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EPIDEMIOLOGY AND RISK FACTORS FOR HEPATITIS "C" VIRUS INFECTION IN SUSPECTED POPULATION VISITING DHQ HOSPITAL DERA ISMAIL KHAN, PAKISTAN

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Abstract
Hepatitis C virus (HCV) infections have varied prevalence rates across locations, which makes them a major public health concern worldwide. A cross-sectional research design collected data from a statistically significant subset of hospital visitors. A mix of structured interviews and serological testing determined the seroprevalence of hepatitis C virus infection. Data on potential risk factors, including demographics, medical history, and behavioral patterns, were also collected. Concerningly, 23.4% of the people surveyed tested positive for hepatitis C viral antibodies, suggesting a worrying expansion of HCV infection among the community under study. In addition, our research has identified several significant risk factors associated with an increased likelihood of contracting Hepatitis C virus infection. These include injectable drug use, a history of smoking, receiving blood transfusions, and having dental surgery, among others. The results add much to our knowledge of the hepatitis C virus epidemiology in Dera Ismail Khan. This study stresses the need for targeted screening, intervention, and preventive programs. Furthermore, there is a need to address modifiable risk factors to reduce the spread of HCV in this specific region.

Keywords: HCV, ICT, Blood Transfusion, IDUs, DHQ Hospital D.I. Khan

Introduction

Viral Hepatitis

The word "hepatitis" is usually used to describe an inflammatory condition in which the liver is affected by a virus that specifically targets liver cells. "Hepatic" means "liver" and "titis" means "inflammation"; together, they form the full word hepatitis. Liver inflammation is what the name

"hepatitis" refers to. The illness is caused by a virus and disrupts the normal functioning of the liver. The complete recognition of HCV occurred in 1975 when a large percentage of transfusion-associated hepatitis patients were shown to be unrelated to hepatitis A or B. The initial detection of HCV in a man's blood without hepatitis A or B1 occurred in 1989[1].
Inflammation and damage to the liver are symptoms of hepatitis C, a virus. The disease-causing HCV virus travels through the bloodstream and can cause either short-term or long-term infections. The condition might potentially deteriorate due to cirrhosis and malignancy. Nearly all instances are treated with antiviral drugs; however, most cases are detected later when treatment effectiveness is lower[2].

Hepatitis C infection can be classified as either acute or chronic based on the symptoms experienced. Acute hepatitis C virus infection (HCV) lasts from the moment of infection until six months have passed. During the acute period of HCV infection, only a small fraction of individuals (15-25%) will show signs of the condition; this is true for 75-85% of cases. Acute hepatitis C is notoriously difficult to detect since its symptoms are so generic and can manifest in many places. Some of the most common symptoms of acute hepatitis C are yellowing of the skin and eyes, lack of appetite, nausea, vomiting, extreme tiredness, flu-like symptoms, and itching. [3].

A Hepatitis C infection that persists for more than six months is called chronic hepatitis C. Chronic hepatitis C can remain symptom-free in its early stages, although symptoms usually manifest in the later stages. Because each patient reacts differently to therapy, there is no one-size-fits-all approach to chronic hepatitis C. Fibrosis is a documented complication of chronic HCV infection; nevertheless, the rate of fibrosis development varies across patients. Liver cirrhosis developed in one-third of untreated chronic HCV patients within 20 years and in the other one-third between 20 and 30 years later, according to new research. Gender (men often advance at a faster pace than women), age, alcohol use, fatty liver, HIV co-infection, and cellular adiposity all have a role in how quickly this occurs.[4].

Hepatitis can be caused by a variety of secondary variables, some of which include alcohol, drugs, toxins, and medications. In humans, the liver is responsible for producing bile, filtering out toxins, metabolizing drugs, storing glycogen, breaking down proteins, carbohydrates, and fats, activating enzymes, and excreting bilirubin. When it comes to human infections, HCV is the main culprit, causing both short-term and long-term problems. The "silent killer" moniker for the hepatitis C virus comes from the fact that many people are symptom-free and thus unaware that they have the virus in their body[5].

