

DIETARY RESTRICTION PRACTICES AND ITS RELATIONSHIP WITH ALANINE AMINOTRANSFERASE LEVELS IN PATIENTS WITH CHRONIC HEPATITIS C

Zafar Ali¹, Riaz Muhammad², Muhammad Abdur Rahman Afridi³, Ali Sebtain⁴,
Muhammad Numan Saleem⁵, Intekhab Alam⁶

¹⁻⁶ Department of Medicine, Lady Reading Hospital, Medical Teaching Institution, Peshawar - Pakistan.

Address for Correspondence:
Dr. Muhammad Abdur Rahman Afridi

Associate Professor,
Department of Medicine, Lady Reading Hospital, Medical Teaching Institution, Peshawar - Pakistan.
Email: rahmanafриди@hotmail.com

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ABSTRACT

Objective: To determine the diet restriction practices in patients with chronic hepatitis C (CHC) and its relationship with alanine aminotransferase (ALT) levels.

Methodology: This was a hospital based descriptive study carried out from January 2013 to December 2014. A total of 504 CHC patients of more than 12 years age and of either gender were included in the study. Patients were selected by non-probability convenient sampling method. They were thoroughly asked about their dietary habits, diet restriction, degree of diet restriction (mild, moderate & severe) and about who advised the diet restriction (doctors, quakes, relatives or self-restriction). Diet restriction was correlated with ALT levels using chi square test and Spearman rank correlation test. Statistical significance was considered at p value <0.05.

Results: Out of 504 patients, there were 214 (42.5%) males and 290 (57.5%) females. Age of the patients ranged from 14 to 90 years with mean age of 37.35 ± 12.770 years. Diet restriction was present in 332 (65.9%) patients. Among these, 55 (16.56%) had mild diet restriction, 69 (20.78%) had moderate dietary restriction while severe diet restriction was found in 208 (62.65%) patients. In 113 (34.0%) patients, diet restriction was advised by quakes followed by relatives or family members in 107 (32.2%), doctors 88 (26.5 %) and self-restriction 24 (7.2%) patients. Correlation of ALT levels with diet restriction or the degrees of diet restrictions was statistically not significant, $\chi^2 = 1.865$, p value = 0.601.

Conclusion: Diet restriction was found in a significant number of CHC patients. Most of them had severe dietary restriction. Correlation of ALT levels with presence of diet restriction or degrees of diet restrictions was not found to be statistically significant.

Key Words: Chronic hepatitis C, Dietary restriction, Alanine aminotransferase

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INTRODUCTION

Around 170 million people are infected with hepatitis C virus (HCV) worldwide^{1,2}. In Pakistan, the estimated prevalence is 4.9% in the general population. This can be translated to approximately 10 million people suffering from HCV infection³. Moreover, Pakistan is among the countries with the highest number of people having active HCV infection. Liver can be affected by HCV in a variety of ways ranging from acute hepatitis C to chronic hepatitis C, cirrhosis and hepatocellular carcinoma. Chronicity occurs in almost 80% of those infected with HCV⁴. Patients with chronic hepatitis C (CHC) are prone to malnutrition. It is considered to be an important prognostic factor regarding their quality of life and

disease outcomes⁵. Unjustified dietary restriction of various food items will further aggravate the matter and worsening of nutritional status in these patients. Therefore efforts are needed to maintain adequate nutritional status (protein intake of 1.5-2.0 gm/kg and a caloric intake of 45 kcal/ kg of body weight) in patients with CHC but without significant liver damage⁶.

A lot of concern has always been shown about the diet of these patients both by the patient and their families. Most of these beliefs and concepts are based on self-thinking or already established practices in society. Lack of education and awareness, result in misconceptions. Many food components have been implicated as hazardous and elevating the liver enzymes by the local

GPs, hakeems, homeopaths, traditional medicine specialists, quacks, religious leaders, faith healers, friends and family elders or parents. Some foods are restricted illogically. This concept leads to food deprivation and in long run to protein energy malnutrition with aggravation of the disease process.

In clinical practice, however, the dietary restriction practice or "parhez" factor is frequently not given attention and is under detected. Clinical research in this area is again limited despite the obvious need and relevance. Some studies addressed the nutritional status and dietary attitudes in cirrhotics due to HCV while others focused on weight reduction strategies to help minimize hepatic steatosis and obesity⁷⁻¹⁰. Recent data suggested that patients with CHC are nutritionally impaired even in the absence of cirrhosis¹¹. But studies specifically addressing the nutritional status or dietary restriction practices in patients with CHC who are without cirrhosis are scarce. Moreover, the relationship of diet restriction with ALT levels was not specifically addressed previously, in our set up.

