

## ORIGINAL ARTICLE

**Frequency of Portal Vein Dilatation in Chronic Liver Diseased Patients through Ultrasound**MANEEZA AHMED<sup>1</sup>, SAHAR KHAN<sup>2</sup>, HABIB ULLAH<sup>3</sup>, ATIQ ULLAH<sup>4</sup>, AQAL ZAMAN<sup>5</sup>, RIZWAN ULLAH<sup>6</sup><sup>1</sup>Demonstrator, Department of Radiology Technology, The Professional college of medical sciences, Peshawar, Pakistan.<sup>2</sup>Lecturer, Department of Radiology Technology, School of Health Sciences, Peshawar, Pakistan.<sup>3</sup>Clinical Technician, Department of Radiology, District Head Quarter Hospital, Alpuri Shangla, Pakistan.<sup>4</sup>Department of Radiology Technology, Institute of Paramedical Sciences, Khyber Medical University, Peshawar, Pakistan.<sup>5</sup>Assistant Professor, Department of Microbiology and Molecular Genetics-Bahudin Zakarya University, Multan, Pakistan.<sup>6</sup>Demonstrator, Department of Radiology Technology, Institute of Paramedical Sciences, Khyber Medical University, Peshawar, Pakistan.

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**ABSTRACT**

**Background:** Cirrhosis is one of the chronic liver disease in which the liver cells get fibrose and healthy tissues converted into scar tissues. The scar tissues compress the sinusoidal space in which portal vein drains, this causes pressure in portal vein and due to the backflow of blood the portal vein dilates. Portal vein dilatation in chronic liver disease patients leads to various complications. The objective of this study was to find out the frequency of portal vein dilatation in chronic liver disease patients and correlate it with age, gender, smoking, spleen size and ascites.

**Methods:** This cross-sectional study, which involves the convenient sampling technique was conducted at Shangla hospital Swat conducted in 2022 with sample size of 171 patients from World Health Organization calculator, out of 171, 2 patients did not give response, so we included 169 patients. confidence level taken is 95%. The level of significance is 5% and Prevalence is 20%. Data was collected through a standard and validated questionnaire which included three portions. 1st portion of questionnaire contained written informed consent. 2nd portion contained demographic profile of the patient. 3rd portion of questionnaire contained all the sonographic findings. Data were analyzed through SPSS version 22. Correlation, spearman and pearson tests were applied.

**Result:** There were total of 169 patients consisted of 102 males and 67 females. Out of 169 patients 53 were having normal portal vein diameter and 116 were having portal vein dilatation. Portal vein diameter is not affected by gender. Age and smoking are associative factors of portal vein dilatation. Ascites occurs in chronic liver disease patients due to dilated portal vein. Portal vein dilatation does not affect spleen size. Early detection of liver diseases and diagnosis of focal and diffuse parenchymal disease can be made possible with ultrasound because its first line of investigation, its efficiency is 95%, its noninvasive, easily available in the backward areas and various factors such as liver size, shape changes, liver markings, echogenicity, nodular pattern, portal vein diameter, inferior vena cava irregularity and spleen size can all be timely detected with ultrasound and life can be saved.

**Conclusion:** It is concluded in this study that portal vein dilatation increases with age and is more common in middle aged people, gender and spleen size does not show any relation with portal vein dilatation. Ascites increases with portal vein dilatation and smoking is also an associative factor for portal vein dilatation in chronic liver disease patients.

**Keywords:** Chronic liver disease, ultrasonography, portal vein dilatation, portal hypertension, cirrhosis, parenchymal disease.