Three structural proteins (E2, E1, and Core) and seven non-structural proteins (NS4B, p7, NS2, NS5B, NS4A, NS5A, and NS3) make up the ten-protein hepatitis C virus (HCV). One of the families of flaviviruses is the hepatitis C virus. A total of 9,600 nucleotides makes up the genome of the hepatitis C virus (HCV), which is positive-sense and single-stranded RNA. It was in 1989 when this viral genome was first found[6]. (Fig: 1)

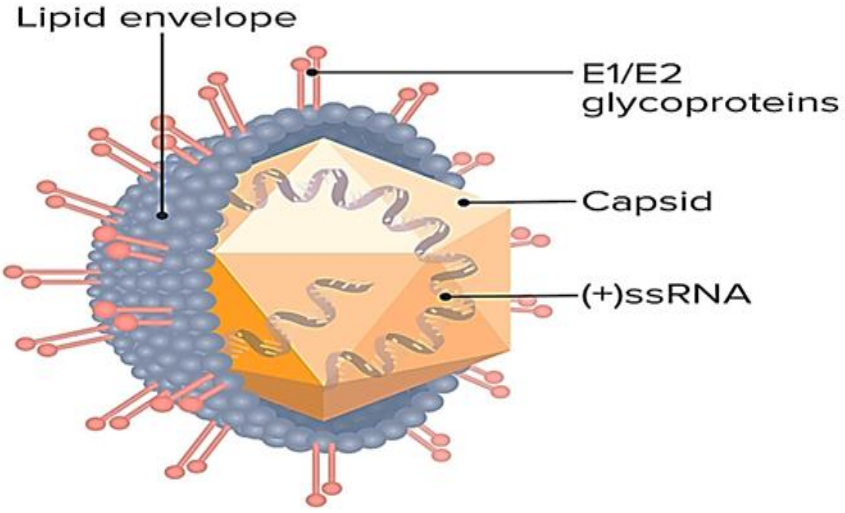


Figure:1 Structure of HCV

Dera Ismail Khan District is one of the areas in Pakistan with a high incidence or prevalence of hepatitis C, which is a major public health concern in Pakistan. To help raise awareness about the transmission channel and other associative risk factors in the area, this study aims to shed light on the epidemiology of HCV infection in this region and identify risk factors associated with its transmission.

Review of Literature

Worldwide, hepatitis C virus (HCV) infections constitute a major financial and logistical strain on healthcare systems. Hepatitis C virus (HCV) is a Flaviviridae family member and a leading cause of chronic liver disorders. The average annual death toll from this virus is 350,000, indicating a significant mortality rate. Recent cases of hepatitis C have reached 1.5 million people globally, bringing the total number of people living with a chronic infection to almost 58 million. One percent of the population was thought to have hepatitis. Estimates put the number of Americans living with chronic hepatitis C at 3.5 million[7].

Worldwide, this virus is estimated to be present in 71 million people, according to the World Health Organization (WHO). Over 399,000 people lost their lives in 2016 due to complications from hepatitis C virus (HCV). The leading causes of death were hepatocellular carcinoma and liver cirrhosis, according to estimates from the World Health Organization. Pakistan has the second-highest HCV prevalence rate in the world, at 4.7%[8].

Only 2% of cases are discovered in the Americas, Australia, and Western Europe, whereas the highest rates of HCV prevalence are observed in Africa and the East Mediterranean. Although the incidence of HCV differs throughout Asian countries, the overall frequency is estimated to be somewhat higher than 2%. Egypt scores better than other nations, with an HCV prevalence of at least 14%[9].

Materials and Methods

Sample Collection

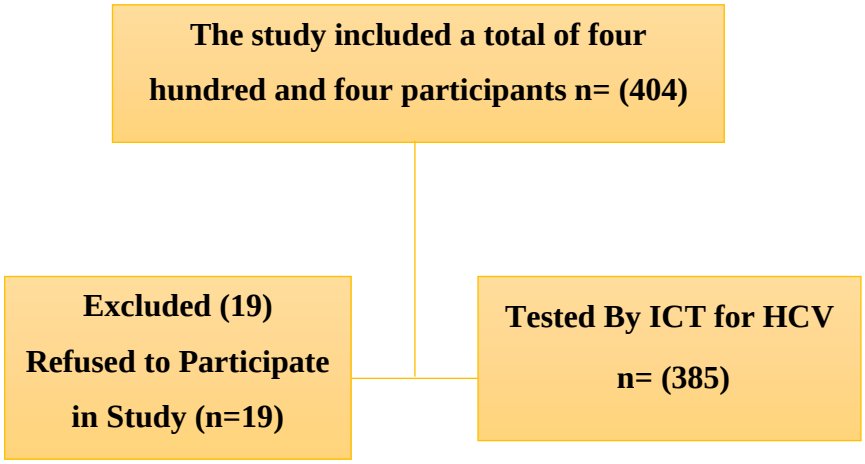
Patients visiting the pathology laboratory at Dera Ismail Khan, Pakistan's District Headquarter Hospital, were surveyed using a questionnaire developed for this study (Appendix 1). Each participant's blood sample was taken after they filled out the questionnaire. The patient has undergone serum testing, namely an anti-HCV immunochromatography test [3,10].

