including genetic, neurological, environmental, and psychosocial. Section 5 presents the main findings of the spatial and statistical analyses. Section 6 discusses the findings in detail, synthesizing the evidence. Finally, Section 7 presents the key findings and suggestions for further research and health policy.

STUDY AREA

Figure 1. Location of babylon governorate in iraq and its administrative divisions

Babylon Governorate is an important historical and economic centre of Iraq. It includes several districts and sub-governorates varying in population, economic activities and urbanization. Babylon Governorate has a high proportion of children and adolescents with a number of child health concerns. There are differences between urban and rural areas in housing conditions, health and education, which could impact on the prevalence and diagnosis of developmental disorders (Figure 1).

Statistical Analysis

The Pearson correlation coefficient was used to test the association between ASD prevalence and explanatory variables (Table 1):

The Pearson correlation coefficient was used to determine the relationship between the spatial distribution of autism and the explanatory variables as indicated in equation (1). This is a measure of the degree and the direction of the linear relationship between two variables.

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2\sum(y-\bar{y})^2}} \quad (1)$$

Table 1. Summary statistics

Category	Genetic	Hereditary	Neurological	Psychological	Environmental
Governorate	31.5	34.5	10.4	9.7	13.9
Mean	33.79	31.77	10.42	9.09	14.94
Standard Deviation	10.58	10.13	3.23	5.06	7.05

DATA AND METHODOLOGY

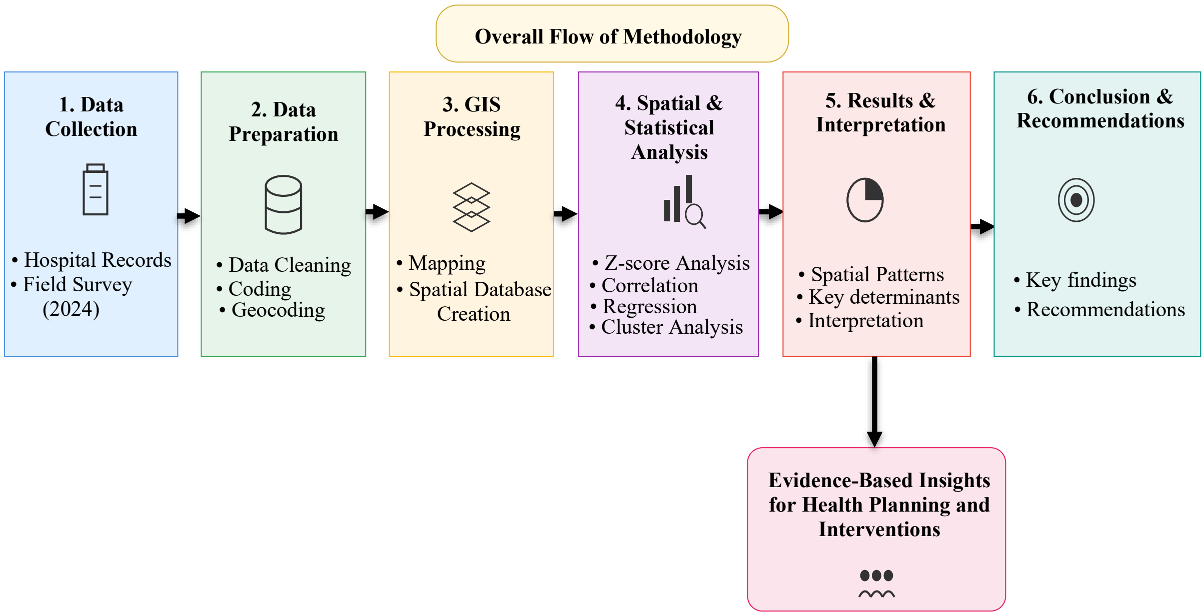

Figure 2. Overall methodological framework for spatial analysis of autism spectrum disorder

In figure 2 illustrates the process adopted in this study to investigate the spatial patterns and risk factors of Autism Spectrum Disorder (ASD) in Babylon Governorate. As shown, it begins with the collection of data from hospital data and surveys in 2024, and then proceeds with data pre-processing (cleaning, coding and geocoding). The data are then imported into a Geographic Information System (GIS) for mapping and database development. Then, spatial and statistical analyses, such as Z-score analysis, Pearson correlation, regression, and cluster analysis, are conducted to detect spatial patterns and associations. These findings are then analyzed to present spatial patterns and factors affecting them and draw conclusions and recommendations to assist with health planning and early intervention.

Data Sources

The study relied on two main sources of data:

1. Official health records from hospitals and medical centers that diagnose developmental disorders.
2. Data from field surveys conducted in 2024 using questionnaires to families of autistic children.
3. The sample of the study was children under the age of 15 years who were diagnosed with autism spectrum disorder.