**INTRODUCTION**

Liver has two blood supplies portal vein and hepatic artery. The portal vein is made from splenic and superior mesenteric vein. It carries 80% of the blood to the liver<sup>1</sup>. The normal diameter of the portal vein is about 7-15mm<sup>2</sup>. CLD is a continuous degradation of liver functions, Cirrhosis is the last stage of chronic liver disease<sup>3</sup>. In Liver cirrhosis normal liver functional cells replace by scar tissue, cirrhosis causes change in hepatic vascular pattern<sup>4</sup>, this change results in increased resistance to portal blood flow which in turn causes portal hypertension<sup>5</sup>. Portal hypertension is defined as when portal venous pressure increases more than 10mmHg<sup>6</sup>. Portal hypertension leads to portal vein dilatation<sup>7</sup>. Liver cirrhosis has two stages one in which liver is heavily scarred but is asymptomatic and other in which liver function is lost<sup>8</sup>. The symptoms include weakness, peripheral oedema, Recurrent infections, splenomegaly, itching, jaundice and bleeding tendency<sup>9</sup>. Liver cirrhosis causes complications which include GIT bleeding, diabetes mellitus, ascites, hepatopulmonary and hepatorenal syndrome, congestive cardiac failure, hepatic encephalopathy, and carcinoma<sup>10</sup>. Liver Cirrhosis usually do not appear in the early stages of the disease<sup>11</sup>. It is diagnosed when patient go to the hospital for screening of a disease and tests such as liver transaminases or radiologic findings are made which shows disease state<sup>9</sup>. Ultrasonography is the initial imaging modality for determining the complications of liver cirrhosis<sup>5,12</sup>, so that it can be stop from progression. Ultrasonography is the initial imaging modality for determining the complications of liver cirrhosis<sup>13</sup>. It provides details about hepatic architecture and plays a major role in the detection of complications of cirrhosis<sup>13,14</sup>. Increase in echogenicity and nodular pattern of the liver can be seen in cirrhosis<sup>15</sup>. Ultrasonography and Doppler ultrasonography of portal

vein are useful for determining the portal hypertension and vessel patency<sup>16</sup>. The major cause of liver cirrhosis in the world is hepatitis B, C and alcohol consumption<sup>17,18</sup>, fatty liver, obesity, drug abuse, diabetes, older age, portal hypertension, ascites and carcinoma are all the causes of liver cirrhosis<sup>19,20</sup>.

Cirrhosis is the 14th most common cause of death in the world. It results in 1.03 million deaths per year around the world<sup>21</sup>. A research study conducted in 1999-2005, the prevalence of liver diseases was 25.28% in Asia. With time the prevalence increased and according to another research study conducted in 2006-2011, the prevalence of liver diseases increased to 28.46%. A recent study conducted in 2017 in Asia the percentage increases up to 33.90%<sup>22</sup>. In Pakistan and specifically in Peshawar, no previous review addressing the diagnostic accuracy of ultrasound in liver diseases was done and the prevalence of liver diseases was high so there was a strong clinical need for noninvasive detection of chronic liver diseases.

**MATERIALS AND METHODS**

**Study Duration:** This cross-sectional study was conducted in 2022,

**Study Design:** it involves convenient sampling technique, consisted of 169 patients who have visited radiology department of Shangla hospital swat for liver Sonographic scans. The study was conducted in the Radiology Department of DHQ, Alpuri Shangla Hospital, Swat, Pakistan.

**Inclusion Criteria:** All patients that come for liver scans in the radiology department of Swat hospital of both genders i.e. male and female are included in this study. Patients are divided into four groups with interval of twenty, that is 5-25years, 25-45 years, 45-65 years and 65-85 years are taken

**Exclusion Criteria:** All patients with liver diseases having HIV, malignant liver cancer, pregnant females, portal vein thrombosis, patients undergone spleen surgery are all excluded.

**Reliability and Validity:** The participants were scanned by using TOSHIBA ultrasound machine for abdominal ultrasound scan with a curve linear probe frequency of 5MHz. Proper written consent was taken from the patient and the information was gathered through questionnaire. The study was approved by the scientific and ethics committees of the hospital and also approval letter was taken from Khyber Medical University as well.

