

Spatial Epidemiology of Drug Addiction and Associated Risk Factors Among Adults in Capital Territory of Pakistan: A Case-Control StudyDr. Muhammad Anees Akram^{*1}, Dr. Nimal Imtiaz², Dr. Alamgir Jogeza³, Dr. Waqas Ahmed Shahzad⁴, Dr. Mehvish Idrees⁵**1 MS Public Health (NUMS, Rawalpindi)****2 Assistant Professor (NUMS, Rawalpindi)****3 MS Public Health (NUMS, Rawalpindi)****4 MS Public Health (NUMS, Rawalpindi)****5 MS Public Health (NUMS, Rawalpindi)**Corresponding Author^{*}: dr.anees@proton.me**KEYWORDS**

Spatial Epidemiology, Drug Addiction, Hot Spot Analysis, Logistic Regression, Risk Factors, Urban Areas, Capital Territory of Pakistan (Islamabad), Youth Addiction, Kachiabadis (informal Settlements), Legal Issues, Family Relationships, Psychological Status, Public Health Interventions.

ABSTRACT

Drug addiction is now an intricate problem globally which affects people, families and communities across the globe. In Pakistan's capital territory, it is important to understand spatial epidemiology and related risk factors of drug addiction in order to develop targeted prevention and intervention strategies. This study seeks to identify the spatial distribution of drug addiction cases, as well as the associated risk factors among adult population in the Capital Territory of Pakistan. A case-control quantitative design was employed in which data were collected from 216 patients at six drug addiction rehabilitation centers of Capital territory of Pakistan over a period of six months. A structured questionnaire was used for both control and case groups. The results from spatial analysis indicated significant hot spots in central area of capital territory of Pakistan with 95% confidence level (Z-score >1.4, $p < 0.2$) showed high prevalence while peripheral areas were not statistically significant (Z-score <-0.9, $p > 0.75$) showed low prevalence of drug addiction.

Logistic regression showed that gender ($p > 0.05$) and employment status ($p > 0.05$) did not significantly predict drug addiction whereas age group had significant negative correlation ($p < 0.05$). Legal issues proved to be a significant positive predictor with odds ratio of 11.428 ($p < 0.001$), the quality of family relationships was a major protective factor against drug addiction ($B = -4.371$, $p < 0.001$, odds ratio = 0.013). In addition, the psychological state showed potential correlation with drug addiction ($p = 0.050$, odds ratio = 2.886). This means that there is spatial clustering of drug addiction in the central region of capital territory of Pakistan. Key risk factors identified include age, legal challenges, psychological problems and strained family relationships. The findings indicate that strategies for curbing drug addiction must be focused on high prevalence zones while at the same time tackling legal and related family obligations to reduce its likelihood among users.

INTRODUCTION

Drug addiction is a public health problem that continues to be a serious concern. It affects individuals, families, and communities around the globe and it is spreading fast. The World Health Organization (WHO) defines drug dependence as a disorder of complex etiology characterized by compulsive drug use, continued use despite harm, and long-lasting changes in brain function (World Health Organization, 2021). In Pakistan today, the issue of substance abuse has reached an alarming level with huge social, economic, and health implications (Ali, Bushra & Iqbal, 2017). Consequently, given its urban nature, Capital Territory of Pakistan exhibits unique drug addiction

patterns which necessitate focused research to inform targeted interventions.

OBJECTIVE OF THE STUDY

This study aims to determine the spatial distribution and associated risk factors of drug addiction among adults in Pakistan's Capital Territory. Understanding spatial epidemiology of drug addiction within different regions at the capital city level will help develop effective strategies aimed at prevention and intervention in each specific area.