Data Analysis

The data that was gathered has been analyzed using appropriate statistical procedures in the SPSS program. To better understand the study population, descriptive statistics such as percentage,

frequency, standard deviation, and mean have been used. To determine the risk factors linked to HCV infection, the data was subjected to risk ratio and odds ratio calculations [11].

RESULTS



HCV prevalence in District Dera Ismail Khan

A total of 385 blood specimens were taken from the 15–56-year-old HCV-suspected population in District Dera Ismail Khan, Pakistan, who were visiting DHQ. 212 of the 385 total participants were men, and 173 were women. The blood samples were then subjected to an immunochromatographic (ICT) assay to identify any antibodies generated in response to the HCV antigen.

Table 1. HCV prevalence in District Dera Ismail Khan

Prevalence of HCV in Suspected Human Population of DHQ Hospital, D.I. Khan					
HCV	Total	Positive Cases	Prevalence of Positive Cases	Negative Cases	Prevalence of Negative Cases
	385	90	23.4	295	76.62

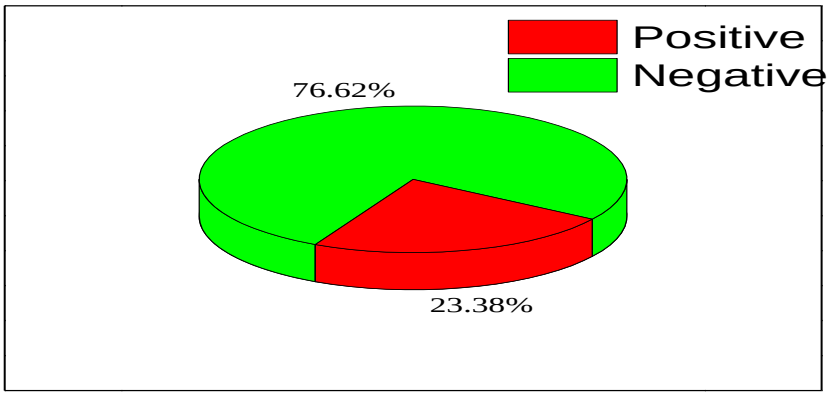


Figure 2. HCV Prevalence in Suspected Population Visiting DHQ Hospital Dera Ismail Khan

Sociodemographic Characteristics of the participants

A demographic profile of the population surveyed is shown in Table 2. Age-wise, most people are between the ages of 26 and 55, with the most prevalent group being 36 to 45. The distribution of genders is roughly equal, with slightly more men (55%) than women (45.1%). The province of KPK is home to the bulk of responders (97.7%), with minimal representation from other provinces. The population's marital status reveals that a sizable number of people are married (71.9%). The

population is distributed evenly between urban (52.2%) and rural (47.9%) areas in terms of location. People who took the survey have a wide range of educational backgrounds; among them, 33.6% are illiterate, and 63.8% are unemployed. Lastly, just 4.7% of the population has a history of health issues running in their family, while 95.6% do not.

Table 2. Sociodemographic Characteristics of the participants

Variables	Category	N (%)
Age	15-26	49 (12.7)
	26-35	91 (23.7)
	36-45	93 (24.15)
	46-55	87 (22.7)
	>56	65 (16.9)
Gender	Male	212 (55)
	Female	173 (45.1)
Province	Punjab	2 (0.5)
	Sindh	2 (0.5)
	Baluchistan	5 (1.3)
	Kpk	376 (97.7)
Marital status	Single	47 (12.2)
	Married	277 (71.9)
	Widowed/divorced	61 (15.9)
Locality	Urban	201 (52.2)
	Rural	184 (47.9)
Qualification	Illiterate	130 (33.6)
	Primary	68 (17.7)
	Secondary	51 (13.3)
	Higher secondary	64 (16.7)
	Undergraduate	40 (10.4)
	Graduate	32(8.3)
Working status	Unemployed	246(63.8)
	Retired	50(13)
	Employ	89(23.2)
Family medical history	Yes	18(4.7)
	No	367(95.6)

