RESEARCH PAPER

Frequency of Predictors of Osteoporosis in Liver Cirrhosis of Viral Etiology

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ABSTRACT

Objective: To determine the frequency of osteoporosis in liver cirrhosis of viral etiology and then compare the predictors of osteoporosis in liver cirrhosis of viral etiology with and without osteoporosis.

Study design: Cross-Sectional Study.

Study place and period: Department of Medicine, Ghurki Trust Teaching Hospital, Lahore from 5 April 2026 to 5 July 2025.

Methodology: One hundred individuals with liver cirrhosis were recruited and underwent Dual energy x-ray absorptiometry (DEXA) scan and BMD level was recorded. Patient were labeled for osteoporosis. Then patients underwent screening for predictors of osteoporosis including being female, low BMI, higher MELD score, higher Child-Pugh class and postmenopausal status. Data was recorded in proforma and analyzed in SPSS v.25. Osteoporosis and predictors will be presented as frequency and percentage. Chi-square test will be applied to compare predictors in individuals with and without osteoporosis with p-value ≤0.05 as significant.

Results: In this study, the mean age of individuals was 46.36 ± 12.97 years. There were 36 (36%) men and 64 (64%) women. The mean BMD was noted as -1.69 ± 1.46. Osteoporosis was observed in 38 (38%) individuals. It was observed that osteoporosis was significantly associated with older age (26 (60.5%) vs. 12 (21.1%)), being females (30 (46.9%) vs. 8 (22.2%)), low BMI (29 (74.4%) vs. 9 (14.8%)), high Child-Pugh class (26 (55.3%) vs. 12 (22.6%)), and high MELD score (29 (74.4%) vs. 9 (14.8%)), P<0.05).

Conclusion: Thus the risk of osteoporosis in local population is high among individuals with liver cirrhosis. The association of osteoporosis was also significant with predictors.

Key words: osteoporosis, liver cirrhosis, viral etiology, predictors, Hepatitis B virus infection, Hepatitis C virus infection.

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INTRODUCTION

Any bone disease in individuals with long-term liver disease is called hepatic osteodystrophy.[1] The disease is classified as normal, osteopenia, osteoporosis, and severe osteoporosis using bone densitometry's T-score, which measures bone mineral density.[1,2] Osteoporosis prevalence in cirrhosis patients varies according to the underlying liver disease's etiology and diagnostic methodology.[2] According to earlier research, the frequency of osteoporosis ranged from 12-70% among cirrhotic individuals depending on the underlying liver disease, its etiology and diagnostic method.[3,4] Advanced age, reduced estrogen levels, alcoholism and tobacco abuse, malnourishment, long-term steroids usage, vitamin-D deficiency, and liver cirrhosis are risk factors for bone loss.[5]

Due to its accuracy and ability to measure several skeletal sites, dual energy x-ray absorptiometry is the most widely used technique for determining bone mass. The frequency of fractures in liver illness can be decreased by early identification and treatment.[6,7] Age, gender, and the severity of liver cirrhosis have all been proposed as risk factors to develop the osteoporosis in individuals. Although individuals with cirrhosis frequently have osteoporosis or osteopenia, it is still unknown if associated risk factors including advanced age, low BMI, and the degree of liver stiffness can cause these conditions.[8,9] It was reported in China that out of 79 patients, 29.1% patients were diagnosed to be osteoporotic. Female gender, low BMI and malnutrition are major factors of osteoporosis.[10]

Rationale of this study is to determine the frequency of predictors of osteoporosis in liver cirrhosis of viral etiology. Though literature, we observed that chances of osteoporosis is highly prevalent among cirrhotic patients, but limited studies had been done before and no study done before in Pakistan, as viral hepatitis is the most

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prevalent cause of cirrhosis in Pakistan. Therefore, there is a need to conduct a study to get evidence for local setting and implement screening of cirrhotic patients, especially due to viral cause on regular intervals for BMD level and also make them aware about adverse consequences of osteoporosis. This will help us to get updated evidence and in future, we will implement findings of this study in local setting.

METHODS

This cross-sectiona1 study was started after taking approval from ethical review board (Ref.No. 2026/05/R-37), at Department of Medicine, Ghurki Trust Teaching Hospital, Lahore from 5 April 2026 to 5 July 2025. Using WHO calculator, sample size was estimated as 100 cases using 95% confidence level, 9% margin of error with previously reported percentage of osteoporosis i.e. 29.1% by Uchida et al., in patients with cirrhosis due to viral cause.[10] Non-probability, consecutive sampling technique was used to recruit the individuals with liver cirrhosis.