Analytical Methods

The paper will use a mixture of statistical and spatial analysis to determine the distribution and determinants of Autism Spectrum Disorder (ASD) in Babylon Governorate. Quantitative and geospatial techniques allow integrating to have a complete view of not only the numeric relationships but also the geographic patterns.

Descriptive Statistical Analysis

The initial statistical analysis to be used was the descriptive one, to summarize and organize the data collected. The relative importance of various causal factors (genetic, hereditary, neurological, psychological and environmental) was described using measures like mean, standard deviation, and percentage distribution. This step offered a background knowledge of the dataset and identified the differences between administrative units.

Pearson Correlation Coefficient

To determine the strength of relationships between ASD prevalence (dependent variable) and the chosen independent variables and their direction, Pearson correlation coefficient analysis was performed. The correlation coefficients are between -1 and +1 which implies negative, null and positive relationships. This approach was useful in determining whether or not individual factors are a significant determinant of ASD prevalence and the extent to which these associations exist.

Cluster Analysis

Cluster analysis was used to cluster administrative units, according to the similarity of ASD prevalence and related factors. It was determined that the spatial clusters/patterns where some districts have similar characteristics were identified using this method and therefore the potential high-risk or low-risk zones were identified. Cluster analysis helps in improved regional classification and facilitates planning interventions.

Spatial Distribution Analysis Using Geographic Information Systems (GIS)

The methodology was based on Spatial distribution analysis with the help of Geographic Information System (GIS). The prevalence rates of ASD were mapped with GIS and the distribution was visualised in the study area. To measure the difference between the mean and the deviations around the mean, standard score (Z-score) mapping was used to indicate high or low prevalence of specific areas. This spatial method helped to identify geographic trends, clustering behavior, and inequality of healthcare accessibility, which is essential in making decisions concerning the health of the population.

In general, these analytical approaches are intertwined to provide a strong structure to comprehend the multifactorial and spatial character of ASD prevalence in the research area.

These techniques were used to analyze the spatial variation of autism prevalence and to evaluate the relationships between autism and selected explanatory variables (Figure 3).

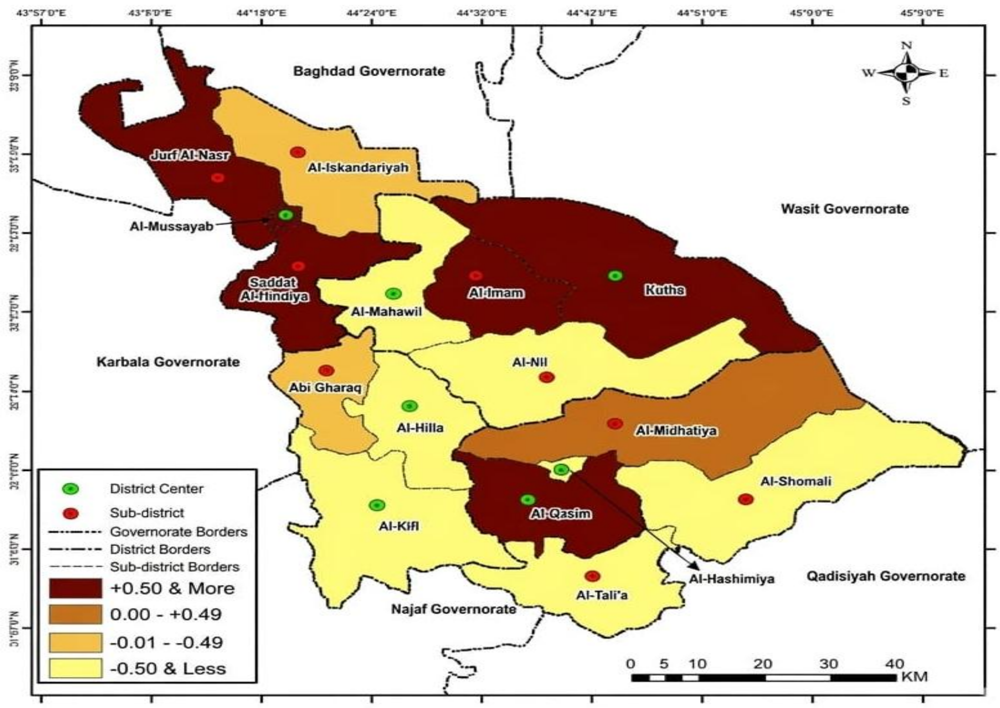

Figure 3. Geographical distribution of the rate of young people with autism spectrum disorder per 10,000 young people according to the standard score and administrative units in babylon governorate for the year 2024

Table 2. Administrative units – genetic, hereditary, neurological, psychological, environmental factors