**Sample Size:** We have derived a sample size of 171 patients from World Health Organization calculator, by putting the following variables in the formula: out of 171, 2 patients did not give response, so we included 169 patients.

- The confidence level taken is 95%.
- The level of significance taken is 5%
- Prevalence is 20%

**Sample Size Calculation:** Sample size is calculated using the following formula and by putting the above mentioned variables in the formula at World Health Organization website.

$$\begin{aligned} \text{Sample size } n &= P(1-P) / (Z/E)^2 \\ n &= 0.20(1-0.20) / (1.96/0.006)^2 \\ n &= 0.16(1067.11) \\ n &= 171 \end{aligned}$$

**Data Collection Procedure:** Data was collected through a standard and validated questionnaire which included three portions. First portion of questionnaire will contain written informed consent. Second portion of questionnaire will contain demographic profile of the patient. Third portion of questionnaire will contain all the sonographic findings.

**Data Analysis Procedure:** Data will be analyzed through SPSS version 22. Correlation, spearman and Pearson tests were applied.

Table 2: Normal and abnormal portal vein in different age groups

	Age of the participant (Years)	Total				
		5 to 25	26 to 45	46 to 65	66 to 85	
Portal Vein Diameter (mm)	7 to 15 ( normal)	8	25	17	3	53
	> 15 ( abnormal)	19	63	28	6	116
Total		27	88	45	9	169

To find out the correlation between portal vein dilatation and gender we observed 102 male patients and 67 female patients. The male patients showed high frequency of PVD. Among 102 male the 25 participants were having the normal PVD and 77 were having dilated PVD. Among the female population out of 67 only 28 patients were having normal PVD while 39 were having dilated PVD. Through cross tabulation when we correlated the portal vein dilatation with gender it showed that male population has greater frequency of portal vein dilatation than female. (Spearman correlation value = -0.18), (value of Sig = 0.018) as the spearman correlation value is in negative and below -0.3 it is concluded that there is a very weak negative correlation between portal vein dilatation and age and the results are significant which means that gender is not an associative factor for portal vein dilatation (Table 3).

Table 3: Normal and abnormal portal vein diameter in male females

	Gender of the participant	Total		
		Male	Female	
Portal Vein Diameter (mm)	7 to 15 ( normal)	25	28	53
	> 15 ( abnormal)	77	39	116
Total		102	67	169

Those patients who were having a cirrhotic liver were also having ascites. While observing these patients, 59 out of 169 were having a fatty liver showed a percentage of 34.9% out of 100 and only 33 of them were having ascites with cirrhotic liver showed a

## RESULTS

In this study, we took a total of 169 patients, among them 102 were males and 67 were females. Patients included in our study were from 5 to 85 years. 27 (16%) patients were from age 5 to 25 years.

Table 1: Descriptive data of patients age, gender, ascites level, smokers, and splenomegaly patients

Portal vein measurements						
	Normal		Dilated		Total	
Age 5-87	53		116		169	
Gender	M	F	M	F	M	F
	25	28	77	39	102	67
Patients with ascites	10		23		33	
Smoker patients	11		38		49	
Patients with splenomegaly	18		60		78	

88(52.1%) patients were from 26 to 45 years. 45(26.6%) patients were from age 46 to 65 years. 9(5.3%) patients were from age 66 to 85 years. The normal range of PVD in female and male was (7 to 15mm), while the PVD greater than 15mm was considered dilated. Patients between 5 to 25 years having a frequency of 27, among them 8 patients were having normal PVD while 19 patients were having dilated PVD. Patients between 26 to 45 years shows frequency of 88 patients among them only 25 were having normal PVD while 63 patients were having dilated PVD. Another group of age between 46 to 65 years were having frequency of 45, among them 17 participants were having the normal PVD and 28 of them were having dilated PVD. The last group between 66 to 85 years having total participants 9 and among them 3 participants were having normal PVD, while 6 of them were having dilated PVD. Through cross tabulation we correlated the portal vein diameter with age. The results are. (Pearson correlation value = -0.067), (Value of Sig = 0.428). As the Pearson correlation value is in negative and below -0.3 shows a very weak correlation and insignificant which means that age is an associative factor for portal vein dilatation in CLD patients (Table 2).

