



# Journal of Health and Medical Sciences

**Din, I. U., & Tao, S. (2023), Ultrasound Shear Wave Elastography in the Evaluation of Liver Fibrosis. *Journal of Health and Medical Sciences*, 6(3), 93-100.**

ISSN 2622-7258

DOI: 10.31014/aior.1994.06.03.281

The online version of this article can be found at:

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The Asian Institute of Research

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# Ultrasound Shear Wave Elastography in the Evaluation of Liver Fibrosis

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## Abstract

**Background:** Chronic hepatitis B virus (HBV) infection affects about 296 million people worldwide and is the leading etiology of cirrhosis and liver cancer globally. In China, chronic hepatitis B has grown to be a significant public health issue. NAFLD (non-alcoholic fatty liver disease) is one of the primary causes of cirrhosis in the globe. Up to 10.3% of NAFLD patients, according to the National Health and Nutrition Examination Survey, had advanced fibrosis. These findings suggest that the real-time Shear wave elastography (SWE) can be used for the assessment of significant fibrosis, sever fibrosis and Cirrhosis. **Objective:** To determine the ultrasound shear wave elastography in the evaluation of liver fibrosis. **Methods:** A cross-sectional study was conducted at First affiliated hospital of Xinjiang Medical university, which was performed between January 2020 and March 2023. The total patients in our study was 118. In 118 consecutive patients who underwent Ultrasound Shear wave elastography (SWE) before their scheduled liver biopsy (59 men, 59 women). We used Michael Mindray ultrasound machine and its frequency was C6-1. The stages of liver fibrosis according to the METAVIR classification system. **Results:** F2 stage of fibrosis is more as compare as compare to others. Liver fibrosis is more common in females as comapre to males. According to the age males have higher risk as compare to females. Total patients in our study was 118. Mean age for males patienst were 44.8983 and for females 48.9492. MEAN±SD of Alanine aminotransferase (ALT) was 92.6±116.14 u/L. The frequency of patients with F0 was 33 (28.0 %), F1 was 5 (4.2%), F2 was 58 (49.2%), F3 was 9 (7.6%) F4 was 13 (11.0%). Frequency of no fatty liver was 49, mild fatty liver was 39, moderate fatty liver was 8, sever fatty liver was 22. Hepatitis B was present in 96 patients and was not present in 22 patients out of 118. Hepatitis C was present in 116 patients and was not present in 2 patients out of 118 (1.7). P-value of hepatitis B is 0.34. P-value of hepatitis C is 1.0. P-value of stages of Liver fibrosis with respect to gender is 0.005. **Conclusion:** Our result concluded that fibrosis stage F2 patients are more in our study (Heaptitis B). Liver fibrosis is more common in females as comapre to males. According to the age males have higher risk as compare to females. Shear wave elastography (SWE) is a straightforward, quick, and repeatable technique for noninvasively assessing liver fibrosis. Benefits include its low cost and global availability.

**Keywords:** Ultrasound Shear Wave Elastography (SWE), Liver Fibrosis, Chronic Hepatitis B Virus (HBV) and Hepatitis C

## 1. Introduction

Chronic hepatitis B virus (HBV) infection affects about 296 million people worldwide and is the principal etiology of cirrhosis and liver cancer globally (Hsu et al., 2023). In China, chronic hepatitis B has emerged as a major public health issue (Zheng et al., 2020). Liver biopsy is now the gold standard for determining if someone has cirrhosis or liver fibrosis (Karkmann et al., 2018). Between 20 and 30 percent of persons in Western countries have nonalcoholic fatty liver disease (NAFLD) (Vernon et al., 2011). The reference standard for grading steatosis and inflammation, two characteristics unique to steatohepatitis, and staging fibrosis, a measure of the severity of liver disease, is often liver biopsy (Kleiner et al., 2005; Sanyal et al., 2005). However, liver biopsy is an intrusive procedure that comes with risk of bleeding, discomfort, and inaccurate sample (Fernandez et al., 2011; Myers et al., 2008). As a result, a noninvasive method is required for the evaluation of hepatic steatohepatitis. Cirrhosis, cancer, and liver failure can develop from hepatic fibrosis. Depending on the degree of liver fibrosis, many clinical therapy modalities exist (Barr et al., 2020). The creation of elasticity-based ultrasonography (US) methods, which assess the speed of elastic shear waves to offer a quantitative assessment of liver stiffness represents a significant advancement in the noninvasive examination of liver fibrosis (Bamber et al., 2013; Grgurevic et al., 2015). In particular for cirrhosis, it has demonstrated high accuracy in fibrosis detection (Friedrich et al., 2008; Bohte et al., 2014). Elastography can only measure stiffness, despite the fact that liver stiffness is often closely linked with the degree of fibrosis (Goodman 2007). Cirrhotic nodules are one example of a fibrotic formation that can grow to be bigger than the US wavelength (Toyoda et al., 2009). One of the main causes of cirrhosis globally is non-alcoholic fatty liver disease (NAFLD) (Gbd, 2017). NAFLD is one of the leading and fastest-growing causes of chronic liver disease worldwide followed by obesity and insulin resistance (Younossi et al., 2016; Younossi et al., 2018). Up to 10.3% of NAFLD patients had advanced fibrosis, according to the National Health and Nutrition Examination Survey (Le et al., 2017). These results imply that real-time SWE can be utilized to evaluate cirrhosis, severe fibrosis, and substantial fibrosis (Jing et al., 2017).