MAIN SIGNIFICANCE

Spatial analysis helps identify hot spots where substance abuse is concentrated, thereby providing crucial information on geographical aspects surrounding the phenomenon

(Cromley&McLafferty,2012). This is important because it will assist in planning for interventions by enabling health authorities to prioritize areas where the need is highest. Moreover, information concerning the risk factors associated with substance abuse can be useful in developing a focused prevention program aiming at addressing the root causes of addiction. For instance, some previous studies have identified various contributory risk factors towards drug addiction such as socio-economic status, legal issues, psychological conditions, and family relationships (United Nations Office on Drugs and Crime, 2019). However, there are no specific studies conducted on this subject matter that take into account the unique socio-cultural context and economic setting of the federal Capital Territory of Pakistan.

RATIONALE

The study thus seeks to investigate how these risk factors interplay with each other across space by focusing on this specific region. Therefore, this study is justified by the importance of carrying out evidence-based interventions while tackling drug addiction problems. It may not be possible to effectively solve a problem unless you understand why and where drug addiction is mostly prevalent. Consequently, an empirical investigation must be carried out in order to fill in this gap with regard to spatial distribution patterns of drug addiction in the capital territory as well as its corresponding danger levels. It is projected that these research findings will carry heavy implications for public health policy and practice. The analysis can inform targeted interventions to meet the needs of different parts of the Capital Territory by identifying high-prevalence zones and important risk factors (Jafar, Aslam& Saeed, 2020). For example, drug rehabilitation centres or outreach programmes and community-based initiatives can be first set up in areas reported to have the highest number of drug addicts. On the other hand, analyzing factors such as family relationship issues and legal issues that act as risk factors will contribute to the development of holistic prevention strategies that address these causes in their entirety. (Mumtaz et al., 2015).

METHODOLOGY

STUDY DESIGN AND SETTING

The study was quantitative cross-sectional design to explore the spatial distribution of drug addiction cases and associated risk factors in the Capital Territory of Pakistan. The study was conducted over six months, from January to June 2024, and included patients from six drug addiction rehabilitation centers located within the capital territory

STUDY POPULATION

The population for this study were adults aged between 15 and 64 years who was undergoing treatment for drug addiction at the Rehabilitation center

INCLUSION CRITERIA

- **Cases:** Participants actively undergoing treatment for drug addiction to substances including Hashish (Charas, Ganja), Opium (Afeem), Methamphetamine (Meth, Crystal), Cannabis/Marijuana (Bhang, Gang), Cocaine (Coke), Alcohol, MDMA (Ecstasy Tablet), Heroin (Smack, Brown Sugar), Diazepam (Valium), Alprazolam (Xanax), and Morphine.
- **Controls:** Participants with a mental illness undergoing treatment at rehabilitation centers and from same geographic area (Capital Territory of Pakistan)

EXCLUSION CRITERIA

Individuals undergo treatment in the rehabilitation center who do not response themselves or those who are from a different geographic area outside the Capital Territory of Pakistan (CPT).

DATA COLLECTION TOOL

A structured questionnaire was administered to collect data on various aspects, including demographic information, employment status, family relationship, legal issues, and psychological status. The questionnaire was pre-tested to ensure its validity and reliability.

DATA COLLECTION PROCEDURE

Data were collected by conducting face-to-face interviews at the rehabilitation centers with the help of ArcGIS Survey App. Informed consent was obtained from participants, and confidentiality was guaranteed throughout the survey.

DATA ANALYSIS

Data analysis was performed using SPSS version 29 (IBM Corp., Armonk, NY, USA) and ArcGIS Desktop, version 10.8.2 (Esri, Redlands, CA, USA). Descriptive statistics were used to summarize demographic and socio-economic data for all participants. The ArcGIS tools have been used to detect the hotspots of drug addiction within the Capital Territory. A spatial distribution of drug addiction cases has been mapped, while the Getis-OrdGi* Statistics test has been conducted to establish the significance of patterns of drug addiction observed in the Capital Territory of Pakistan. Logistic regression was carried out to identify important predictors of drug addiction in the Capital Territory of Pakistan. We propose a logistic regression model that incorporates age, gender, employment status, legal issues, psychological status, and quality of family relationship. The odds ratios (OR) with 95% confidence intervals (CI) with the p-values were estimated to identify the importance of each of the identified predictors. In all of the analyses, the p-value less than 0.05 was considered statistically significant.