Inclusion Criteria: Individuals aged 20-70 years, either gender, diagnosed with cirrhosis due to viral etiology were enrolled. Cirrhosis was is defined as presence of ALT and AST>40 IU, coarse liver on abdominal ultrasound, due to viral hepatitis B or C.

Exclusion criteria: Patients on steroids, malnutrition, smoking, alcoholism, chronic renal failure (creatinine >1.8 mg/dl or on dialysis), taking supplements for osteoporosis or oral hormonal treatment or with cirrhosis due to non-viral etiology were not included in the study.

All the individuals were included in the study from Medical OPD. Informed consent was taken before enrolment. Demographics like age, gender, BMI, occupation, duration of cirrhosis, lifestyle, and daily diet were noted. Then patients underwent DEXA scan and BMD level was recorded. Patient was labeled as osteoporosis present if T score <-2.5 and below the reference value. Then individual underwent screening for predictor of osteoporosis including older age (above 50 years), female gender, low BMI (BMI <18.5 kg/m^2), higher MELD score (MELD score >20), higher Child-Pugh class (class >A) and postmenopausal status (among females). Individuals with osteoporosis were managed as per standard protocol. All this information was recorded in proforma.

All the collected data was entered and analyzed into SPSS version 25. Numerical variables i.e. age, BMI, duration of cirrhosis, BMD level were presented by mean ± SD. Categorical variables i.e. gender, occupation, lifestyle, daily diet, osteoporosis and predictors were presented as frequency and percentage. Predictors were compared in individuals with or without osteoporosis by using chi-square test. Data was stratified for age, gender, BMI, duration of cirrhosis, occupation, lifestyle, daily diet. Post stratification, chi-square test was applied to compare stratified groups for osteoporosis and predictors, keeping p-value ≤0.05 as significant.

RESULTS

In this study, we enrolled total 100 individuals with mean age of 46.36 ± 12.97 years. There were 36 (36%) men and 64 (64%) women. The mean BMI was 21.51 ± 4.73 Kg/m^2. Out of 100 individuals, 28 (28%) were doing their own business or having entrepreneurship, 27 (27%) were doing jobs, 41 (41%) were housewives and 4 (4%) were retired men. Among all, 48 (48%) had active lifestyle, while 32 (32%) had sedentary lifestyle and 20 (20%) were doing exercise or started gym. There were more individuals taking home-made meals (57%), while about 18% were still taking fast-food or street food, 19 (19%) were following diet plan and only 6 (6%) had mess or hostel food. The mean duration of cirrhosis was 3.83 ± 1.92 years. The mean BMD was noted as -1.69 ± 1.46. Table-I

Table-I: Basic characteristics of individuals with liver cirrhosis (n = 100)

		Mean
Age (years)		46.36 ± 12.97
Gender	Male	36 (36%)
	Female	64 (64%)
BMI (Kg/m^2)		21.51 ± 4.73
Occupation	Business/ Entrepreneur	28 (28%)
	Job	27 (27%)
	Housewife	41 (41%)
	Retired	4 (4%)
Lifestyle	Active	48 (48%)
	Sedentary	32 (32%)
	Exercise/Gym	20 (20%)
Daily diet	Home-made	57 (57%)
	Fast-food/Street-food	18 (18%)
	Diet	19 (19%)
	Mess/Hostel	6 (6%)
Duration of cirrhosis (years)		3.83 ± 1.92
BMD		-1.69 ± 1.46

Out of 100 individuals of liver cirrhosis, osteoporosis was observed in 38 (38%) individuals. Figure-1

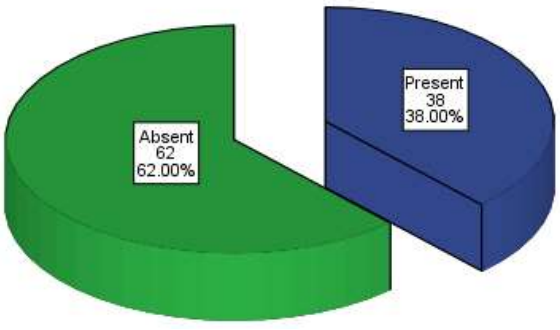

Figure-1: Osteoporosis detected on DEXA scan (n = 100)