Administrative Unit	Genetic (Relative Importance)	Standard Score	Hereditary (Relative Importance)	Standard Score	Neurological (Relative Importance)	Standard Score	Psychological (Relative Importance)	Standard Score	Environmental (Relative Importance)	Standard Score
Al-Hillah District Center	18.5	-1.45	47.7	1.57	7.7	-0.84	14.6	1.09	11.5	-0.49
Abi Ghraq Sub-district	31.2	-0.24	25	-0.67	14.6	1.29	18.8	1.92	10.4	-0.64
Al-Kifl District Center	23.7	-0.95	44.1	1.22	15.3	1.51	10.1	0.20	6.8	-1.15
Al-Mahawil District Center	23.9	-0.93	37.3	0.55	13.4	0.92	7.5	-0.31	17.9	0.42
Al-Neel Sub-district	25.7	-0.76	37.2	0.54	11.4	0.30	5.7	-0.67	20	0.72
Al-Imam Sub-district	41.4	0.72	17.2	-1.44	6.9	-1.09	6.9	-0.43	27.6	1.80
Kutha District Center	39.5	0.54	28.9	-0.28	2.6	-2.42	7.9	-0.24	21.1	0.87
Al-Hashimiyah District Center	23.2	-1.00	41.1	0.92	10.7	0.09	7.1	-0.39	17.9	0.42
Al-Midhtiya Sub-district	37.5	0.35	20.8	-1.08	8.4	-0.63	8.3	-0.16	25	1.43
Al-Shomali Sub-district	25	-0.83	33.3	0.15	8.3	-0.66	11.2	0.42	22.2	1.03
Al-Qasim District Center	45.2	1.08	23.3	-0.84	9.6	-0.25	6.8	-0.45	15.1	0.02
Al-Tali'ah Sub-district	26.5	-0.69	35.3	0.35	14.7	1.33	5.9	-0.63	17.6	0.38
Al-Musayyib District Center	51	1.63	29.4	-0.23	9.8	-0.19	3.9	-1.03	5.9	-1.28
Saddat Al-Hindiya Sub-district	52.2	1.74	21.7	-0.99	13	0.80	4.4	-0.93	8.7	-0.89
Jurf Al-Nasr Sub-district	46.3	1.18	17.1	-1.45	9.7	-0.22	22	2.55	4.9	-1.42
Al-Iskandariyah Sub-district	29.8	-0.38	48.9	1.69	10.6	0.06	4.3	-0.95	6.4	-1.21

In table 2 indicates that the highest percentage in the governorate was for genetic causes (34.5%), followed by hereditary causes (31.5%) and then environmental causes (13.9%) and then neurological causes (10.4%), and the lowest percentage was for psychological causes (9.7%). Study those causes as follows: table 2 Distribution of the relative importance of causes of autism spectrum disorder among young people under 15 years of age according to the standard score and administrative units in the Babylon Governorate for the year 2024.

CAUSES OF AUTISM SPECTRUM DISORDER

Genetic Factors

Genetics is thought to play the most important role in autism spectrum disorder (ASD). It has been suggested that numerous genes may be involved in brain development and the pathways of communication between neurons. Parents and siblings of children with autism are more likely to have a child with autism.

Neurological Factors

Many people with ASD have been found to have neurological anomalies. Neuroimaging studies have found structural and functional brain differences in brain connectivity. These may affect cognitive, language, and social skills.

Environmental Factors

Pregnancy and early life environmental factors may contribute to the risk of developing autism. These include maternal health issues, exposure to environmental toxins, and stress during pregnancy. Environmental factors may influence genetic factors.