The present study was carried out in non-cirrhotic and non-obese CHC patients and in the absence of hepatic steatosis. These patients are often subjected to strict and unnecessary dietary restrictions, predominantly of fat and protein. Given these facts, it would be prudent to screen all CHC patients for dietary restrictions practices. The purpose of our study was to determine the dietary restriction practices in patients with chronic hepatitis C and to identify its relationship with alanine aminotransferase levels. It may help in providing the scientific basis for the dietary modifications in liver disease and increased public awareness. It will help the practicing physicians and gastroenterologists to be aware of these beliefs and practices in order to effectively counsel the patients regarding their diets and not imposing unnecessary restrictions on dietary intake. This will help health promotion and reducing dietary complications in patients with CHC.

METHODOLOGY

This was a hospital based descriptive cross-sectional study of 504 CHC patients presented between January 2013 to December 2014, to the Department of Medicine, Lady Reading Hospital, Peshawar and to the private clinic of one of the author of this study. All patients with CHC (irrespective of ALT levels) of more than 12 years age and of either gender were included in the study. Patients with evidence of decompensation of liver disease (cirrhosis, hepatocellular carcinoma), obesity or over weight (BMI >26), diabetics, non-alcoholic steato-hepatitis (NASH) and those taking alcohol or other hepatotoxic drugs were excluded from the study. These conditions would have influenced their dietary intake and might result in confounding and bias. The sample

was calculated by WHO sample size calculator. By keeping 5% prevalence of CHC³, at 95% confidence interval and 4.5% margin of error the calculated sample size was 475, but to cover for contingency factor or drop outs etc. a sample of 504 was included. Study approval was taken from Institutional review board of the hospital. Declaration of Helsinki of 1975 was followed in the study protocol. Patients were briefed about the purpose of our research and their rights were explained to them. They were assured of the confidentiality and anonymity of the information. After that an informed written consent in Urdu language was obtained. To minimize the errors clear instructions were given to the study participants.

Chronic Hepatitis C was operationally defined as positive anti-HCV antibodies, tested by immuno-chromatographic testing (ICT) or enzyme linked immunosorbent assay (ELISA) method, duration of illness of more than 06 months and an ultrasound (USG) of the liver showing absence of signs of portal hypertension, such as a dilated portal vein, ascites or splenomegaly. Alanine aminotransferase levels were considered as normal if the reported value was less than 40 iu/l while ALT level of 40 u/l or greater was considered as raised ALT level. Diet restriction (parhez) was operationally defined as willfully avoiding necessary food items for at least 06 months. It was further categorized as mild (only avoiding beef & rice), moderate (avoiding in addition, mutton, chicken, eggs and milk/ milk products) and severe (using only boiled vegetables and avoiding fish, fruits, oil, fats, sweets and spices as well).

Patients were selected by non-probability convenient sampling method. Interviews of 504 seropositive CHC patients who fulfilled the inclusion criteria were conducted. The setting of study was OPD and Medical wards of Department of Medicine, Lady Reading Hospital, Medical Teaching Institution, Peshawar as well as the private clinic of one of the author of this study. A structured questionnaire covering demographics (age, sex, address, marital status, occupation, socioeconomic status, duration of illness, family history of hepatitis and knowledge regarding CHC) was used. They were thoroughly asked about their dietary habits, diet restriction, degree of diet restriction (mild, moderate & severe) and about who advised the diet restriction (doctors, quakes, relatives or self-restriction). Relevant investigations including serum ALT, blood glucose level and USG were carried out at Lady Reading Hospital, Peshawar. A pre-designed proforma was used to enter the data.

Data were then entered into SPSS version 21.0 and analysis was carried out. For numerical variables (age and serum ALT), mean \pm SD was calculated; while for categorical variables (gender, knowledge of CHC, presence of diet restriction and degree of diet restriction frequencies and percentages were calculated. Diet res-

striction was correlated with ALT levels using chi square test and Spearman rank correlation test. A Kruskal-Wallis H test was applied and Box plots were made to show the relationship between diet restriction (qualitative variable) and ALT levels (quantitative variable). Statistical significance was considered at p value <0.05. All results were presented as tables and graphs.