It was observed that osteoporosis was significantly associated with older age (26 (60.5%) vs. 12 (21.1%), p-value <0.001). Osteoporosis was also significantly higher

in females (30 (46.9%) vs. 8 (22.2%), p-value = 0.015). Low BMI is also a significant predictor of osteoporosis and observed in 29 (74.4%) individuals with low BMI than 9 (14.8%) in individuals with normal BMI or overweight (p-value <0.001). Similarly, we also observed that osteoporosis was significantly associated with high Child-Pugh class 26 (55.3%) than low Child-Pugh class 12 (22.6%), p-value = 0.001. Also the high MELD score was also found to be the significant predictor of osteoporosis (29 (74.4%) vs. 9 (14.8%), p-value < 0.0001) than patients with low MELD score. Table-II

Table-II: Association of osteoporosis with predictors (n = 100)

		Osteoporosis		Significance
		Present n = 38	Absent n = 62	
Older age (above 50 years)	Yes	26 (60.5%)	17 (39.5%)	<0.001
	No (less than 50 years)	12 (21.1%)	45 (78.9%)	
Being female	Yes	30 (46.9%)	34 (53.1%)	0.015
	No (males)	8 (22.2%)	28 (77.8%)	
Low BMI (<18.5 kg/m^2)	Yes	29 (74.4%)	10 (25.6%)	<0.001
	No	9 (14.8%)	52 (85.2%)	
High Child-Pugh class	Yes	26 (55.3%)	21 (44.7%)	0.001
	No	12 (22.6%)	41 (77.4%)	
High MELD score	Yes	29 (74.4%)	10 (25.6%)	<0.001
	No	9 (14.8%)	52 (85.2%)	

It was observed that occupation, lifestyle and daily diet had no association with osteoporosis (p-value >0.05). Table-III

Table-III: Association of osteoporosis with occupation, lifestyle and daily diet

		Osteoporosis		Significance
		Present n = 38	Absent n = 62	
Occupation	Business / Entrepreneur	6 (21.4%)	22 (78.6%)	0.136
	Job	10 (37.0%)	17 (63.0%)	
	Housewife	20 (48.8%)	21 (51.2%)	
	Retired	2 (50.0%)	2 (50.0%)	
Lifestyle	Active	21 (43.8%)	27 (56.3%)	0.348
	Sedentary	12 (37.5%)	20 (62.5%)	
	Exercise/Gym	5 (25.0%)	15 (75.0%)	
Daily diet	Home-made	25 (43.9%)	32 (56.1%)	0.477
	Fast-food/Street-food	6 (33.3%)	12 (66.7%)	
	Diet	6 (31.6%)	13 (68.4%)	
	Mess/Hostel	1 (16.7%)	5 (83.3%)	

DISCUSSION

In this study, we observed that mean BMD on DEXA scan of all individuals was -1.69 ± 1.46. Osteoporosis was observed in 38 (38%) individuals. It was observed that osteoporosis was significantly associated with older age (26 (60.5%) vs. 12 (21.1%)), being females (30 (46.9%) vs. 8 (22.2%)), low BMI (29 (74.4%) vs. 9 (14.8%)), high Child-Pugh class (26 (55.3%) vs. 12 (22.6%)), and high MELD score (29 (74.4%) vs. 9 (14.8%)), P<0.05).

In a Chinese study, Uchida et al. found that 29.1% of the 79 patients had an osteoporotic diagnosis. Osteoporosis was more common in females (69% vs. 41%; P<0.05). Only corrected calcium was substantially greater in osteoporosis patients among the biochemical markers of bone metabolism. Malnutrition, low BMI, and being female are important risk factors for osteoporosis. Low BMI (r = 0.430; p-value = 0.001) and considerably older age (osteoporotic: 63 years vs. non-osteoporotic: 56 years; p-value = 0.009) were found to be significantly linked with osteoporosis.[10]

In a related study, Lonele et al., reported that 71% and 24.3% of the seventy participants had osteopenia and osteoporosis, respectively. MELD (r = 0.576, p-value <0.001) and the Child-Pugh score (r = 0.670, p-value <0.001) showed a significant positive connection with the Controlling Nutritional Status score. Of these, 49 had lumbar spine osteopenia and 15 had osteoporosis. In patients with liver cirrhosis, osteoporosis was correlated with age, obesity, grade of varices, Child-Pugh score, and MELD score (p<0.05).[11] The USA data reported that 12.6% of persons over 50 in the country have age-adjusted osteoporosis.[12]