Psychosocial Factors

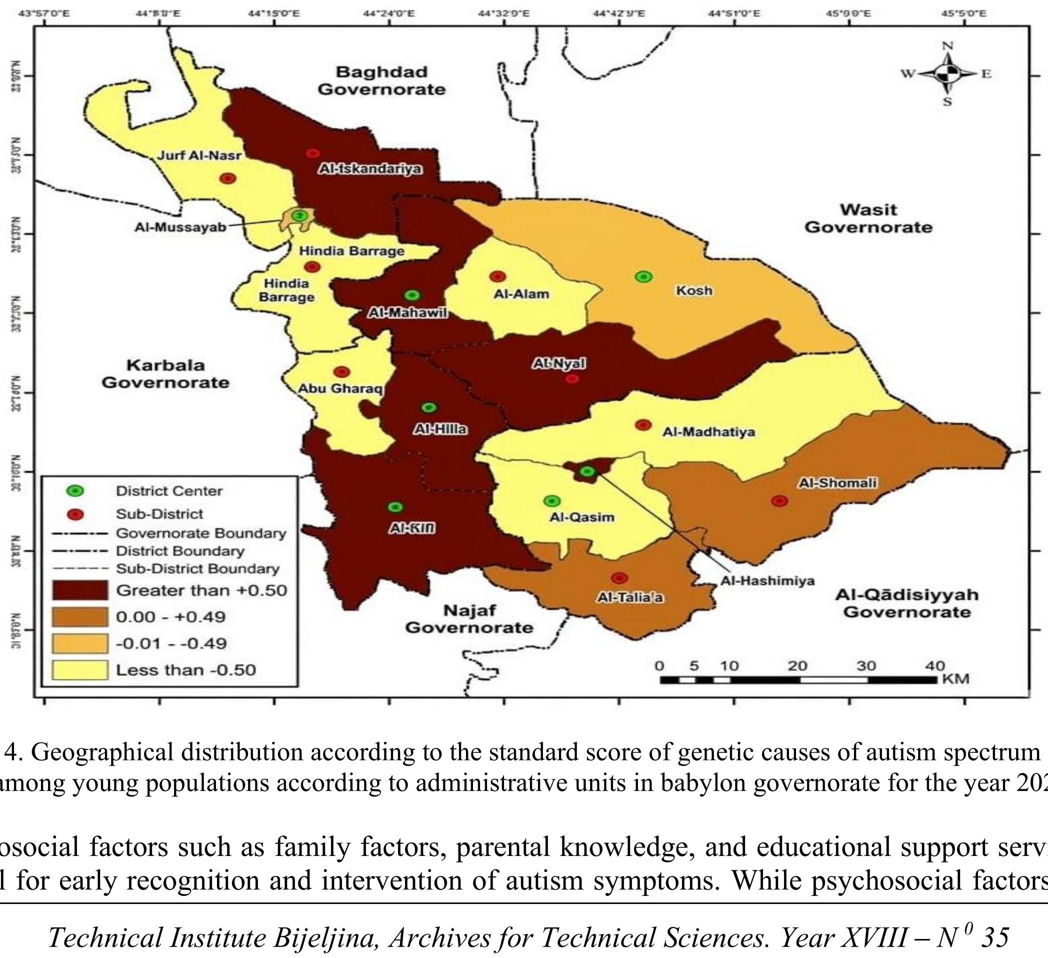

Figure 4. Geographical distribution according to the standard score of genetic causes of autism spectrum disorder among young populations according to administrative units in babylon governorate for the year 2024

Psychosocial factors such as family factors, parental knowledge, and educational support services are crucial for early recognition and intervention of autism symptoms. While psychosocial factors do not cause autism, may affect the severity of developmental difficulties experienced by children with autism (Figure 4).

RESULTS

Simple Correlation Coefficient (Pearson)

The Pearson simple correlation coefficient is used to measure the relationship between two variables. The coefficient varies from (+1) to (−1). The closer to 1 the value is, the stronger is the relationship between the variables. However, the value of the correlation becomes weaker as the value approaches (0), which means no correlation. If it is positive, then it is a direct relationship, but if it is negative, then it is an inverse relationship (Shahata, 2011, p. 390) (Table 3).

Table 3. Model of causes and independent variables spatially associated with autism spectrum disorder in babylon governorate, 2024

X1	Genetic causes of autism spectrum disorder
X2	Hereditary causes of autism spectrum disorder
X3	Neurological causes of autism spectrum disorder
X4	Psychological causes of autism spectrum disorder
X5	Environmental causes of autism spectrum disorder

From tables (4) and (5), it is clear that there are both inverse and direct correlation relationships (weak and very weak) between the dependent variable (Y) (autism spectrum disorder) and the independent causes as follows:

1. Weak positive and negative correlations were found with variables (X4, X5, X3, and X2), with values of (−0.059, −0.059, 0.058, and 0.053), respectively.

2. A very weak negative correlation was observed with variable (X2), with a value of (−0.004).

Furthermore, table (4, 5) show correlations among the independent variables themselves, as follows:

1. Variable (X1: genetic causes of autism spectrum disorder) has a very strong negative correlation with variable (X2), with a value of (−0.776**), indicating high statistical significance. It also shows weak negative correlations with variables (X3, X5, and X4), with values of (−0.242, −0.192, and −0.115), respectively.

2. Variable (X2: hereditary causes of autism spectrum disorder) shows weak negative and positive correlations with variables (X5, X3, and X4), with values of (−0.228, 0.223, and −0.205), respectively.

3. Variable (X3: neurological causes of autism spectrum disorder) has a moderate negative correlation with variable (X5), with a value of (−0.430), and a very weak positive correlation with variable (X4), with a value of (0.020).

4. Variable (X4: psychological causes of autism spectrum disorder) shows a weak negative correlation with variable (X5), with a value of (−0.260).