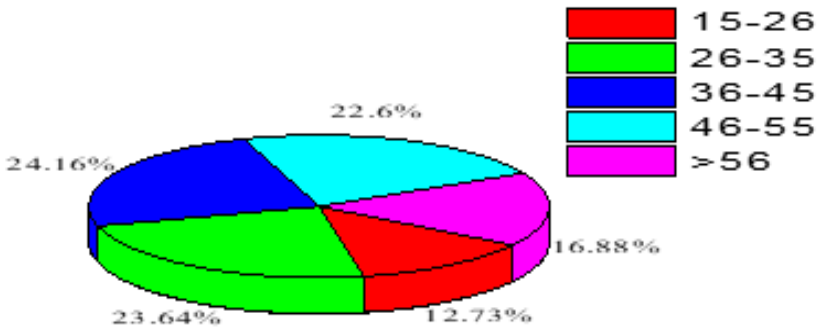


Figure 3. Age-wise Prevalence of HCV

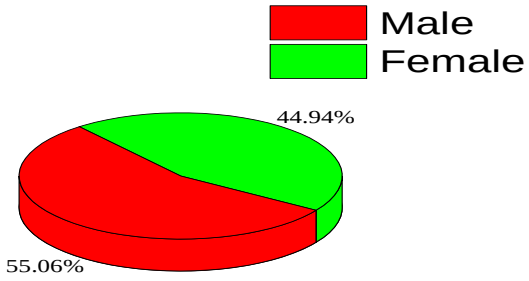


Figure 4. Gender-wise Prevalence of HCV

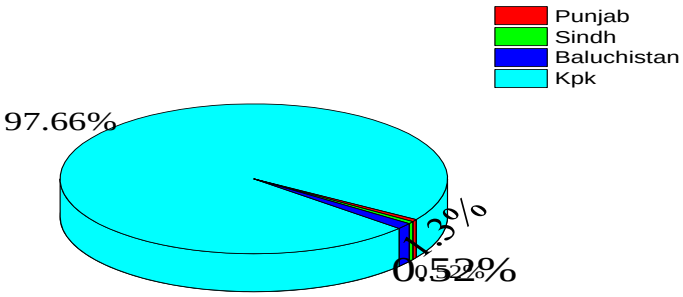


Figure 5. Province-wise Distribution of HCV

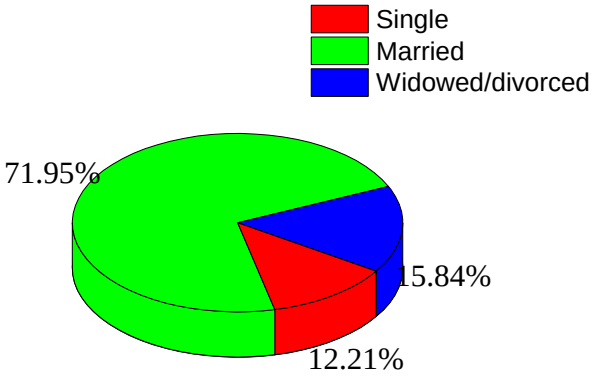


Figure 6. Marital-wise Prevalence of HCV

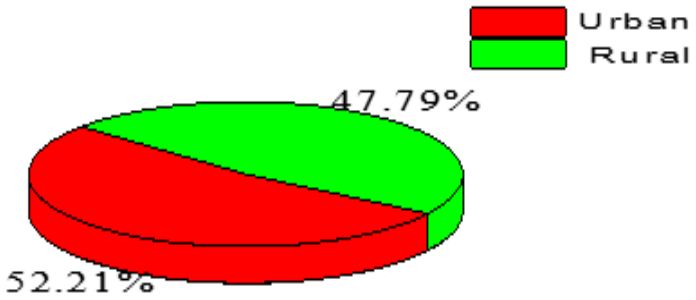


Figure 7. Locality-wise Prevalence of HCV

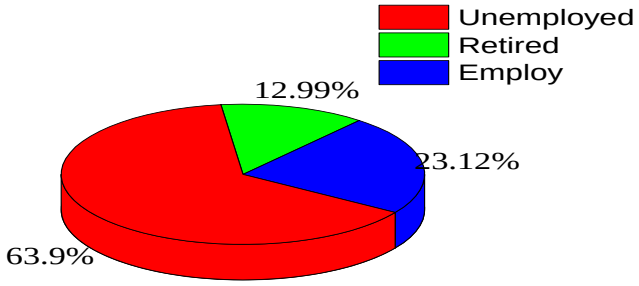


Figure 8. Qualification-Wise HCV Prevalence

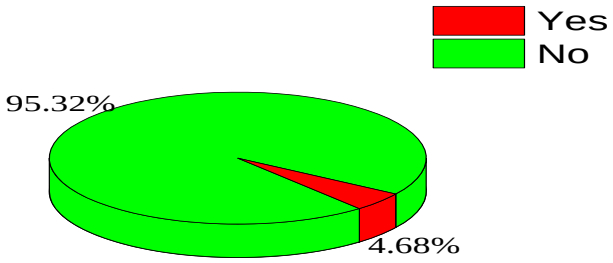


Figure 9. Working status-wise HCV Prevalence

Associated Risk Factors of HCV with Gender

Table 3 displays the study's findings, which included the odds ratios (OR) and p-values that indicated the significance of the connections for several characteristics linked to hepatitis C infection. The results are interpreted as follows: A 1.44-fold increased risk of hepatitis C infection was seen in those with a history of international travel compared to those without a history of such travel. The odds ratio points to a moderate association, but the p-value of 0.086 means it isn't significant at the traditional 0.05 level of significance. There was a statistically significant link between receiving blood transfusions and a substantially lower risk of hepatitis C infection (odds ratio = 0.592, p-value = 0.011). This provides more evidence that transfusion recipients are at reduced risk of contracting

hepatitis C. Individuals who reported being injectable drug users had a substantially higher risk of hepatitis C, with an odds ratio of 2.353. This association is highly significant (p-value = 0.001), indicating a strong link between injectable drug use and hepatitis C infection. Those with a history of smoking exhibited a significantly higher risk of hepatitis C infection, with an odds ratio of 3.300. This association is highly significant (p-value < 0.001), indicating a robust relationship between smoking and hepatitis C. Reusing needles did not show a statistically significant association with hepatitis C infection, as indicated by the odds ratio of 1.062 and a p-value of 0.516. Utilizing barber services did not exhibit a statistically significant association with hepatitis C infection, with an odds ratio of 1.229 and a p-value of 0.214.