## 2. Materials and Methods

A cross-sectional study was conducted at First affiliated hospital of Xinjiang Medical University, which was performed between January 2020 and March 2023, The total patients in our study was 118. In 118 consecutive patients who underwent Ultrasound Shear wave elastography (SWE) before their scheduled liver biopsy (59 men, 59 women). We used Michael Mindray ultrasound machine and its frequency was C6-1. The stages of liver fibrosis according to the METAVIR classification system. Informed consent was obtained from all patients. Shear wave elastography (SWE) measurements were obtained at four sites in the liver. Biopsy specimens were reviewed in a blinded manner by a pathologist using METAVIR criteria. SWE measurements and biopsy results were compared by using the Spearman correlation and receiver operating characteristic (ROC) curve analysis. Data was tabulated and analyzed by SPSS.

### 2.1. Clinical and laboratory examination

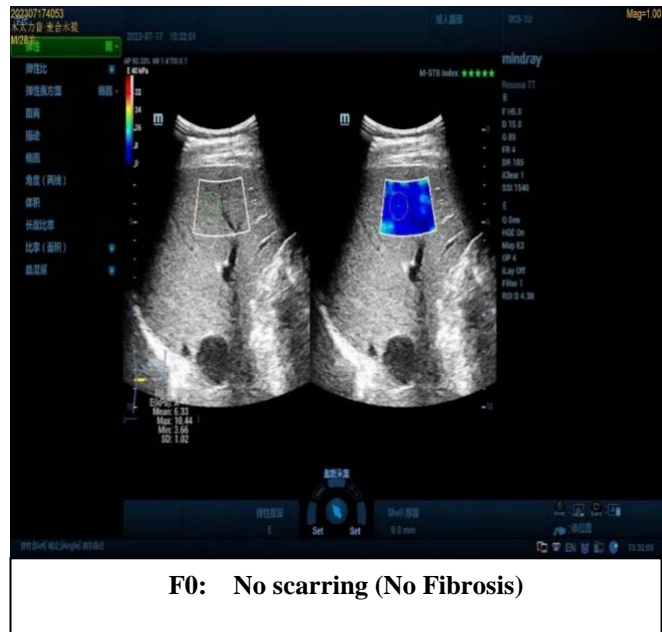
Weight, sex, and age were noted. After the patients had fasted for eight hours, venous blood samples were taken in order to evaluate the enzymes alanine aminotransferase (ALT), aspartate aminotransferase (AST), glutamyl-transpeptidase (GGT), and alkaline phosphatase (ALP). Body mass index (BMI).

## 3. Results

According to our study total patients were 118, Distribution of patients according to gender was (59 were males and 59 were females). Distribution of patients according to mean age (out of 118 patients, 44.8983 were males and 48.9492 were females). Distribution of patients according to mean age of standard deviation (16.16 were males and 12.92 were females). Graphical Representation of gender represent that both gender are same in number 59 were males and 59 were females.

