ORIGINAL RESEARCH ARTICLE
pISSN 0976 3325 | eISSN 2229 6816
Open Access Article
www.njcmindia.org

Prevalence of Non Alcoholic Fatty Liver Disease (NAFLD) among Adults Aged 30 Years and Above in a Rural Population of Jammu- An Observational Study

Anuj Kapoor[1], Shoket Chowdary[2], Deepika Dewan[3], Ghanshyam Dev[4], Rashmi Kumari[5], Dinesh Kumar[6]

Financial Support: None declared
Conflict of Interest: None declared

How to cite this article:
Kapoor A, Chowdary S, Dewan D, Dev G, Kumari R, Kumar D. Prevalence of Non Alcoholic Fatty Liver Disease (NAFLD) among Adults Aged 30 Years and Above in a Rural Population of Jammu- An Observational Study. Natl J Community Med 2018;9(11):787-793

Author's Affiliation:
[1]Medical Officer, Directorate of Health Services; [2]Asst Prof, Dept of Gasstroenterology; [3]Medical Officer, PG Dept of Community Medicine, [4]Professor & Head, Dept of Radiodiagnosis; [5]Asst Prof, PG Dept of Community Medicine, [6]Prof & Head, PG Dept of Community Medicine, Government Medical College, Jammu

Correspondence
Dr. Dinesh Kumar
kumardineshpsm@gmail.com

Date of Submission: 08-09-18
Date of Acceptance: 13-10-18
Date of Publication: 30-11-18

ABSTRACT

Background: Non alcoholic fatty liver disease (NAFLD) is one of the most common causes of chronic liver disease globally and its burden is increasing in India. There is still paucity of knowledge regarding the actual burden and risk factors of NAFLD especially in rural areas.

Methodology: The present study was conducted in six villages under Health and Demographic Surveillance System (HDSS) in Block RS Pura. A total of 322 adults aged 30 years and above were selected using simple random sampling to estimate the prevalence of NAFLD . The number of eligible participants as per inclusion criteria were 258 and Out of them, finally 250 participants reported for undergoing ultrasonography of the liver, anthropometry, blood pressure recording, and biochemical tests .

Results: Prevalence of NAFLD was 37.2% (31.4-43.3). Majority of participants had mild severity (57%). Persons with low physical activity and high BMI (both overweight and obese persons) had maximum prevalence of NAFLD 66.7%, 26.2% and 43.07% respectively. Hypertensives and women with higher waist hip ratio also reported higher prevalence. Regarding biochemical levels, the prevalence was higher in subjects having high SGOT (69.8%) ,SGPT (43.5%), serum alkaline phosphates (43.4%) and serum LDL levels(64.4%).

Conclusions: The prevalence of NAFLD is high in rural areas of India.

Key Words: Nonalcoholic fatty liver disease (NAFLD), Prevalence, Risk factors, Rural area

INTRODUCTION

Non-**A**lcoholic **F**atty **L**iver **D**isease (NAFLD) is a public health problem worldwide and is recognized as one of the most common forms of liver diseases, affecting 2.8-24% of the general population.[1] and currently the most common cause of abnormal liver function tests . The overall prevalence of NAFLD in western countries vary from 15-40% to 9-40% [2] in Asian countries .In India, the prevalence of NAFLD in T2DM patient is reported to be range in 12.5-87.5%.[3-4] NAFLD is now recognised as the hepatic component of the metabolic syndrome which includes hyperlipdemia, glucose intolerance, obesity and systemic hypertension. The risk of severity of it increases with the number of components of the metabolic syndrome.

The most common documented comorbidities that have been associated with NAFLD include obesity, impaired insulin sensitivity and dyslipidemia, type 2 diabetes mellitus and glucose intolerance, with or without superimposed obesity. [5]

The natural history of the disease is still unclear. In studies with paired biopsies (one biopsy performed after the period of follow-up), the disease progressed in 32-41%, remained stable in 34-50%, and improved in a minority of the patients with NAFLD.[6] Since 2005, five retrospective studies have been published and have included a total of 74 patients with NAFLD and paired liver biopsy specimens with follow up period ranging from 1 to 15 years.[7]

The true prevalence of NAFLD and non alcoholic steatohepatitis (NASH) is unknown given that the disease definition and modalities used for diagnosis are not standardized. Methodology of epidemiology studies of NAFLD vary widely as well, with only limited data from large population-based studies. There is limited data on the prevalence of NAFLD from India. Most of the studies examining the natural history of NAFLD in India and worldwide have been conducted in hospital settings with a smaller sample size and hence generalizability is questionable. There is limited information regarding prevalence of NAFLD from rural India.