With an odds ratio of 0.722 and a p-value of 0.096, there was no statistically significant relationship between having undergone organ transplantation and hepatitis C infection. With a p-value of 0.340 and an odds ratio of 0.876, major surgery was not associated with a statistically significant risk of hepatitis C infection. A p-value of 0.104 and an odds ratio of 0.707 indicate that there is no statistically significant link between having a family history of the disease and hepatitis C infection.

With an odds ratio of 0.701 and a p-value of 0.061, getting piercings did not demonstrate a statistically significant connection with hepatitis C infection. With a p-value of 0.437 and an odds ratio of 1.065, receiving acupuncture treatments was not associated with a statistically significant risk of hepatitis C infection. Dialysis patients were 1.515 times more likely to contract hepatitis C than the general population. The correlation between the two variables is highly significant (p-value = 0.037). There was a 1.471-fold increase in the incidence of hepatitis C infection in patients who had oral surgery. With a p-value of 0.003, this correlation is very significant. Overall, the results show that hepatitis C infection is linked to multiple variables. Among the most important risk factors for hepatitis C, there is a history of injectable drug use, smoking, blood transfusions, and oral surgery. However, there are no significant connections between hepatitis C infection and characteristics such as barber services, major surgery, organ transplantation, illness family history, piercing, or acupuncture in this population. These results have important implications for our knowledge of hepatitis C risk factors and possible treatments for the disease.

Table 3. HCV Risk factor identification with gender

Factors	Category	Gender		COR and 95% CI	*p*-value
		M	F		
Travel abroad history	Yes	56	34	1.44 (.888-2.341)	0.086
	No	156	139		
Blood received	Yes	129	125	.592(384-913)	0.011
	No	83	48		
Injectable drug user	Yes	59	24	2.353(1.390-3.984)	0.001
	No	153	149		
Smoking history	Yes	99	36	3.300(2.092-5.207)	.000
	No	101	149		
Needles reuse	Yes	97	260	1.062(.491-2.296)	.516
	No	15	13		
Barber	Yes	59	53	1.229(.787-1921)	.214
	No	141	132		
Organ transplantation	Yes	59	46	.722(.459-1.134	.096
	No	141	139		
Major surgery	Yes	45	40	.876(.539-1.423)	.340
	No	167	133		
Disease family	Yes	39	43	.707(.433-1.156)	.104
	No	172	131		

Piercing	Yes	68	69	.701(.461-1.068)	.061
	No	124	104		
Acupuncture	Yes	61	67	1.065(.680-1.669)	.437
	No	131	126		
Dialysis	Yes	79	50	1.515(983-2.334)	.037
	No	130	126		
Dental surgery	Yes	69	158	0.0492(.680-2.669)	.003
	No	142	16		