Table 4. Correlation matrix between the rate of young population with autism spectrum disorder and its causes in babylon governorate, 2024

	Y	**X1**	**X2**	**X3**	**X4**	**X5**
Y	1	0.053	-0.004	0.058	-0.059	-0.059
X1		1	-0.776**	-0.242	-0.115	-0.192
X2			1	0.223	-0.205	-0.228
X3				1	0.020	-0.430
X4					1	-0.260
X5						1

Table 5. Simple correlation coefficients of factors affecting autism spectrum disorder in babylon governorate, 2024

Dependent Variable (Y)	Independent Variables	Correlation Coefficient
Autism prevalence rate	X1	0.053
	X2	-0.004
	X3	0.058
	X4	-0.059
	X5	-0.059

This study shows weak associations between the spatial distribution of autism and the variables. This would mean that autism is developed due to interactions of multiple factors, rather than one single cause (Figure 5, 6).

Figure 5. Geographical distribution according to the standard score of genetic causes of autism spectrum disorder among young populations according to administrative units in babylon governorate for the year 2024

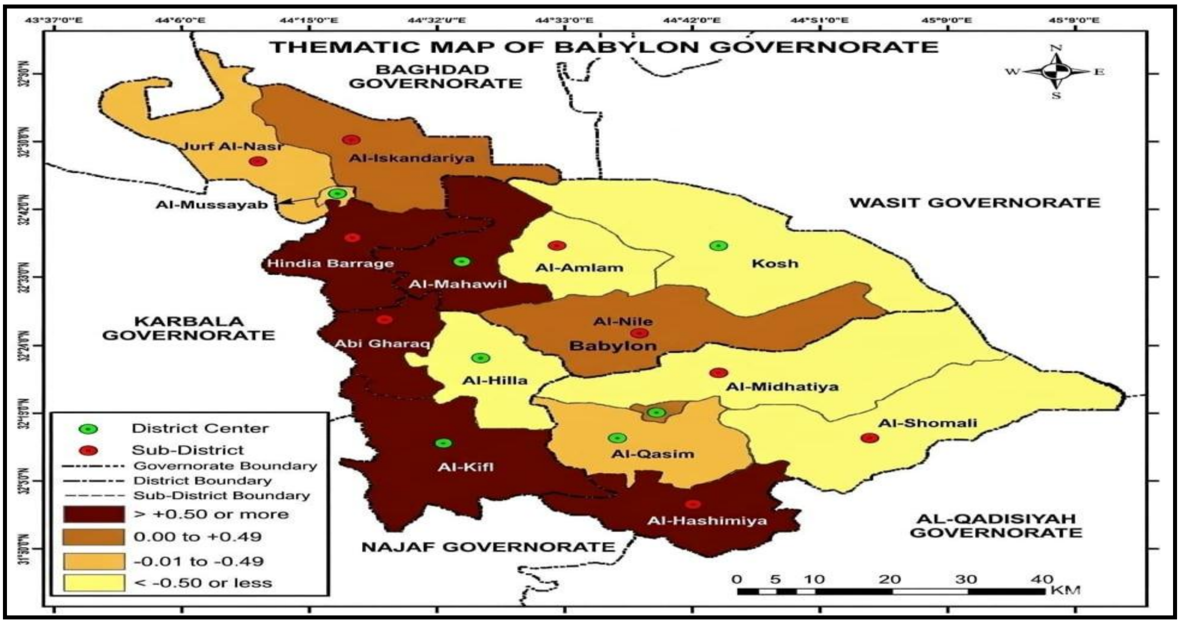

Figure 6. Geographical distribution according to the standard score of neurological causes of autism spectrum disorder among young populations under 15 years of age according to administrative units in babylon governorate for the year 2024

Table 6. Hypothesis validation results

Hypothesis Code	Hypothesis Statement	Method Used	Result
H1	There is a significant spatial variation in ASD prevalence across administrative units of Babylon Governorate.	GIS Spatial Analysis (Z-score, Mapping)	Accepted
H2	Genetic and hereditary factors significantly influence ASD prevalence.	Descriptive Statistics & Pearson Correlation	Partially Accepted
H3	Environmental, neurological, and psychological factors significantly affect ASD prevalence.	Pearson Correlation Analysis	Rejected

In table 6, the outcomes of the hypothesis testing show that although the spatial difference in ASD prevalence is quite clear, the statistical correlations among ASD and its causal factors are weak in general. This implies that the causes of ASD cannot be reduced to any single dominant variables but are instead multifactorial and complex and therefore necessitated the integration of spatial and epidemiological analysis.

DISCUSSION

This study has established that there are significant spatial differences in Autism Spectrum Disorder (ASD) prevalence among the administrative districts of Babylon Governorate, thus proving the spatial variability of ASD. The GIS analysis has uncovered that ASD is relatively more prevalent in urban compared to rural regions. This could be because of a mix of factors, including the high population density, infrastructure of health care and awareness, and diagnostic ability in the cities. Therefore, the spatial difference in the prevalence of ASD may also be attributed to the actual prevalence of ASD in addition to differences in the accessibility of diagnostic services and reporting systems.