percentage of 19.5% out of 100. We found out the correlation between PVD and ascites and it showed that out of 33 patients who were having ascites 10 participants were having a normal PVD and 23 patients were having a dilated PVD. We also included those patients which were having a fatty liver because in our study sample 59 patients were having a fatty liver, in these patients out of 59, those who were having a normal PVD were 16 while the rest of 43 participants were having dilated PVD. Through crosstabs we correlated the portal vein dilatation with ascites. (Pearson correlation value = -0.059), (Sig value = 0.49). As the Pearson Correlation value is in negative and below 0.3, indicating very weak correlation and is insignificant. From the results it is concluded that portal vein dilatation in CLD patients will progress to ascites (Table 4).

Table 4: Portal vein dilatation in ascitic patients

	Other Finding	Total			
		Ascites Volume	Fatty Liver	No	
Portal Vein Diameter (mm)	7 to 15 (normal)	10	16	27	53
	> 15 (abnormal)	23	43	50	116
Total		33	59	77	169

We studied 169 patients including male and female. Out of 169 the 49 participants having a percentage of 29.0% were

smokers and 120 having a percentage of 71.0% were nonsmokers. All the participants were scanned for the PVD. Out of 169 participants the 53 participants were having a normal PVD, While 116 participants were having a dilated PVD. Out of these 53 patients who fell into the normal range, 11 participants were smokers while the rest of 42 were nonsmokers. Among 116 participants, which were having a dilated PVD, 38 participants were smokers and 48 were nonsmokers. We correlated the portal vein diameter through crosstabs and it was concluded that (Spearman correlation value = -0.12) (Significant value = 0.1). As the spearman correlation value is below minus 0.3, which shows a negative and weak correlation and it is totally insignificant which means that smoking affects portal vein diameter in chronic liver disease patients but the correlation is negative (Table 5).

Table 5: Portal vein dilatation in smokers and non-smokers

Portal Vein Diameter (mm) * Smoking		Smoking		Total
		Yes	No	
Counts	7 to 15 ( normal)	11	42	53
	> 15 ( abnormal)	38	78	116
Total		49	120	169

In our research we selected 169 participants including male and female. We measured the spleen size of all the participants and found their frequencies and percentages through descriptive statistics. Out of 169 the 78 participants were having an enlarged spleen showing a percentage of 46.2%. The spleen size of these participants were greater than 12cm so we considered them as Enlarged. Out of 169 the 91 participants were having a normal spleen measuring in the range of 12cm. They were showing a percentage of 53.8%. Then we correlated their PVD with their spleen sizes. And through cross tabulation it was concluded that out of 78 participants who were having an enlarged spleen size, the 18 participants were having normal PVD while 60 participants were having dilated PVD. (Pearson correlation value = -0.16), (significant value = 0.03). From the Pearson correlation value, it was concluded that there is a weak correlation between portal vein dilatation and spleen size and the value is significant which means that portal vein dilatation does not affect spleen size (Table 6).

Table 6: Portal vein dilation in patients with splenomegaly.

Counts		Spleen Size		Total
		Enlarged	Normal	
Portal Vein Diameter (mm)	7 to 15 ( normal)	18	35	53
	> 15 ( abnormal)	60	56	116
Total		78	91	169

**DISCUSSION**

In our research study we find out the correlation between PVD and gender. We observed 102 male patients and 67 females. Among 102 males, the 25 participants were having the normal PVD and 77 were having dilated PVD. Among the female population out of 67 only 28 patients were having normal PVD while 39 were having dilated PVD. According to our study, Spearman correlation value is -0.18 as the spearman value is in negative and below -0.3 it is concluded that there is a very weak negative correlation between PVD and age and the results are significant which means that gender is not an associative factor for PVD.