4.8 HCV Risk Factor Assessment with Locality

Table 4. shows the findings of a study that classified parameters related to hepatitis C infection by urban and rural areas. The statistical significance of these connections in each location is shown by the odds ratios (OR) and p-values. The results are presented here with an analysis. No statistically significant connection between hepatitis C infection and prior international travel was seen in either urban or rural locations. With p-values higher than 0.05 (0.302), the odds ratios for the two locations were nearly 1 (1.168 for urban and 0.726 for rural). Both urban and rural populations do not show a significant correlation between travel history and hepatitis C infection. No statistically significant connection between hepatitis C infection and prior international travel was seen in either urban or rural locations. With p-values higher than 0.05 (0.302), the odds ratios for the two locations were nearly 1 (1.168 for urban and 0.726 for rural). Both urban and rural populations do not show a significant correlation between travel history and hepatitis C infection. With p-values higher than 0.05 (0.154), the odds ratios were marginally over 1, with urban at 1.275 and rural at 0.835.

There was a statistically significant correlation between injectable drug use and hepatitis C infection; but intriguingly, this correlation varied between rural and urban locations. There was no statistically significant link between injectable drug users and hepatitis C in urban regions, while a considerably reduced risk was observed in rural areas (OR = 0.478, p-value = 0.003). There was no statistically significant correlation between a history of smoking and hepatitis C infection in either rural or urban settings. There were p-values larger than 0.05 (0.213) and odds ratios close to 1 (1.214 for urban and 0.797 for rural).

There was no statistically significant correlation between hepatitis C infection and needle reuse in either rural or urban settings. Results showed p-values higher than 0.05 (0.126) and odds ratios close to 1 (0.581 for urban and 1.94 for rural).

Both urban and rural areas did not find statistically significant relationships between hepatitis C infection and organ transplantation, major surgery, disease family history, piercing, or acupuncture. These variables did not have statistically significant odds ratios or p-values. In both urban and rural areas, there was a statistically significant connection between hepatitis C infection and dialysis. The odds ratio was 0.376 in rural areas and 0.577 in urban areas, suggesting a lower probability of infection in the former. The p-values for both locations were extremely significant (p = 0.008). Hepatitis C infection was significantly associated with dental surgery in both rural and urban settings. Highly significant p-values (p = 0.0045) were associated with the odds ratios of 1.248 in urban regions and 0.906 in rural areas.

In conclusion, the study's results show that hepatitis C infection is linked to multiple variables, while the weight of these relationships differs among regions. Hepatitis C infection was consistently linked to injectable drug use, dialysis, and dental surgery in both rural and urban populations. Neither location showed any significant connections with other characteristics, such as smoking, blood transfusions, or travel history. It appears that hepatitis C risk factors differ across urban and rural populations. Therefore, it is necessary to develop prevention techniques that are tailored to each local setting.

Table 4. HCV Risk factor identification with locality

Factors	Category	Locality		COR and 95% CI	*p*-value
		U	R		
History of international travel	Yes	49		1,168(.726-1.880)	0.302
	No	40			
		151			
		145			
Blood received	Yes	137		1.275(.835-1945)	0.154
	No	116			
		64			
		68			
Injectable drug user	Yes	32		.478(.290-.789)	.003
	No	51			
		169			
		133			
Smoking history	Yes	75		1.214(.797-1849)	.213
	No	60			
		126			
		124			
Needles reuse	Yes	182		.581(.261-1.94)	.126
	No	174			
		19			
		10			
Barber	Yes	59		1.062(.683-1.653)	.239
	No	53			
		141			
		132			
Organ transplantation	Yes	69		1.293(.822-2.033)	.160
	No	45			
		141			
		137			
Major surgery	Yes	47		1.148(.706-1.865)	.333
	No	38			
		154			
		146			
Disease family	Yes	41		.872(.534-1.424)	.336
	No	41			
		160			
		143			
Piercing	Yes	63	73	.699(.460-1.064)	.059
	No	137			
		111			
Acupuncture	Yes	61		1.317(.840-2.064)	.138
	No	46			
		139			
		138			
Dialysis	Yes	56	73	0.587(.376-.885)	.008
	No	145			
		111			