The regression analysis also gives an insight into the contribution of different causal factors to the prevalence of ASD. Genetics and heredity factors were the most important ones, with 34.5% and 31.5% of the variance, respectively, indicating the high genetic basis of ASD. In comparison, the neurological (10.4%), environmental (13.9%), and psychological (9.7%) factors were not found to be of the same significance. Although there are these differences, the low correlations (between -0.059 and 0.058) between the prevalence of ASD and the individual variables, as shown in the Pearson correlation analysis, indicate that no variable can be used to explain the spatial variation of ASD by itself. This may indicate that individual factors alone cannot predict the spatial distribution of ASD, supporting the current hypothesis that ASD is a complex disease and the combination of genetic, environmental, and socio-demographic factors causes it.

As figure 7 indicates, the geographical distribution of the psychological causes differs between administrative divisions, albeit with a small statistical impact. The figure demonstrates spatial variation, which indicates variation in family, awareness, education, and support services. Psychological factors might not be the direct causes of ASD, but might contribute to the early identification, treatment, and severity of the symptoms, particularly in areas that have poor health facilities.

The other factors, which are environmental, are not significant statistically; however, should not be ignored. Genetic factors may act together with other factors such as prenatal factors, maternal exposure to environmental toxins, and early childhood developmental factors to influence ASD. This underlines the necessity of a combined method of analysis combining genetic and environmental aspects. The results of spatial clustering of ASD cases also suggest that there are environmental risk factors that might be associated with environmental exposures, availability of health care facilities, or socio-economic disparities.

The powerful approach of this study, which will enable us to consider simultaneously both spatial clustering and determinants of ASD, is the use of Geographic Information Systems (GIS) and statistical methods. This is a multifaceted method that can be used to identify the high-risk areas and guide the policy of the population's health. The results highlight the importance of taking into account the spatial aspects of health care, particularly in the developmental diseases such as ASD.

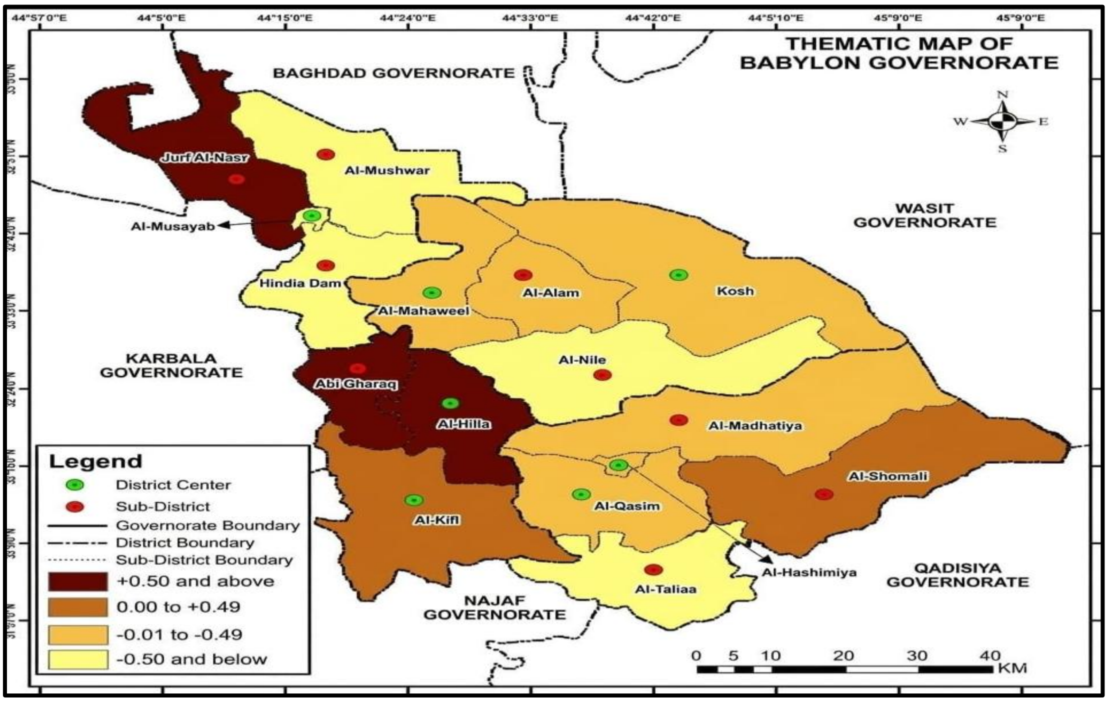

Figure 7. Spatial distribution of psychological causes of autism spectrum disorder among children standardised score and administrative division in babylon governorate in 2024

Regarding policy, the findings suggest the significance of policy measures in the areas that lack diagnostic centers and have a lower level of awareness. Spatial disparities in the diagnosis and treatment of ASD can be addressed by enhancing the capacity of specialized health-care services, enhancing early detection initiatives, and raising awareness. Lastly, longitudinal data with the application of advanced spatial statistical modeling should be considered in future research to inform temporal trends and causality.