A research study conducted in northeastern Nigeria, included a total of 200 subjects comprising 100 with CLD and other 100 were included in matched control group, in which 106 (53%) males and 94(47%) females, aged between 18 and 73 years. according to this study, Portal vein diameter was more in males than in females<sup>3</sup>.

Patients included in our study were from 5to 85 years. 27(16%) patients were from age 5 to 25years. 88(52.1%) patients were from 26 to 45 years. 45(26.6%) patients were from age 46 to 65 years. 9(5.3%) patients were from age 66 to 85 years. Pearson correlation value is -0.067. As Pearson value is negative and

below -0.3 shows a very weak correlation and insignificant which means that age is an associative factor for PVD in CLD patients.

A research study conducted in Tikur Anbessa Specialized Hospital, states that normal portal vein diameter is 7.9 + 2mm. The patients were scanned in supine and the transducer was held in the oblique position in the right upper quadrant of the abdomen. In this study a total of 502 patients were included and among them 312 (62.2%) were females and 190 (37.8%) were males. Patients' were between 5 to 85years of age. Their study showed that portal vein diameter increases with increasing the age of the patients<sup>23</sup>.

In our study there were total 169 patients out of which 33 patients were having ascites. Out of 33 patients, 10 patients were having normal PVD and 23 patients were having PVD. Pearson correlation value is -0.059. As the Pearson value is negative and below 0.3, indicating very weak correlation and is insignificant. From the results it is concluded that PVD in CLD patients will progress to ascites.

In a research study conducted in the United States, between 1999-2016 showed that those who aged between 25-34 years and 35-44 years experienced sharp increases in ascites related mortality, in 2009; the average change for these groups was 13.5% and 7.4%. People aged between 75- 84 years experienced a later increase in mortality due to ascites during 2013-16 and people aged 85 years or more showed a linear increase during 1999-2016 , in all these groups as ascites increases with time over the years so portal vein also dilates, cirrhosis becomes severe and chances of death increases<sup>24</sup>.

Out of 169 the 49 participants were smokers and 120 were nonsmokers. Out of 169 participants the 53 participants were having a normal PVD, While 116 participants were having a dilated PVD. Out of these 53 patients, 11 participants were smokers while the rest of 42 were nonsmokers. Among 116 participants, which were having a dilated PVD, 38 participants were smokers and 48 were nonsmokers. Spearman correlation value is -0.12

As the spearman value is below minus 0.3, which shows a negative and weak correlation and it is totally insignificant which means that smoking affects PVD in CLD patients but the correlation is negative.

Smoking and alcohol consumption are the risk factors for cirrhosis but in countries like US, Spain, France, Italy etc. where alcohol consumption is high, higher are the cirrhosis death rates and in countries like Iceland, New Zealand, Norway etc. where alcohol consumption is low, the cirrhosis death rates are also low.

In a research study conducted in the United States, between 1999-2016 showed that due to alcohol consumption cirrhosis increases and average annual percentage change for deaths was increased in many states including Louisiana (13.1%, 7.7% to 18.9%), Kentucky (12.8%, 9.8% to 15.8%), New Mexico (9.3%, 6.3% to 12.4%), California (12.9%, 6.7% to 19.5%) and Delaware (9.8%, 5.1% to 14.7%)<sup>24</sup>.

Out of 169 the 78 participants were having an enlarged spleen showing a percentage of 46.2%. The spleen size of these participants were greater than 12cm so we considered them as Enlarged. Out of 169 the 91 participants were having a normal spleen measuring in the range of 12cm. Then we correlated their PVD with their spleen sizes. And through cross tabulation it was concluded that out of 78 participants who were having an enlarged spleen size, the 18 participants were having normal PVD while 60 participants were having dilated PVD. Pearson correlation value is -0.16.From this value, it was concluded that there is a weak correlation between PVD and spleen size and the value is significant which means that PVD does not affect spleen size.