RESULTS

DEMOGRAPHIC AND SOCIOECONOMIC CHARACTERISTICS OF THE STUDY POPULATION

There were 108 cases of drug addiction and 108 matched controls in the research. Out of the total of 216, 18 females were considered 8.3%, while 198 males were considered 91.7%. The highest number of respondents fell into the category of the age bracket 26-40 years old, at 38.0%. This was followed by the 41-60 age bracket, at 28.2%; then the age bracket 19-25 years, 23.6%; 1-18 years with 6.5%; and the category of those from 61 years and above with 3.7%. Employment status is highest for employed 58.3%, followed by unemployed at 23.6%, 14.4% for students, and 3.7% retired. The majority, 81.9%, report no legal issues while for 18.1% these issues are present. About half of the sample reported strained family relationships, 49.1%, as opposed to supportive, which was 50.9%. About half of the individuals have no psychiatric issues 49.5%, while the other half has psychiatric issues 50.5%.

Table 1 Frequency Distribution of Various Characteristics.

Characteristic	Category	Frequency	Percent	Cumulative Percent
Gender	Female (0)	18	8.3	8.3
	Male (1)	198	91.7	100.0
Age Group	1 (1-18)	14	6.5	6.5
	2 (19-25)	51	23.6	30.1
	3 (26-40)	82	38.0	68.1
	4 (41-60)	61	28.2	96.3
	5 (61 >)	8	3.7	100.0
Employment Status	Employed	126	58.3	58.3
	Unemployed	51	23.6	81.9
	Student	31	14.4	96.3
	Retired	8	3.7	100.0
Legal Status	No	177	81.9	81.9
	Yes	39	18.1	100.0
Family Relationship	Strained	106	49.1	49.1
	Supportive	110	50.9	100.0
Psychiatric Status	No	107	49.5	49.5

Characteristic	Category	Frequency	Percent	Cumulative Percent
	Yes	109	50.5	100.0
Substance Use	(Controls)	108	50.0	50.0
	(Cases)	108	50.0	100.0

SPATIAL DISTRIBUTION OF DRUG ADDICTION

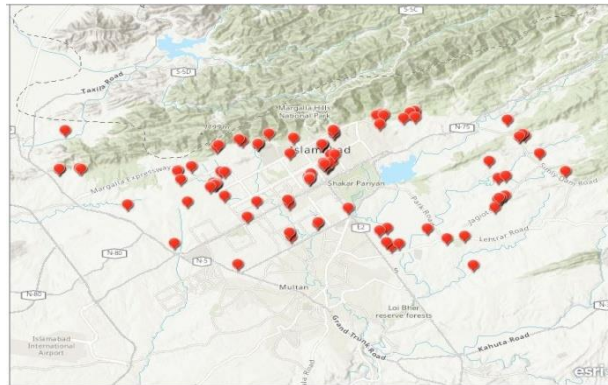


Figure 1 Spatial Distribution of drug addiction Cases in Capital territory of Pakistan

Figure 1 depicts the geographic distribution of the cases reported, which is 108 cases of drug addiction from different locations of the capital territory of Pakistan. The location points on the map indicate individual cases that make it possible to develop a reasonable idea about the pattern and clustering of substance abuse in space..

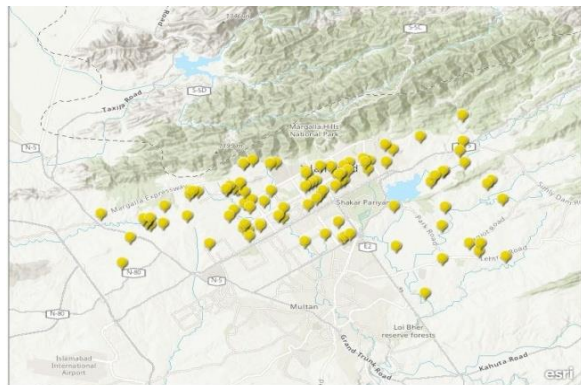


Figure 2 Spatial Distribution of Controls in Capital territory of Pakistan

Figure 2 shows geographic distribution of the 108

reported controls of the study population in different locations of the capital territory of Pakistan. Each data point on the map represents a single controls