RESULTS

In our study, out of 504 patients there were 214 males and 290 females. Male to female ratio was 1: 1.35. Among females, 274 (54.4%) were housewives. Among males, laborers were 78 (15.5%), businessmen 49(9.7%), government servants 48 (9.5%), farmers 17 (3.4%), students 31 (6.2%) and others were 7 (1.4%). Serum ALT was raised in 406 (80.6%) of patients and ranged from 40 to 789 iu/l with mean of 101.75 ± 95.136 . Baseline demographics of study participants are shown in table 1.

Diet restriction was present in 332 (65.9%) patients while 172 (34.1%) were taking routine diet and not following any dietary restrictions (p value 0.001). Severe diet restriction was found in 208 (62.65%) patients. Gender wise distribution of patients with diet restriction is shown in table 2. In 113 (34.0%) patients, diet restriction was advised by quakes (table 3). Correlation of diet restriction and ALT levels was not significant as shown by Spearman's Rho test in table 4. Similarly, statistically significant difference was not found in normal versus raised ALT levels among the patients with diet restrictions or no restrictions (table 5). A Kruskal-Wallis H test showed that there was not a statistically significant difference in ALT levels among the different degrees of diet restrictions, $\chi^2=1.865$, p =0.601 (table 6). Boxplots

in figures 1 & 2 showed the correlation of raised ALT levels with presence of diet restriction and with degree of diet restriction respectively.

DISCUSSION

Diet is one of the most important parts of CHC management. Prohibition of food items in patients with CHC is not supported by evidence because it is not considered helpful regarding recovery or clinical improvement¹². However certain false beliefs regarding diet restriction may be prevalent in the community with resultant inadequate dietary intake¹³. The concept of dietary restriction (Parhez) is deeply rooted and practiced for long in our culture. In our study, there were 57.5% females. Similar gender distribution (53% females) was shown by Kumar et al¹⁴. Mean age of our study participants was 37.35 ± 12.770 years. This was in accordance with the studies by Ismail et al¹¹ (mean age 33.63 ± 4.51 years) and Badruddin et al¹⁵ (mean age in the late 40's).

Inadequate intake of protein and energy due to unjustified dietary restrictions and dietary taboos leads to malnutrition in CHC patients. In the present study, diet restriction was found in 65.9% patients as compared to 34.1% patients with no dietary restriction (p value =0.001). Most of the diet restricted patients had severe dietary restrictions (62.65%) followed by moderate (20.78%) and mild in (16.56%) patients. Our findings are in accordance with the other published studies^{11,14,16-19}. Kumar et al¹⁴, showed that 70% of their study participants were following diet restriction or parhez. In the study by Gottschall et al¹⁶, there was inadequate protein intake in 46.8% while energy intake was inadequate in 52.1% of patients. Ismail et al¹¹ reported malnutrition

Table 1: Baseline demographics of study participants (n=504)

Demographics	Frequency/Range	Percentages/Mean
Gender	Male	214
	Female	290
Age in years	14-90	37.35 ± 12.770
Alanine Amino-transferase (ALT) Level	Normal (11-39)	98
	Raised (40-789)	406
Level of Knowledge regarding Hepatitis C	All about	110
	Heard of	69
	None	325
Family History of Hepatitis	Yes	165
	No	339
Presentation as Jaundice	Yes	36
	No	468
Marital Status	Married	436
	Single	62
	Widowed	6

Table 2: Gender and diet restriction in chronic hepatitis C patients (n=504)

Gender	Diet Restriction				Total
	None	Mild	Moderate	Strict	
Male	79 (15.67%)	19 (03.77%)	24 (04.76%)	92 (18.25%)	214 (42.46%)
Female	93 (18.45%)	36 (07.14%)	45 (08.93%)	116 (23.01%)	290 (57.54%)
Total	172 (34.12%)	55 (10.91%)	69 (13.69%)	208 (41.26%)	504 (100%)

Table 3: Relative frequencies of diet restriction as advised by different advisors (n=504)

Diet Restriction Advised By	Yes (n=332)	No (n=172)	Total (n=504)
Doctors	88 (26.5 %)	85 (49.4%)	173 (34.3%)
Quakes	113 (34.0%)	14 (8.1%)	127 (25.2%)
Relatives	107 (32.2 %)	35 (20.3%)	142 (28.2%)
Self	24 (7.2%)	38 (22.1%)	62 (12.3%)
Total	332 (100%)	172 (100 %)	504 (100%)