Dental surgery	Yes	61	66	5.5204(.906-	.0045
	No	37		1.865)	
		221			

Discussion

The demographic information gathered about the surveyed population included age, gender, place of residence, marital status, neighborhood, level of education, work status, and medical history of the family. The distribution of genders is rather balanced, most people live in the province of KPK, a sizable percentage are unemployed, and there isn't much family medical history of hepatitis C. Due to the absence of vaccination and effective treatment for HCV, the prevalence of the disease is higher among both men (Babozai) and women (Kabal). A primary strategy for avoiding and managing HCV outbreaks is to restrict the spread of the virus. [12] A recent global systematic analysis of HCV prevalence and incidence in men who have sex with men (MSM) has generated updated data that may be used to inform community education and public health policy.[13]

Highlights the surveyed population's awareness and misconceptions regarding hepatitis C transmission. While there is good awareness of certain transmission modes like shared injection equipment and sexual contact, there are notable misconceptions about casual contact and airborne transmission. This issue merits more research in the current setting of the global HCV outbreaks. The group most vulnerable to HCV infection is new or young injecting drug users (IDUs).[14]
My research indicates that a poor immune system is the reason for the high prevalence of positive HCV in the 61–70 age range, which sheds light on the awareness of hepatitis C treatment among the surveyed population.

Though most people are aware that drugs are available and that there may be a cure, there are knowledge gaps on specifics of treatment, like the usage of direct-acting antivirals (DAAs) and the idea of a sustained 62 viral response 12 weeks after therapy (SVR12). In this sense, every blood transfusion presents a possible risk of transmission [15]. Compared to my research, the total frequency was 23.66% in the two chosen districts Swat Tehsils (Babozai and Kabal), which is greater than in Lahore. Because the folks used soiled devices like razors, needles, and surgical instruments.
This study suggests that there are multiple factors linked to hepatitis C infection. Injectable drug use, smoking history, blood transfusions, and dental surgery are strongly linked to an increased risk of hepatitis C. However, in this population, characteristics such as a history of travel abroad, barber services, organ donation, major surgery, family history of disease, piercing, and acupuncture do not show any significant links to hepatitis C infection. These findings have significance for comprehending the risk factors and potential interventions (such as medical treatments or strategies) for preventing and managing hepatitis C. [16]
Acute hepatitis C (AHC) refers to the six months following infection with the Hepatitis C virus. In a broader sense, the six months following the acquisition of the virus are commonly known as the period when severe symptoms of hepatitis C virus infection become apparent. [17,18]

Conclusion

Acute hepatitis C (AHC) refers to the six months following infection with the Hepatitis C virus. In a broader sense, the six months following the acquisition of the virus are commonly known as the period when severe symptoms of hepatitis C virus infection become apparent. To effectively address the transmission of HCV and improve the health outcomes of the people in Dera Ismail Khan, it is crucial to implement local data collection initiatives and establish collaborative partnerships among healthcare officials, researchers, and community members. These efforts will enable the development of precise interventions. The results of this study, which include information about how common HCV infection is, the characteristics of the affected population, and the factors that contribute to the risk of infection, provide important knowledge about the patterns of HCV infection in the region of

Dera Ismail Khan. The findings serve as a foundation for evidence-based interventions, such as improved infection control protocols, increased access to screening and treatment resources, and comprehensive public awareness campaigns, specifically tailored to address the unique challenges faced by the community in question.

Recommendations

The advice presented is based on a study on the epidemiology and risk factors linked to Hepatitis C Virus (HCV) infection among individuals who visited DHQ Hospital in Dera Ismail Khan, Pakistan.

To reduce the danger of contamination, it is crucial to implement and maintain strict infection control policies in healthcare institutions, focusing on preventing the reuse of syringes and needles that have encountered microorganisms. Promote the use of disposable medical equipment and develop efficient procedures for its proper disposal. To ensure that secure blood transfusions are accessible, it is crucial to implement rigorous procedures for blood screening and testing. To prevent the spread of the Hepatitis C Virus (HCV) through blood products, it is crucial to establish a system of monitoring and regulation for blood banks. Execute educational programs aimed at healthcare staff and patients to improve their understanding of safe injection techniques and the risks associated with improper utilization. Improving the availability and accessibility of screening services for Hepatitis C Virus (HCV) is necessary, especially in geographically remote areas. Ensuring sufficient access to appropriate treatment and follow-up care is crucial for patients diagnosed with Hepatitis C Virus (HCV). Develop and execute public education campaigns targeting the spread, prevention, and importance of early identification and treatment of the Hepatitis C Virus (HCV). Attention should be directed to populations that are deemed vulnerable, including individuals who engage in intravenous drug use and participate in high-risk sexual behaviors.