Table 1: Distribution of patients according to gender and mean age (n=118)

Variable	Frequency	Percentage
<b>Gender:</b>		
Male	59	100.0
Female	59	100.0
Total	118	100%
	<b>Mean</b>	<b>SD</b>
<b>Age</b>		
	44.8983	16.16
Male	48.9492	12.92
Female	46.92	14.71
<b>Total Age</b>		

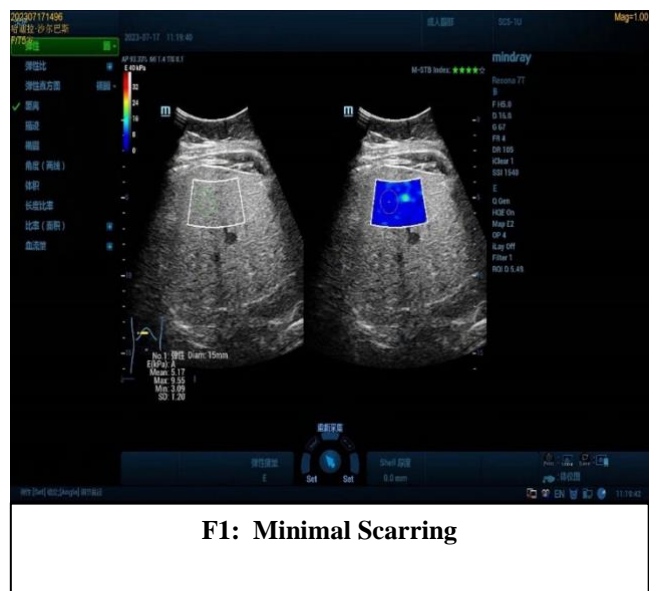


Mean and Standard Deviation (SD) of liver Function

MEAN±SD of Alanine aminotransferase (ALT) was 92.6±116.14 u/L, MEAN±SD of Aspartate aminotransferase (AST) was 74.23±81.75 u/L, MEAN±SD of Alkaline phosphatase (ALP) was 302.46±999.9 u/L, MEAN±SD of Total Bilirubin (TBIL) was 55.03±204.98 umol/L, MEAN±SD of bilirubin test (DBIL) was 7.28±21.3 umol/L, MEAN±SD of Gamma-glutamyl transferase (GGT) was 172.80±711.1 u/L, MEAN±SD of Creatine kinase (CNE) was 4938.51±2287.2 u/L, MEAN±SD of Blood nitrogen urea (BUN) was 43.59±31.5 mmol/L,

Table 2: Mean and SD of enrolled patients (n=118)

Variables	MEAN±SD
ALT	92.6±116.14
AST	74.23±81.75
ALP	302.46±999.9
TBIL	55.03±204.98
DBIL	7.28±21.3
GGT	172.80±711.1
CNE	4938.51±2287.2
BUN	43.59±31.5



The stages of Liver fibrosis according to the METAVIR classification system (n=118),

The frequency of patients with F0 was 33 (28.0 %), The frequency of patients with F1 was 5 (4.2%)

The frequency of patients with F2 was 58 (49.2%), The frequency of patients with F3 was 9 (7.6%)

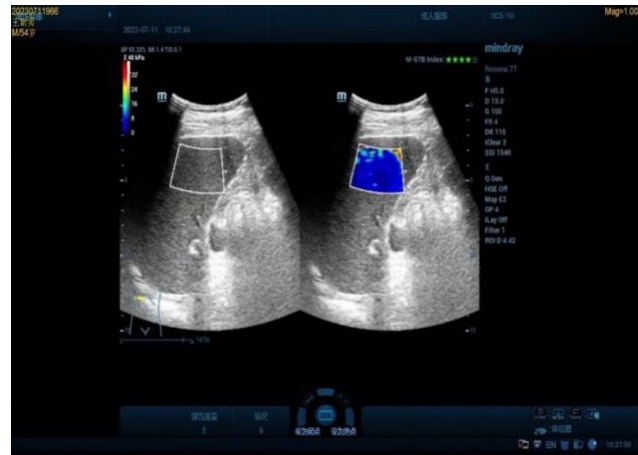
The frequency of patients with F4 was 13 (11.0%)

In the above pie graph F2: 49%, F0: 28%, F4: 11%, F3: 8% and F1: 4%.

Distribution of patients on the basis of Fatty Liver (n=118). Frequency of no fatty liver was 49 and its percentage was 41.5%. Frequency of mild fatty liver was 39 and its percentage was 33.1%. Frequency of moderate fatty liver was 8 and its percentage was 6.8%. Frequency of severe fatty liver was 22 and its percentage was 18.6%.