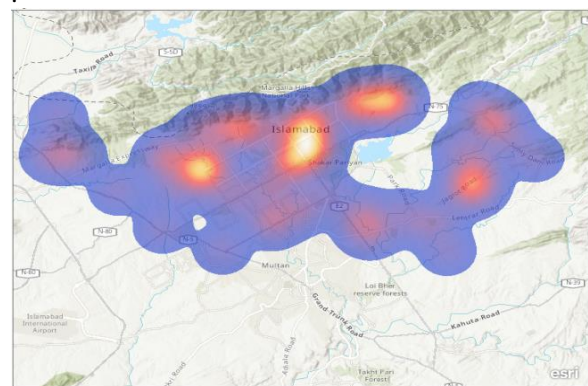


Figure 3 Heat Map of drug addiction in Capital territory of Pakistan

Figure 3 depicts drug addiction prevalence in the capital territory of Pakistan. The heat map elaborates that red areas reflect higher prevalence rates since those specific hotspots have a high proportion of affected individuals. The prevalence rates for areas in blue are low, hence making them coldspots where relatively smaller numbers of individuals were found affected by drug addiction. The shades vary in gradation for both colors-the darker shades reflecting more pronounced prevalence rates. Noticeably, the map presents its highest prevalence in the center, going down consecutively to its periphery.

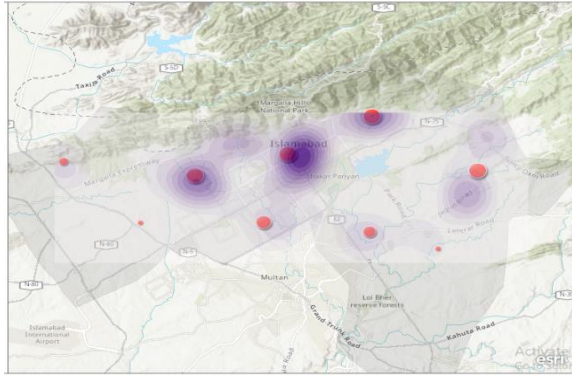


Figure 4 Density Map of drug addiction in Capital territory of Pakistan

Figure 4 provides information on drug addiction density within the capital territory of Pakistan. The higher the density in a region of the map, the higher the concentration of drug addiction present.

SPATIAL ANALYSIS

The spatial analysis revealed crucial hot spots of drug addiction concentrated within central areas of the capital territory. The zones achieved confidence levels of 95% and 90%. Such results indicate that there was a significant concentration of cases. On the other hand, non-significant outcomes emerged for peripheral areas since they possessed low prevalence levels. P-values less than 0.2 signify the areas of the central zone possess a level of statistical significance, whereas p-values larger than 0.75 reflect those for the peripheral regions that have no significance. There are clear results of Z-score analysis indicating high prevalence at the center with Z-scores greater than 1.4 and low prevalence at the periphery, with the Z-scores lesser than -0.9.

Table 2 Hot Spot Analysis of drug addiction in Capital territory of Pakistan
Zones of Capital Territory of Pakistan (G)Z score (G)P value

Zones of Capital Territory of Pakistan	(G)Z score	(G)P value
Zone 1 (Urban Center)	>1.4	<0.2
Zone 2 (Periphery)	<-0.9	>0.75

The maps produced from the spatial analysis give a visual representation of the hot spots of drug addiction in CPT and pinpoints the areas where interventions should be suitably targeted. These findings are critically necessary for public health officials and policy makers to outline priorities and implement the most effective prevention and intervention strategies in the high prevalence areas.

Figure 5 shows the hot spots of Getis-OrdGi Statistics in different colors that stand for different confidence levels. Hot spots can be considered those places where high concentrations of drug addiction cases can be found.