In a word, this study contributes to the development of a new area of research, namely, spatial epidemiology, indicating that the prevalence of ASD depends on several multifaceted and spatially heterogeneous factors. The results of this study can inform the health care planning in the region, which in turn can result in improved diagnosis and treatment of children with ASD.

Recommendations

1. Establish specialized diagnostic centers for autism in all districts of Babylon Governorate.
2. Increase public awareness regarding early symptoms of autism.
3. Expand research using GIS to identify spatial clusters of developmental disorders.
4. Improve training programs for healthcare professionals dealing with autism.
5. Strengthen collaboration between universities, health institutions, and social organizations

CONCLUSION

This research adopted a hybrid GIS-epidemiological approach to map and explore the spatial distribution and risk factors for Autism Spectrum Disorder (ASD) among children in the Babylon Governorate. The findings revealed a large spatial variability in ASD prevalence (7.45-45.78 per 10,000 children) in the administrative divisions, indicating clearly the existence of regional differences. Spatial analysis also revealed a cluster in urban areas, suggesting that high prevalence might be a result of awareness and availability of the services, and incidence. This spatial analytical model was able to predict the hotspots for health service planning after standardization (Z-score). Overall, the results highlight that ASD is not due to a single factor, but is multifactorial (biological and environmental). This study demonstrates the use of spatial and statistical analysis in public health. Future work should examine how to integrate more sophisticated spatial statistics (e.g., hotspot analysis, Moran's I), predictive models and time series data to discover temporal changes. This study should be extended to other regions and include exposure and genetics to better understand and inform intervention strategies. Further studies are needed to include more sophisticated spatial statistical methods like hotspot analysis (including hotspot analysis: Getis-Ord Gi*) and spatial regression analysis to understand the prevalence of ASD in relation to underlying patterns and relationships. To enhance generalizability of findings, the expansion of the dataset by means of longitudinal studies and incorporation of larger and multi-regional samples would help. Also, incorporation of environmental exposure information, accessibility of healthcare, and socio-economic factors can help us realise more about the multifactoriality of ASD. Predictive analysis can be further improved by the use of machine learning models and GIS, which can be used to identify potential cases of illnesses and implement more specific and targeted interventions in the field of public health.

REFERENCES

[1] Keepers GA, Fochtmann LJ, Anzia JM, Benjamin S, Lyness JM, Mojtabai R, Servis M, Choi-Kain L, Nelson KJ, Oldham JM, Sharp C. The American Psychiatric Association practice guideline for the treatment of patients with borderline personality disorder. American Journal of Psychiatry. 2024 Nov 1;181(11): 1024-8.https://doi.org/10.1176/appi.ajp.24181010

[2] McHenry SE. “Gay is good”: History of homosexuality in the DSM and modern psychiatry. American Journal of Psychiatry Residents' Journal. 2022 Sep 8;18(1):4-5. https://doi.org/10.1176/appi.ajp-rj.2022.180103

[3] Yen JY, Higuchi S, Lin PY, Lin PC, Chou WP, Ko CH. Functional impairment, insight, and comparison between criteria for gaming disorder in the International Classification of Diseases, and internet gaming disorder in Diagnostic and Statistical Manual of Mental Disorders. Journal of Behavioral Addictions. 2022 Dec 27;11(4):1012-23. https://doi.org/10.1556/2006.2022.00079

[4] DePierro J, D'Andrea W, Spinazzola J, Stafford E, van Der Kolk B, Saxe G, Stolbach B, McKernan S, Ford JD. Beyond PTSD: Client presentations of developmental trauma disorder from a national survey of clinicians. Psychological Trauma: Theory, Research, Practice, and Policy. 2022 Oct;14(7):1167. https://psycnet.apa.org/doi/10.1037/tra0000532

[5] Lord C, Brugha TS, Charman T, Cusack J, Dumas G, Frazier T, Jones EJ, Jones RM, Pickles A, State MW, Taylor JL. Autism spectrum disorder. Nature reviews Disease primers. 2020 Jan 16;6(1):5. https://doi.org/10.1038/s41572-019-0138-4

[6] Lord C, McCauley JB, Pepa LA, Huerta M, Pickles A. Work, living, and the pursuit of happiness: Vocational and psychosocial outcomes for young adults with autism. Autism. 2020 Oct;24(7):1691-703. https://doi.org/10.1177/1362361320919246