Table 4: Correlation of diet restriction and ALT level

Correlation of Diet Restriction and ALT Level		Presence of Diet Restriction	Alanine Aminotransferase
Spearman's Rho	Presence of Diet Restriction	Correlation Coefficient	1.000
		Sig. (2-tailed)	.508
		N	504
	Alanine Amino-transferase Level	Correlation Coefficient	-.030
		Sig. (2-tailed)	1.000
		N	504

Table 5: Degree of diet restriction and alanine aminotransferase levels

Presence of Diet Restriction	Degree of Diet Restriction	Normal ALT (n=98)	Raised ALT (n=406)	Total (n=504)	Significance
No	None	33 (100%)	139 (100 %)	172 (34.1%)	.207
Yes	Mild	10 (26.5 %)	45 (49.4%)	55 (10.9 %)	
	Moderate	20 (34.0%)	49 (8.1%)	69 (13.7 %)	
	Strict	35 (32.2 %)	173 (20.3%)	208 (41.3%)	
Total		98 (100%)	406 (100 %)	504 (100%)	

Table 6: Correlation of diet restriction and ALT level using Kruskal-Wallis H test

Kruskal-Wallis H Test	Type of Restriction	N	Mean Rank	Chi-Square	df	Asymp. Sig.
Alanine Amino-transferase	None	172	246.52	1.865	3	.601
	Mild	55	244.81			
	Moderate	69	242.07			
	Strict	208	262.94			
	Total	504				

Figure 1: Correlation of diet restriction and raised alanine aminotransferase levels

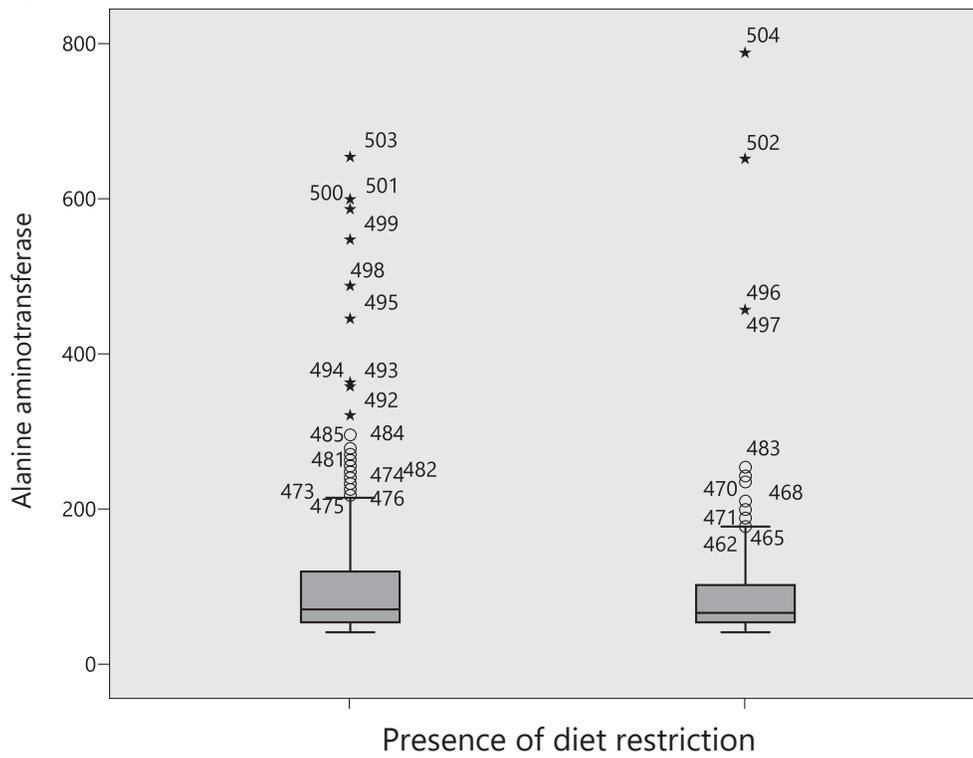
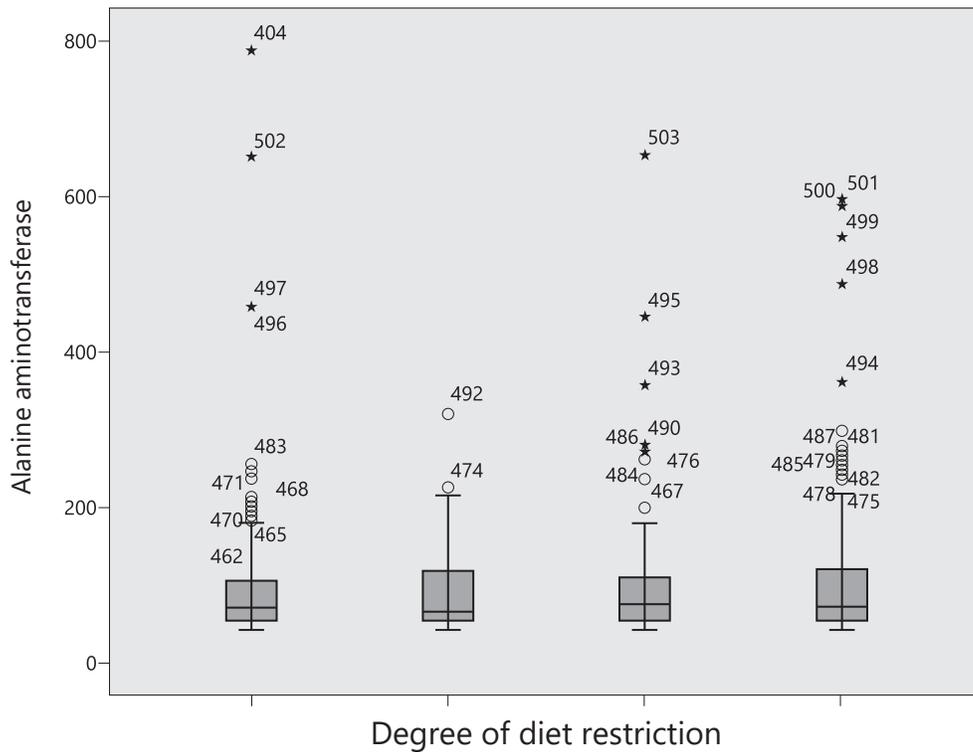