The orange and red colors in the middle of the map indicate substantial hot spots, meaning that there is strong evidence of drug addiction being more prevalent in those areas. These are at a 95% and 90% confidence levels, respectively.

On the other side, white in peripheral areas of the map shows insignificant analysis. That would mean there is no sufficient evidence to confirm that drug addiction is more prevailing taking into consideration those areas against by accident.

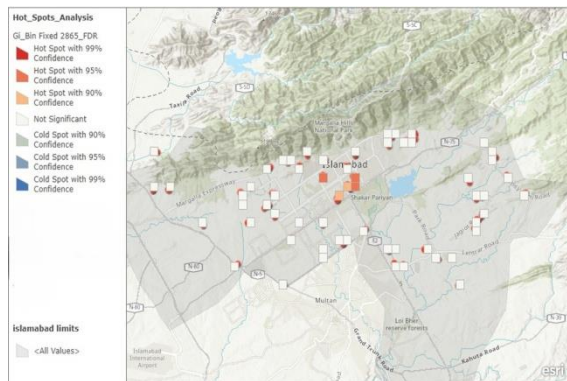


Figure 5 Different levels of confidence in capital territory of Pakistan

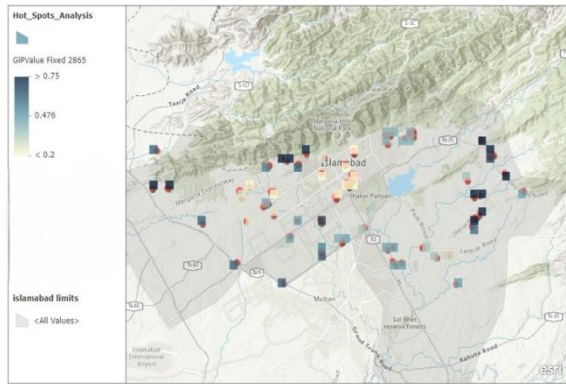


Figure 6 Different levels of significance in capital territory of Pakistan

Figure 6 is needed to emphasize the significance of the analysis based on p-values. The yellow areas in the middle of the map have p-values below 0.2, hence statistically significant. That is, it would take less than 20% to capture such an observed level of clustering of drug addiction cases using random chance. Contrary, the dark-shaded areas in the periphery have p-values above 0.75 and are not significant. This would then suggest that the clustering of drug addiction cases in these areas could well be due to random chance.

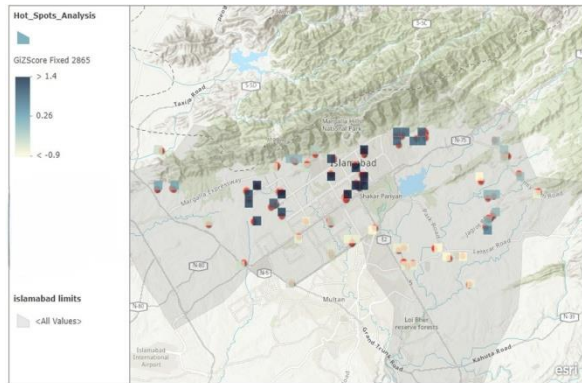


Figure 7 Z-score of drug addiction in capital territory of Pakistan

Figure 7 focuses on the Z-score, showing the standard deviation of a feature's value from the mean value of all features. In the center, it is positive and greater than 1.4, showing high significance with a high prevalence of drug addiction. It is in dark color. In the periphery, it is negative and less than -0.9, showing non significance and low prevalence of drug addiction.

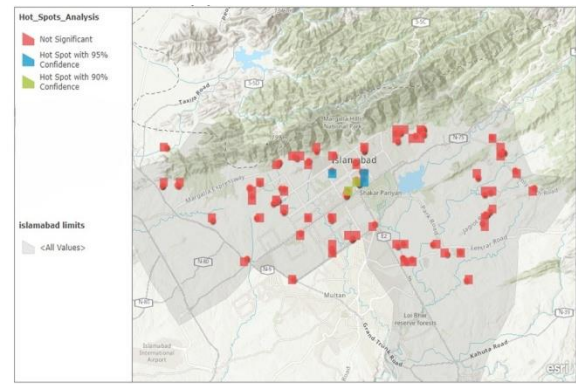


Figure 8 prevalence of drug addiction in capital territory of Pakistan

Figure 8 presents the final results of the hot spot analysis. The red spots around the periphery of the capital territory of Pakistan are insignificant, showing a low prevalence of drug addiction in those areas.