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REFERENCES

1. Ali, S., Ali, B., Khan, B., Khan, M., & Ali, S. (2023). Sero-prevalence of hepatitis-c virus among blood donors in northern Pakistan. *MOJ Public Health, 12*(1), 37-41.
2. Romanivna, M. S., Olehivna, G. O., & Yaroslavovich, S. D. (2023). *INCIDENCE AND PREVALENCE OF HEPATITIS C IN UKRAINE AND THE WORLD.* Paper presented at the Colloquium-journal.
3. Khan, M. K., Saad, M., & Ullah, R. (2021). A Concise Review on Hepatitis C Virus Infection-Associated Type 2 Diabetes Mellitus and Its Impact on Anti-HCV Therapy.
4. Chatterjee, S., Majumder, B., & Basu, D. (2021). A review to explore the association between diabetes mellitus and hepatitis. *metabolism, 35*(36), 37.
5. Sohail, A. (2023). Awareness and Prevalence of Hepatitis B and C in Rural Areas of Lahore, Pakistan.
6. Yechezkel, I., Law, M., & Tzarum, N. (2021). From structural studies to HCV vaccine design. *Viruses, 13*(5), 833.
7. Saleem, U., Aslam, N., Siddique, R., Iqbal, S., & Manan, M. (2022). Hepatitis C virus: Its prevalence, risk factors and genotype distribution in Pakistan. *European Journal of Inflammation, 20*, 1721727X221144391.
8. Abdel-Gawad, M., Nour, M., El-Raey, F., Nagdy, H., Almansoury, Y., & El-Kassas, M. (2023). Gender differences in prevalence of hepatitis C virus infection in Egypt: a systematic review and meta-analysis. *Scientific Reports, 13*(1), 2499.

9. Organization, W. H. (2021). *Global progress report on HIV, viral hepatitis and sexually transmitted infections, 2021: accountability for the global health sector strategies 2016–2021: actions for impact*: World Health Organization.
10. Haqqi, A., Munir, R., Khalid, M., Khurram, M., Zaid, M., Ali, M., . . . Afzal, M. S. (2019). Prevalence of hepatitis C virus genotypes in Pakistan: current scenario and review of literature. *Viral immunology*, *32*(9), 402-413.
11. Khan, M. K., Saad, M., & Ullah, R. (2021). A Concise Review on Hepatitis C Virus Infection-Associated Type 2 Diabetes Mellitus and Its Impact on Anti-HCV Therapy.
12. McCarthy, R. V., McCarthy, M. M., Ceccucci, W., McCarthy, R. V., McCarthy, M. M., & Ceccucci, W. (2022). What do descriptive statistics tell us. *Applying predictive analytics: Finding value in data*, 55-85.
13. Niu, Z., Zhang, P., & Tong, Y. (2016). Age and gender distribution of Hepatitis C virus prevalence and genotypes of individuals of physical examination in WuHan, Central China. *Springerplus*, *5*, 1-9.
14. Jin, F., Dore, G. J., Matthews, G., Luhmann, N., Macdonald, V., Bajis, S., . . . Grulich, A. E. (2021). Prevalence and incidence of hepatitis C virus infection in men who have sex with men: a systematic review and meta-analysis. *The lancet Gastroenterology & hepatology*, *6*(1), 39-56.
15. Roy, É., Arruda, N., Leclerc, P., Haley, N., Bruneau, J., & Boivin, J.-F. (2012). Injection of drug residue as a potential risk factor for HCV acquisition among Montreal young injection drug users. *Drug and alcohol dependence*, *126*(1-2), 246-250.
16. Basit, A., Rahim, K., Ahmad, I., Shafiq, M., Mushtaq, S., Shaheen, H., & Khan, I. (2014). Prevalence of hepatitis B and C infection in Pakistan. *J Inf Mol Biol*, *2*(3), 35-38.
17. Antonelli, A., Ferri, C., Galeazzi, M., Giannitti, C., Manno, D., Mieli-Vergani, G., . . . Palazzi, C. (2008). HCV infection: pathogenesis, clinical manifestations and therapy. *Clinical and Experimental rheumatology*, *26*(2), S39.
18. Munir, A. (2023). Prevalence of Hepatitis B Virus and Hepatitis C Virus in Sub Division Ladha, South Waziristan: Prevalence of Hepatitis B Virus and Hepatitis C Virus. *Journal of Animal and Plant Research*, *1*(1), 1-4.