The final analysis included a research by Kang et al., on a cohort of 836 people from ten investigations. Osteoporosis prevalence was 14.80% (95% CI: 14.19-15.49). Men and people under 50, who are often not thought to be at a higher risk of osteoporosis, can fall into this category. In order to include this in future predictions models for bony fractures, more research is needed to assess the risk of osteoporosis based on the etiology and stage of cirrhosis, particularly in younger guys.[2]

One well-known significant factor of osteopenia and osteoporosis is getting older. The study's findings that osteoporosis is more common among younger people highlight how crucial it is to understand how cirrhosis contributes to the early onset of osteoporosis in this demographic. The frequency of osteoporosis in men was only 4.4%, according to this CDC research. [12] The data from a meta-analysis displays the pooled prevalence rate was 15% and equal gender representation, with 50% of the participants being men. This suggests that guys with cirrhosis are more likely than the general population to develop osteoporosis. Gonzalez-Calvin et al., discovered that although men with viral cirrhosis showed signs of increased osteoporosis, postmenopausal women with cirrhosis and healthy postmenopausal women without

cirrhosis did not differ in terms of bone mass or bone resorption rates.[13, 14]

The prevalence of osteoporosis in older people was 21.7% (95% CI: 18.8-25%), and the overall prevalence in older men and women was 35.3% (95% CI: 27.9-43.4%) and 12.5% (95% CI: 9.3-16.7%), according to a review of 40 studies with a total sample size of 79,127 people. Additionally, Asia had the greatest reported rate of osteoporosis among the elderly, at 24.3% (95% CI: 20.9-28.1%).[3]

Osteoporosis was found to be 24.4% prevalent in the Eastern Mediterranean. Saudi Arabia had the highest frequency of osteoporosis (32.7%), while Kuwait had the lowest incidence (15.1%).[3] Osteoporosis and related consequences are becoming more common in Eastern Mediterranean countries as a result of longer life expectancies.[15] As reported by Zamani et al., and Irani et al., the lower levels of vitamin D and less consumption of calcium, reduced exposure to the sun, excessive smoking history (more than twenty cigarettes per day), and a positive family history of osteoporosis are the significantly associated factors of osteoporosis.[15, 16]

Women are more likely than men to have osteoporosis. The study's findings were consistent with those of numerous other investigations.[16-18] One independent risk factor for osteoporosis in older adults is female gender. This rise could be linked to a drop in women's postmenopausal estrogen.[19, 20] In this study, we also found a substantial correlation between female gender and osteoporosis, particularly among older females who were post-menopausal (30 (46.9%) vs. 8 (22.2%), p-value <0.05). The most significant associated factor of osteoporosis in male gender is a history of fractures.[20]

In general, males have higher bone-mass and bone contents than females. Additionally, man develop a higher level of bone-mass later in life than woman do. It is believed that 49% of women over 50 have osteoporosis.[21] Osteoporosis affects roughly one-tenth of women over 60, one-fifth of women over 70, two-fifths of women over 80, and two-thirds of women over 90 globally.[22] Osteoporosis is five times as common in women over 50 than in the general population. According to Ma et al., the prevalence of osteoporosis was 52.1% in men and 69.1% in women.[23] According to Zeng et al., the prevalence of osteoporosis in males was higher than females (45.9% vs. 11.8%, respectively, p<0.05) and according to Nielsen et al., also observed that the risk of osteoporosis is higher in males than females (22.2% vs. 10.8%, respectively, p<0.05).[24, 25]

In this study, we also faced few limitations. We did not observe laboratory parameters involved in osteoporosis including inflammatory markers (CRP, Interleukin-36) or intact parathyroid hormone, vitamin D level, calcium level & phosphate levels, and liver function tests that could alter the bone density. In further studies it is recommended to consider these parameters for assessment of osteoporosis in cirrhotic individuals and improve their level by supplementation and better therapeutic protocols. We also did not planned to check the association of osteoporosis with presence of ascites, or fibrosis.

CONCLUSION

Thus the risk of osteoporosis in local population is high among individuals with liver cirrhosis. The association of osteoporosis was also significant with predictors. Now we have got the magnitudes for local population and found prevalence of osteoporosis high as compared to other populations and all the predictors were significantly associated with osteoporosis. Now we will implement findings in local setting and will recommend to screen liver cirrhosis patients for BMD in order to timely diagnose the osteoporosis and timely manage the individuals to prevent any bone loss or degenerative bone disease.

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