[7] Maenner MJ. Prevalence of autism spectrum disorder among children aged 8 years—autism and developmental disabilities monitoring network, 11 sites, United States, 2016. MMWR. Surveillance summaries. 2020;69. http://dx.doi.org/10.15585/mmwr.ss6904a1

[8] Knopf A. Autism prevalence increases from 1 in 60 to 1 in 54: CDC. The Brown University Child and Adolescent Behavior Letter. 2020 Jun;36(6):4. https://doi.org/10.1002/cbl.30470

[9] Mathew L, Kauffman E, Schmidt R, Hertz-Picciotto I, Lyall K. Environmental risk factors for autism. InEncyclopedia of Autism Spectrum Disorders 2021 Mar 14 (pp. 1796-1809). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-91280-6_102054

[10] Lai MC, Hull L, Mandy W, Chakrabarti B, Nordahl CW, Lombardo MV, Ameis SH, Szatmari P, Baron-Cohen S, Happé F, Livingston LA. Commentary: ‘Camouflaging’in autistic people–reflection on Fombonne (2020). Journal of Child Psychology and Psychiatry. 2021 Aug;62(8). https://doi.org/10.1111/jcpp.13344

[11] Bertelsen N, Landi I, Bethlehem RA, Seidlitz J, Busuoli EM, Mandelli V, Satta E, Trakoshis S, Auyeung B, Kundu P, Loth E. Imbalanced social-communicative and restricted repetitive behavior subtypes of autism spectrum disorder exhibit different neural circuitry. Communications biology. 2021 May 14;4(1):574. https://doi.org/10.1038/s42003-021-02015-2

[12] Sato A, Ikeda K. Genetic and environmental contributions to autism spectrum disorder through mechanistic target of rapamycin. Biological psychiatry global open science. 2022 Apr 1;2(2):95-105. https://doi.org/10.1016/j.bpsgos.2021.08.005

[13] Mattheisen M, Grove J, Als TD, Martin J, Voloudakis G, Meier S, Demontis D, Bendl J, Walters R, Carey CE, Rosengren A. Identification of shared and differentiating genetic architecture for autism spectrum

disorder, attention-deficit hyperactivity disorder and case subgroups. Nature genetics. 2022 Oct;54(10): 1470-8. https://doi.org/10.1038/s41588-022-01171-3

[14] Livingston LA, Shah P, Milner V, Happé F. Quantifying compensatory strategies in adults with and without diagnosed autism. Molecular autism. 2020 Feb 12;11(1):15. https://doi.org/10.1186/s13229-019-0308-y

[15] Genovese A, Butler MG. Clinical assessment, genetics, and treatment approaches in autism spectrum disorder (ASD). International journal of molecular sciences. 2020 Jan;21(13):4726. https://doi.org/10.3390/ijms21134726

[16] Perochon S, Di Martino JM, Carpenter KL, Compton S, Davis N, Eichner B, Espinosa S, Franz L, Krishnappa Babu PR, Sapiro G, Dawson G. Early detection of autism using digital behavioral phenotyping. Nature Medicine. 2023 Oct;29(10):2489-97. https://doi.org/10.1038/s41591-023-02574-3

[17] Zeidan J, Fombonne E, Scorah J, Ibrahim A, Durkin MS, Saxena S, Yusuf A, Shih A, Elsabbagh M. Global prevalence of autism: A systematic review update. Autism research. 2022 May;15(5):778-90. https://doi.org/10.1002/aur.2696

[18] Li YA, Chen ZJ, Li XD, Gu MH, Xia N, Gong C, Zhou ZW, Yasin G, Xie HY, Wei XP, Liu YL. Epidemiology of autism spectrum disorders: Global burden of disease 2019 and bibliometric analysis of risk factors. Frontiers in pediatrics. 2022 Dec 5; 10:972809. https://doi.org/10.3389/fped.2022.972809

[19] Solmi M, Song M, Yon DK, Lee SW, Fombonne E, Kim MS, Park S, Lee MH, Hwang J, Keller R, Koyanagi A. Incidence, prevalence, and global burden of autism spectrum disorder from 1990 to 2019 across 204 countries. Molecular Psychiatry. 2022 Oct;27(10):4172-80. https://doi.org/10.1038/s41380-022-01630-7

[20] Li Z, Yang L, Chen H, Fang Y, Zhang T, Yin X, Man J, Yang X, Lu M. Global, regional and national burden of autism spectrum disorder from 1990 to 2019: results from the Global Burden of Disease Study 2019. Epidemiology and Psychiatric Sciences. 2022 Jan;31:e33. https://doi.org/10.1017/S2045796022000178