On the other hand, blue and green hot spots in the central part of the study area showed statistical significance for 95% and 90% probability confidence levels, respectively. This therefore indicates higher prevalence of drug addiction in the central areas.

STATISTICAL ANALYSIS

Through logistic regression analysis, some of the important predictors of drug addiction were identified. The gender and employment status factors were not significant predictors, with respective p-values greater than 0.05, showing that these factors do not influence a person's probability of developing addictive stages of drug addiction. Age group had a negative significant correlation, with older people having less chance of developing addictive stages of drug addiction as p-values were less than 0.05. This suggests that the younger the age, the higher the vulnerability factor for drug addiction, hence the need to target policy interventions on youth. Having legal problems proved to be a strong positive predictor with an odds ratio of 11.428, $p < 0.001$. It has been observed from the result that persons with legal problems are, in turn, more predisposed toward drug addiction, which shows a very high degree of correlation between the two aspects. Family relationship quality was a strong protective factor; the regression coefficient of -4.371 had a p-value of less than 0.001, while the odds ratio was 0.013. These are healthy family relationships, which play a very important role in preventing drug addiction. The psychological status also showed a potential

association with drug addiction, $p = 0.050$, with an odds ratio of 2.886, qualifying personnel with

psychological problems as more vulnerable to drug addiction.

Table 3 Logistic Regression Analysis

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Gender	1.413	1.231	1.317	1	.251	4.107
Age_Group			11.610	4	.020	
Age_Group (1-18)	-2.778	1.394	3.971	1	.046	.062
Age_Group (19-25)	-3.393	1.538	4.869	1	.027	.034
Age_Group (26-40)	-4.701	1.578	8.874	1	.003	.009
Age_Group (41-60)	-5.947	2.038	8.517	1	.004	.003
Employment_Status			1.728	3	.631	
Employment_Status Employed	.925	.796	1.350	1	.245	2.523
Employment_Status Unemployed	-.181	1.008	.032	1	.858	.835
Employment_Status Student	.962	1.615	.355	1	.551	2.617
Legal_Issues	2.436	.730	11.149	1	<.001	11.428
Family_Relationship	-4.371	.579	56.932	1	<.001	.013
Psychiatric_Status	1.060	.540	3.846	1	.050	2.886
Constant	3.206	2.105	2.320	1	.128	24.687

DISCUSSION

The hot spot analysis of the aerial distribution of drug addiction depicts a discrimination rate in the capital territory for Pakistan, examining its concentration in areas lying centrally. Particularly those areas with kachiabadis (informal Settlements) highly have concentrated cases of drug addiction. This agrees with literature that determines urban centers as high-risk zones due to high population density, dynamics of social conditions, and availability of illicit drugs

(UNODC, 1998). Moving out of the center of Islamabad, beyond grasp, the rate of drug addiction becomes considerably lower, directly pointing to an important socio-environmental risk of an urban setting.

The logistic regression of case control analysis provides an idea about different risk factors that have resulted in greater addiction rates in central Islamabad. Interestingly, age is proved to be a

significant predictor. Lower level of drug addiction is found in older adults; this might be because developmentally, social responsibilities, and neurological changes reduce the craving for drugs (China & Anthony, 2003; Luthar& Ansari, 2005; Chambers et al., 2003). There is a high positive correlation between legal problems and drug addiction, underlining the complicated interaction of socio-legal factors with substance abuse. Persons experiencing legal problems are highly vulnerable to addictive behavior from criminal activities associated with financing their addiction or by the criminalization of drug possession, maintaining vicious cycles of addiction and incarceration. This requires a multi-faceted approach that incorporates harm reduction, diversion programs, and reentry services.