Figure 2: Correlation of degree of diet restriction and raised alanine aminotransferase levels



in 14% of the chronic hepatitis C sub-group of patients without cirrhosis. Similarly, Yasutake et al¹⁷ reported decreased intake of calories, protein and fat in the sub-group of chronic HCV patients. Amin et al¹⁸ showed that 67.5% had insufficient caloric intake and the mean caloric intake of CHC patients was significantly lower than compensated cirrhotic patients (1858.70 ±630.2 Vs. 1923.75 ±595.8 Kcal/day respectively, p value =0.016). Deficient intake (68.10%) of nutrients and energy in CHC patients was recorded by Meng et al¹⁹.

According to different studies, dietary restriction in patients with CHC resulted in avoidance of food items in varying amounts. An Italian study reported that 64% of hepatitis patients restricted intake of fried foods and fats²⁰. In another study, spicy foods were avoided by 85%, oily food 64.1% and fried food by 24.8% patients. Meat was completely avoided by 3% and reduced in intake by 66% of hepatitis patients¹⁴. Badruddin et al¹⁵ showed that meat was avoided by 72%, oily foods 64%, spicy foods 34%, milk or milk products 28% and rice by 20% of study participants. Restriction regarding spices and fats also leads to decreased palatability of the food ultimately leading to reduced overall food intake and worsened nutritional status^{21,22}.

Our results showed that diet restricting practices were mostly advised by quakes (34.0%) and relatives (32.2%) followed by doctors (26.5%) while 7.2% of patients had self-restriction. Patients who had no diet restriction, 49.4% were asked by the doctors not to reduce their healthy diet. So the unjustified practice of dietary restriction or parhez was not only endorsed by patients and their families, but unfortunately the quakes and the ignorant physicians also impose it unnecessarily. In the study by Badruddin et al¹⁵ multi-source advice was reported. About 33.5% received advice from family doctors, 24.8 % from the gastroenterologists, 14.6% from friends or family members and 4.9% from homeopaths or hakeems.

Self-restriction of food items as a result of food taboos is also of concern. Patients are worried about worsening of their disease if specific food items are not avoided and unjustifiably indulge in diet restriction practices (parhez). Foods are considered as 'hot' or 'cold' by patients themselves. Sometimes just as a precaution certain foods are avoided even if they have no plausible explanation for it²³. The over-enthusiastic dietary restrictions by doctors is considered unprofessional and an important cause of deteriorating nutritional status of these patients^{11,24}. Of particular note is the restriction of meat as a result of wrong advice by doctors or misperception by patients when they are advised "not to take too much meat" and they stop taking it altogether.