Table 3: Distribution of patients on the basis of Fatty Liver (n=118)

Fatty liver	Frequency	Percentage
No	49	41.5
Mild	39	33.1
Moderate	8	6.8
Severe	22	18.6
Total	118	100.0



**F2: Scarring has occurred and extended outside the liver area (Significant Fibrosis)**

Table 3: The mean BMI of enrolled patients (n=118)

BMI
<b>24.10±4.28</b>

Distribution of patients on the basis of hepatitis B and hepatitis C (n=118)

Hepatitis B was present in 96 patients out of 118 (81.4%), Hepatitis B was not present in 22 patients out of 118 (18.6%). Hepatitis C was present in 116 patients out of 118 (98.3%), Hepatitis C was not present in 2 patients out of 118 (1.7%).

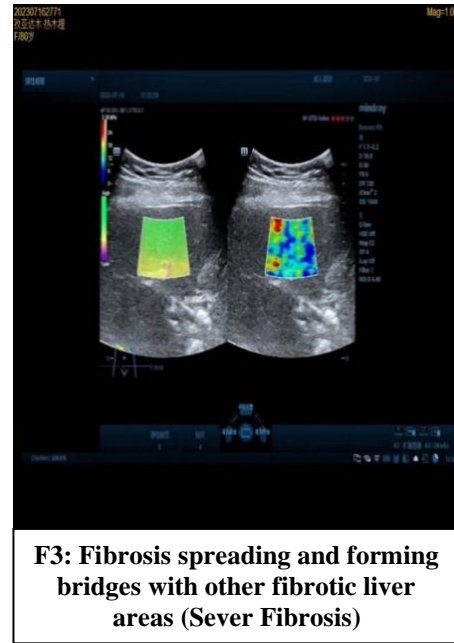
Distribution of patients on the basis of Hepatitis B and Hepatitis C with respect to gender (n=118). Hepatitis B was present in male patients 58 (98.3%) and Hepatitis B was not present in male patients 1 (1.7%). Hepatitis B was present in female patients 58 (98.3%) and Hepatitis B was not present in female patients 1 (1.7%). P-value of hepatitis B is 0.34.

Hepatitis C was present in male patients 46 (78.0%) and Hepatitis C was not present in male patients 13 (22.0%). Hepatitis C was present in female patients 50 (84.7%) and Hepatitis C was not present in female patients 9 (15.3%).

P-value of hepatitis C is 1.0

Table 4: Distribution of patients on the basis of Hep B and Hep C with respect to gender (n=118)

Hepatitis B			
Gender	Frequency	Percentage	P-Value
<b>MALE</b>			
YES	58	98.3	0.34 Not significant
NO	1	1.7	
<b>FEMALE</b>			
YES	58	98.3	0.34 Not significant
NO	1	1.7	
Hepatitis C			
<b>Male</b>			
YES	46	78.0	1.0 Not significant
NO	13	22.0	
<b>Female</b>			
YES	50	84.7	1.0 Not significant
NO	9	15.3	



Distribution of patients on the basis of Stages of Liver fibrosis with respect to gender (n=118). Frequency of F0 in male Patients was 25 (42.4%), Frequency of F1 in male Patients was 1 (1.7%), Frequency of F2 in male Patients was 26 (44.1%), Frequency of F3 in male Patients was 2 (3.4%), Frequency of F4 in male Patients was 5 (8.5%). Frequency of F0 in female Patients was 8 (13.6%), Frequency of F1 in female Patients was 4 (6.8%), Frequency of F2 in female Patients was 32 (54.2%), Frequency of F3 in female Patients was 7 (11.9%), Frequency of F4 in female Patients was 8 (13.6%).