Family relationships protect against the risk of drug addiction. Good bonding within the family provides support and resiliency, thus decreasing substance abuse vulnerability according to Brook et al., 2010 ,Hawkins et al., 1992, and Dishion et al., 2002. Poor bonding on the other hand creates more addiction risks, and there is, therefore, a need for early intervention and family-based programs for addiction prevention according to Fergusson et al., 2002, and Hops et al., 1990. It also influences psychiatric co morbidity due to drug addiction. Thus, individuals with psychiatric disorders have higher chances of getting addicted, which states that mental health disorders interact in a complicated manner with the habit of substance abuse either through self-medication or an increase in symptoms of psychiatry due to chronic use of substances. (Khantzian, 1997; Degenhardt et al., 2003; Kendler et al., 2003) Therefore more studies are required in order to understand and treat this co morbidity

CONCLUSION

This study provide a clear overview of the spatial distribution of drug addiction and its determinants in Islamabad. Hotspot maps show that most of the concentration lies in the central regions, especially in the slums. This is an indicative trend that perhaps the risk of drug abuse could be higher within urban centers, their population density, issues with the law, family relationship, and access to illicit drugs. It reflects that reduction in drug addiction is very greater from center to periphery of Islamabad.

The final analysis of logistic regression shows that age is the very important factor generally the elder people are less likely to be addicted to drugs, which could be due to various life factors which diminish their urge to take drugs. Legal problems show a strong correlation with drug addiction and that those people facing law problems are at high risk because of the after effects of crimes or laws related to carrying drugs in relation to their usage. The family situation is also a determining factor. Strong family bonding has a very protecting role from drug addiction, and inversely, dysfunctional family situations increase the risks of addiction to drugs. Besides, psychiatric illnesses are of great influence on drug addiction, showing that mental health issues are deeply linked with addictive disorders.

RECOMMENDATIONS

The hotspot maps and the statistical data highlight the occurrence of drug addiction in Islamabad, particularly in the center and in kachiabadis. These places have high population densities with poor quality housing conditions and poor health healthcare facilities, which render them prone to drugs. Young adults of Islamabad specifically students, are targeted because drugs are within easy access for them. They also experience weakened family bonds, high levels of mental disturbances coupled with major legal hurdles. Less drug addiction occurs within suburban as well as rural areas. These issues can be addressed through:

1. **Shifting Focus from Law Enforcement to Prevention:** Emphasis on prevention of drug use rather than its mere law enforcement.
2. **Strengthening Family Support Systems:** Strengthening family support through specific program initiatives.
3. **Expanding Mental Health Services:** Increase access to counseling, therapy, and psychiatric services, especially in places particularly in high-risk zones.
4. **Implementing Harm Reduction Programs:** Introduce Needle exchange programs and supervised injection sites need to be introduced to reduce health risks and link users with treatment channels.
5. **Increasing Rehabilitation Centers:** The government, in partnership with the Anti-

Narcotics Force (ANF), should establish more rehabilitation centers.

6. **Make Community Awareness Programs:** Organize awareness campaigns on drug addiction and its prevention to the public by targeting schools, colleges, and community centers.
7. **Train Law Enforcement Officers:** Train Law Enforcement Officers to identify people with drug addiction problems and refer them for treatment centers.
8. **Promote Collaboration Among All Stakeholders:** Encourage collaboration among all stakeholders, comprising government

agencies, NGOs, health care providers, and community groups for continued support.

9. **Use Artificial Intelligence (AI):** Use the technology of artificial intelligence to predict future trends in drug addiction and proactively intervene using Spatial predicting modeling.
10. **Border Fencing and Control:** Improvement of border fencing to prevent transportation of drugs from Afghanistan to Pakistan, as well as illegal migration that results in drug trafficking.
11. **Strict Regulation of Alcohol Permits:** Monitor and regulate the issuance of alcohol permits granted to the Christian community to prevent misuse and curb the illegal supply of alcohol to other communities.

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