In our study, the correlation of ALT levels with presence of diet restriction or degrees of diet restrictions

was not found to be statistically significant (p = 0.601). This is in contrast to what has been reported by Iwasa et al²⁵. In that study, the mean serum alanine aminotransferase levels decreased significantly from 66 to 49 u/l. However they studied only 22 patients and moreover controlled diet was given to their patients and they were not on strict parhez. In another study, in 16 out of 19 patients, there was gradual fall in serum ALT levels with weight reduction. After 12 weeks, the overall decrease in mean ALT level was from 137 to 94 u/l (p=0.002)²⁶. However the study consisted of small sample of only 19 subjects and they had hepatic steatosis as well. Moreover, Most patients were in the overweight or obese weight range (BMI 26–35) and had significant visceral adiposity, as demonstrated by an elevated waist circumference (>94 cm in males and >80 cm in females).

The study by Rusu et al²⁷ showed benefits of low-calorie diet and low-fat diet in patients with CHC. On low-calorie diet and low-fat diet for 12 months, they observed a mean change in ALT level from 57.5 to 42 u/l and from 67 to 46 u/l respectively. However that study was mainly focused on successful weight reduction in obese (>70% of participants) and patients with steatosis. Similarly, weight reduction was reported as beneficial in patients with CHC who were overweight^{22,28}.

CONCLUSION

Diet restriction was found in a significant number of CHC patients. Most of them had severe dietary restrictions. It was unjustifiably advised by quakes, relatives and doctors and even practiced by patients themselves. Correlation of ALT levels with presence of diet restriction or degrees of diet restrictions was not found to be statistically significant.

RECOMMENDATIONS

Unjustified diet restriction or parhez should be discouraged in patients with chronic hepatitis C. Effective counseling needs to be done regarding normal diet to ensure satisfactory nutrients intake and improve the overall clinical outcome of the patients. They should be made understand that normal diet will not negatively affect the course of their disease.

REFERENCES

1. Friedman LS. Liver, biliary tract & pancreas disorders: chronic hepatitis C. In: Papadakis MA, McPhee JS, editors. Current medical diagnosis and treatment. 56th Ed. New York:McGraw Hill Edu; 2017:689-91.
2. World Health Organization. Hepatitis C; 2017. Available at: <http://www.who.int/mediacentre/factsheets/fs164/en/>
3. Qureshi H, Bile KM, Jooma R, Alam SE, Afridi HU. Prevalence of hepatitis B and C viral infections in Pakistan: findings of a national survey appealing for effective preven-