A research study, The Correlation between PVD and craniocaudally length of the spleen size conducted in Lahore has a total of 1000 patients among them 369 were females and 631 were males ranging from 4 to 79 years. The normal spleen length they included in their study was 10.29 ± 1.89 cm and the normal PVD they included was 10.27 ± 1.78 mm, values above and below this range was considered abnormal. Ultrasound machine with a 3.5MHz probe was used to measure the craniocaudally length of

spleen and portal vein in all thousand patients. They took confidence level of 95% and according to their study, there is a strong correlation between the splenic length and portal vein diameter<sup>25</sup>.

## CONCLUSION

In our study there were total 169, 102 males and 67 females, the patients were divided in four groups age wise having an interval of twenty between them. We found the correlation of PVD with gender, age and Ascites, smoking and spleen size. So it is concluded in our research study that PVD increases with age and is more common in middle aged people, gender and spleen size does not show any relation with PVD. Ascites increases with PVD and smoking is also an associative factor for PVD in CLD patients.

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## REFERENCES

- Saha N, Sarkar R, Singh MM. Portal vein diameter in a tertiary care centre in North-East India. IOSR J Dent Med Sci Ver I [Internet]. 2015;14(12):2279–861. Available from: [www.iosrjournals.org](http://www.iosrjournals.org)
- Geleto G, Getnet W, Tewelde T. Mean Normal Portal Vein Diameter Using Sonography among Clients Coming to Radiology Department of Jimma University Hospital, Southwest Ethiopia. *Ethiop J Health Sci.* 2016;26(3):237–42.
- Luntsi G, Muhammad MA, Shirama YB, Lawal Mohammed M, Suleiman A, Ochie K. Sonographic evaluation of the portal vein diameter in patients with chronic liver disease in northeastern Nigeria. *Ultrasound.* 2021;29(1):36–43.
- Goñi-Esarte S, Juanbeltz R, Martínez-Baz I, Castilla J, Miguel RS, Herrero JI, et al. Long-term changes on health-related quality of life in patients with chronic hepatitis C after viral clearance with direct-acting antiviral agents. *Rev Esp Enfermedades Dig.* 2019;111(6):445–52.
- Cogollo M, Bosch J, Tsochatzis EA, Bosch J, Burroughs AK. *Seminar Liver cirrhosis Liver cirrhosis.* 2012;
- Galligan JJ, Smathers RL, Shearn CT, Fritz KS, Backos DS, Jiang H, et al. Oxidative stress and the ER stress response in a murine model for early-stage alcoholic liver disease. *J Toxicol.* 2012;2012.
- Sudha Rani K, Sudarsi B, Siddeswari R, Manohar S. Correlation of Portal Vein Size with Esophageal Varices Severity in Patients with Cirrhosis of Liver with Portal Hypertension. *Int J Sci Res Publ* [Internet]. 2015;5(1):1–5. Available from: [www.ijsrp.org](http://www.ijsrp.org)
- Ayele T, Gebremickael A, Gebremichael MA, George M, Wondmagegn H, Esubalew H, et al. Ultrasonographic Determination of Portal Vein Diameter Among Adults with and without Chronic Liver Disease at Selected Referral Hospitals in Southern Ethiopia. *Int J Gen Med.* 2022;15(November 2021):45–52.