Table 5: Distribution of patients on the basis of Stages of fibrosis with respect to gender (n=118)

Stages of fibrosis			
Gender	Frequency	Percentage	P-Value
<b>MALE</b>			
F0	25	42.4	0.005 significant
F1	1	1.7	
F2	26	44.1	
F3	2	3.4	
F4	5	8.5	
<b>FEMALE</b>			
F0	8	13.6	0.005 significant
F1	4	6.8	
F2	32	54.2	
F3	7	11.9	
F4	8	13.6	



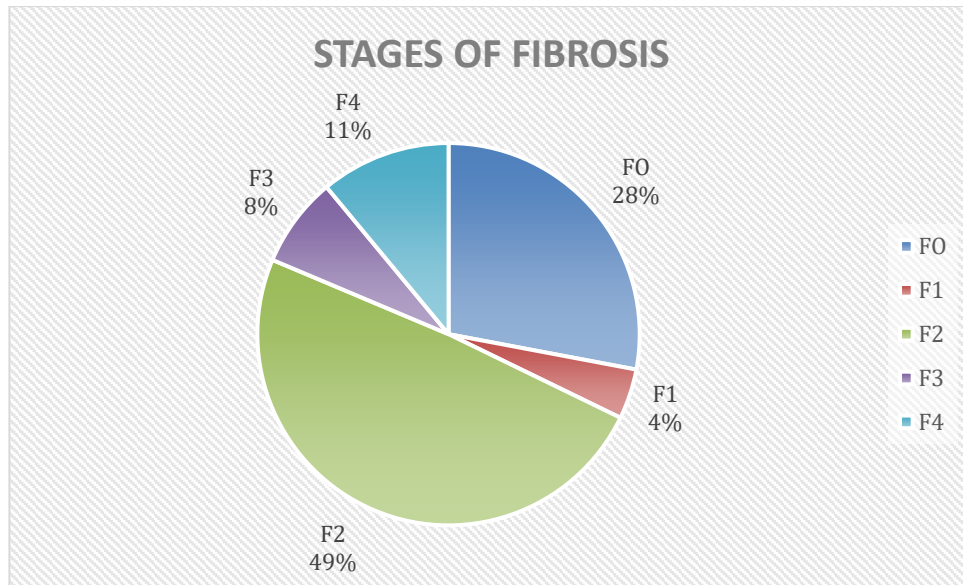


Figure 6: Pie Graph Representation of Stages of Fibrosis

P-value of stages of Liver fibrosis with respect to gender is 0.005.

#### 4. Discussion

In this study, the diagnostic precision of real-time Shear wave elastography (SWE) in estimating liver fibrosis was compared against histology. These findings suggest that real-time SWE can be used for the assessment of significant fibrosis, severe fibrosis, and cirrhosis (Jing et al., 2017). Currently, the pathological evaluation of hepatic wound tissue is still required for the diagnosis of liver fibrosis. The approach is intrusive, hence its widespread usage in clinical practice is currently restricted. The development of a non-invasive diagnostic indicator for liver fibrosis has received a lot of attention (Lu et al., 2003). In this prospective cross-sectional study, we evaluated the ideal region from which to obtain measurements and estimated the diagnostic accuracy of SWE for liver fibrosis estimation in patients with chronic liver disease CLD and hepatitis C virus HCV using liver biopsy as the standard of reference (Samir et al., 2015). In clinical practice, the precise and non-invasive categorization of liver fibrosis is of utmost importance. Recently, a deep learning system for employing ultrasound shear wave elastography to stage liver fibrosis was published, and it performed well (Yasaka et al., 2018). Histopathologically, hepatic fibrosis is a consequence of the excessive accumulation of extracellular matrix components in the liver. This process is caused by a wound healing response to persistent liver damage, inducing hepatic stellate cell activation, high alpha smooth muscle actin production, and collagen type I and III secretion, and can progress to cirrhosis (Crespo et al., 2016). Liver fibrosis results from excessive extracellular matrix accumulation due to injury and main to cirrhosis, cancer and death (Ullah et al., 2022). Imaging allows for the assembling of sufficient detailed information on the overall levels of probe accumulation in the tissue or organ of interest due to the much clearer images of the anatomical and spatial distribution of the probe (Tuguntaev et al., 2022).

#### 5. Conclusion

Our result concluded that F2 fibrotic patients are more in our study (Hepatitis B). Liver fibrosis is more common in females as compared to males. According to the age males have higher risk as compared to females. Shear wave elastography (SWE) is a straight forward, quick, and repeatable technique for noninvasively assessing liver fibrosis. Benefits include its low cost and global availability.

**Author Contributions:** All authors contributed to the research process.

**Funding:** Not applicable.

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

**Informed Consent Statement/Ethics approval:** Not applicable.

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