- tion and control measures. *East Mediterr Health J* 2010; 16:S15-23.
4. Ansaldo F, Orsi A, Sticchi L, Bruzzone B, Icardi G. Hepatitis C virus in the new era: perspectives in epidemiology, prevention, diagnostics and predictors of response to therapy. *World J Gastroenterol* 2014; 20:9633-52.
 5. Lee MH, Yang HI, Yuan Y, L'Italien G, Chen CJ. Epidemiology and natural history of hepatitis C virus infection. *World J Gastroenterol* 2014; 20:9270-80.
 6. Menta PL, Correia MI, Vidigal PV, Silva LD, Teixeira R. Nutrition status of patients with chronic hepatitis B or C. *Nutr Clin Pract* 2015; 30:290-6.
 7. Pattullo V, Duarte-Rojo A, Soliman W, Vargas-Vorackova F, Sockalingam S, Fantus IG et al. A 24-week dietary and physical activity lifestyle intervention reduces hepatic insulin resistance in the obese with chronic hepatitis C. *Liver Int* 2013; 33:410-9.
 8. Nseir W, Hellou E, Assy N. Role of diet and lifestyle changes in nonalcoholic fatty liver disease. *World J Gastroenterol* 2014; 20:9338-44.
 9. Goossens N, Negro F. The impact of obesity and metabolic syndrome on chronic hepatitis C. *Clin Liver Dis* 2014; 18:147-56.
 10. Maggio R, Viscomi C, Andreozzi P, D'Ettore G, Viscogliosi G, Barbaro B et al. Normocaloric low cholesterol diet modulates Th17/Treg balance in patients with chronic hepatitis C virus infection. *PLoS One* 2014; 9:e112346.
 11. Ismail FW, Khan RA, Kamani L, Wadalawala AA, Shah HA, Hamid SS et al. Nutritional status in patients with hepatitis C. *J Coll Physicians Surg Pak* 2012; 22:139-42.
 12. Kachaamy T, Bajaj JS. Diet and cognition in chronic liver disease. *Curr Opin Gastroenterol* 2011; 27:174-9.
 13. Peres WA, Paula TP. Role of Nutrition in the Progression and Treatment of Hepatitis C Virus-Related Chronic Liver Disease: A Review. *J Food Nutri Diet* 2016; 1:109.
 14. Kumar R, Bajwa F, Khan EA, Gorar ZA. Knowledge and practices about dietary habits among hepatitis B and C patients attending two public sector hospitals at Islamabad. *Isra Med J* 2011; 3:3-6.
 15. Badruddin SH, Jafri SM, Ahmed A, Abid S. Dietary practices and beliefs of patients with chronic liver disease. *J Pak Med Assoc* 1999; 49:216-20.
 16. Gottschall CB, Pereira TG, Rabito EI, Álvares-Da-Silva MR. Nutritional status and dietary intake in non-cirrhotic adult chronic hepatitis C patients. *Arq Gastroenterol* 2015; 52:204-9.
 17. Yasutake K, Bekki M, Ichinose M, Ikemoto M, Fujino T, Ryu T et al. Assessing current nutritional status of patients with HCV-related liver cirrhosis in the compensated stage. *Asia Pac J Clin Nutr* 2012; 21:400-5.
 18. Amin HM, Samie RMA, Hamed FS, Abo Zaid EM, Hammad EM. Assessment of Nutritional Status of Patients with Chronic Hepatitis C and HCV-Related Cirrhosis in the Compensated Stage. *Am J Int Med* 2016; 4: 24-35.
 19. Meng QH, Yu HW, Li J, Wang JH, Ni MM, Feng YM et al. Inadequate nutritional intake and protein-energy malnutrition involved in acute and chronic viral hepatitis Chinese patients especially in cirrhosis patients. *Hepatogastroenterology* 2010; 57:845-51.
 20. Scognamiglio P, Galati V, Navarra A, Longo MA, Aloisi MS, Antonini MG et al. Impact of hepatitis C virus infection on lifestyle. *World J Gastroenterol* 2007; 13:2722-6.
 21. Ibrahim AA, Salem HEM, Zaky DZ, El-Sayed EA, Hamed AM, Kazem YMI. Dietary patterns in Egyptian patients with chronic hepatitis C related liver disease: a cross-sectional study. *J Liver* 2015; 4:176.
 22. Singh N, Choudhary JK, Srivastava M. Nutritional and clinical profile of patients in different stages of alcoholic and virus related liver disease: an Indian perspective. *Webmed Central Plus Gastroenterol* 2013:39:1-7.
 23. Corish C. Nutrition and liver disease. *Nutr Rev* 1997; 55:17-20.
 24. Parrish CR, Krenitsky J, McCray S. Nutrition for patients with hepatic failure. *Prac Gastroenterol* 2003; 6: 23-42.
 25. Iwasa M, Iwata K, Kaito M, Ikoma J, Yamamoto M, Takeo M et al. Efficacy of long-term dietary restriction of total calories, fat, iron, and protein in patients with chronic hepatitis C virus. *Nutrition* 2004; 20:368-71.
 26. Hickman IJ, Clouston AD, Macdonald GA, Purdie DM, Prins JB, Ash S et al. Effect of weight reduction on liver histology and biochemistry in patients with chronic hepatitis C. *Gut* 2002; 51:89-94.
 27. Rusu E, Jinga M, Enache G, Rusu F, Dragomir AD, Ancuta I et al. Effects of life style changes including specific dietary intervention and physical activity in the management of patients with chronic hepatitis C--a randomized trial. *Nutr J* 2013; 12:119.
 28. Carreño V. Review article: management of chronic hepatitis C in patients with contraindications to anti-viral therapy. *Aliment Pharmacol Ther* 2014; 39:148-62.

CONTRIBUTORS

ZA conceived the idea, planned the study and drafted the manuscript. RM and MARA helped acquisition of data and did statistical analysis. AS and MNS helped acquisition of data. IA critically revised the manuscript and supervised the study. All authors contributed significantly to the submitted manuscript.