- Garcia-compean D, Jaquez-quintana JO, Gonzalez-gonzalez JA, Maldonado-garza H, Garcia-compean D, Jaquez-quintana JO, et al. Liver cirrhosis and diabetes: Risk factors, pathophysiology, clinical implications and management. 2009;15:280–8.
- Sarin SK, Kumar M, Eslam M, George J, Al Mahtab M, Akbar SMF, et al. Liver diseases in the Asia-Pacific region: a Lancet Gastroenterology & Hepatology Commission. *Lancet Gastroenterol Hepatol* [Internet]. Elsevier Ltd; 2020;5(2):167–228. Available from: [http://dx.doi.org/10.1016/S2468-1253\(19\)30342-5](http://dx.doi.org/10.1016/S2468-1253(19)30342-5)
- Ullah A, Rahman M ur, Iqbal MJ, Ahn CW, Kim IW, Ullah A. Frequency-dependent impedance spectroscopy on the 0.925(Bi0.5Na0.40K0.10)TiO3-0.075(Ba0.70Sr0.30)TiO3 ceramic. *J Korean Phys Soc.* 2016;68(12):1455–60.
- Shannon A, Alkhouri N, Carter-Kent C, Monti L, Devito R, Lopez R, et al. Ultrasonographic quantitative estimation of hepatic steatosis in children With NAFLD. *J Pediatr Gastroenterol Nutr.* 2011;53(2):190–5.
- Hernaes R, Lazo M, Bonekamp S, Kamel I, Brancati FL, Guallar E, et al. Diagnostic accuracy and reliability of ultrasonography for the detection of fatty liver: A meta-analysis. *Hepatology.* 2011;54(3):1082–90.
- Riestra-Candelaria BL, Rodríguez-Mojica W, Vázquez-Quiñones LE, Jorge JC. Ultrasound accuracy of liver length measurement with cadaveric specimens. *J Diagnostic Med Sonogr.* 2016;32(1):12–9.
- Soyupak SK, Narl N, Yapcolu H, Satar M, Aksungur EH. Sonographic measurements of the liver, spleen and kidney dimensions in the healthy term and preterm newborns. Vol. 43, *European Journal of Radiology.* 2002. p. 73–8.
- Ballestri S, Romagnoli D, Nascimbeni F, Francica G, Lonardo A. Role of ultrasound in the diagnosis and treatment of nonalcoholic fatty liver disease and its complications. *Expert Rev Gastroenterol Hepatol* [Internet]. Taylor & Francis; 2015 May 4;9(5):603–27. Available from: <https://doi.org/10.1586/17474124.2015.1007955>
- Stickel F, Datz C, Hampe J, Bataller R. *Pathophysiology and Management of Alcoholic Liver Disease: Update 2016.* 2017;11(2):173–88.
- Wasim M, Biland B, Idrees M, Zeb M, Waqar M, Khan M, et al. Assessment of risk factors and clinical presentations in a liver cirrhotic state-Pakistan. *World Appl Sci J.* 2014;32(7):1252–7.
- Ahn CW, Kim HS, Woo WS, Won SS, Seog HJ, Chae SA, et al. Low-temperature sintering of Bi0.5(Na,K)0.5TiO3 for multilayer ceramic actuators. *J Am Ceram Soc.* 2015;98(6):1877–83.
- Kistler KD, Molleston J, Unalp A, Abrams SH, Behling C, Schwimmer JB. Symptoms and quality of life in obese children and adolescents with non-alcoholic fatty liver disease. *Aliment Pharmacol Ther.* 2010;31(3):396–406.
- States U, Amendment E. EPIDEMIOLOGY OF CIRRHOSIS OF THE LIVER: 1964;57(12).
- Mann RE, Ph D, Smart RG, Ph D, Govoni R, Ph D. *The Epidemiology of Alcoholic Liver Disease.*
- Ntirenganya F, Ntakiyiruta G, Kakande I. - 9990 East Cent . Afr . J . surg . ( Online ). *East Cent Afr J surg.* 2012;17(August):52–64.
- Tapper EB, Parikh ND. Mortality due to cirrhosis and liver cancer in the United States, 1999-2016: observational study. 2016;
- Zaman S, Gilani SA, Bacha R, Manzoor I, Hasan ZU. Correlation between portal vein diameter and craniocaudal length of the spleen. *J Ultrason.* 2019;19(79).