OBJECTIVES

The study conducted to estimate the prevalence of NAFLD in adults aged 30 years and above in rural area of Jammu and to study factors selected risk factors in relation to NAFLD.

METHODS

The present study was observational cross sectional community based study conducted in the newly developed Health and Demographic surveillance System (HDSS) area in Block RS Pura which is a rural field practice area of the Department of Community Medicine and Govt. Medical College Hospital Jammu for a period of one year w.e.f., 1st November 2016 to 31st October 2017. The HDSS area extends in 6 villages including Gazian, Alawal Chak, Langotian, Benagarh, Tutre and Ganda comprising of total population of 5010. The physical detail of the study area is depicted in fig 1.

The study was carried out after obtaining ethical clearance from the Institutional Ethical Committee, Government Medical College, Jammu (IECGMCJ). The required sample size was calculated using the formula $z^2 \times p \times (1-p)/L^2$ where p was assumed to be 30% and relative precision was kept as 20%. Confidence level and response rate was set as 95% & 90% respectively. A total of 322 adults ≥30 years of age were required to estimate the prevalence of NAFLD.

We employed simple random sampling technique

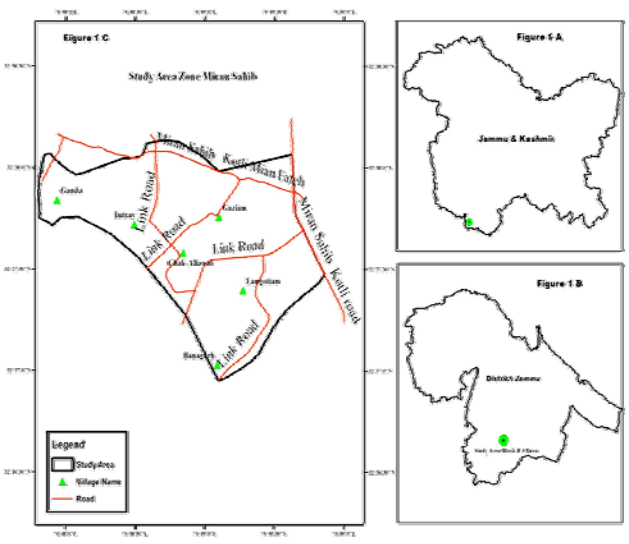

Fig 1: Study area

to select 322 participants. Inclusion criteria was 1) Willing to participate in study and thereby provide Consent 2) Age 30 years or more .3).Willing to undergo investigations required as per the study and Exclsuion criteria was 1). Individuals taking >20 gms/day or 140 gms/ week of alcohol for >1 year . 2) Patients with chronic liver diseases, Hepatitis B or C, a known case of autoimmune hepatitis or Wilson diseases. The list of selected participants was shared with local health workers and a visit was scheduled to a particular village in consultation with the worker with-out disturbing their routine home visit schedule. Accompanied by the local worker, the investigator visited randomly selected participant, and requested him/her to participate in the study. In case the house of the participant was found locked or the participant was not available at home, another visit was made after seeking appointment from him. If the house was found consistently locked or the participant has moved away or he declined to participate, he/she was excluded from the study. There were 258 eligible participants as per inclusion criteria. But finally 250 participants reported for undergoing ultrasonography (USG) of the liver, anthropometry, blood pressure recording, and biochemical tests and were included in the study. Flow chart depicting participant flow is depicted in figure 2

The consenting eligible participant after being briefed about the purpose of study were subjected to in person interview to collect socio-demographic and clinical details from him using a semi-structured questionnaire. Dietary history was obtained using 24 hour recall method. Physical activity was obtained using Global Physical Activity Questionnaire (GPAQ) version 2.[8]

Then the participants were physically examined which included general and systemic examination.

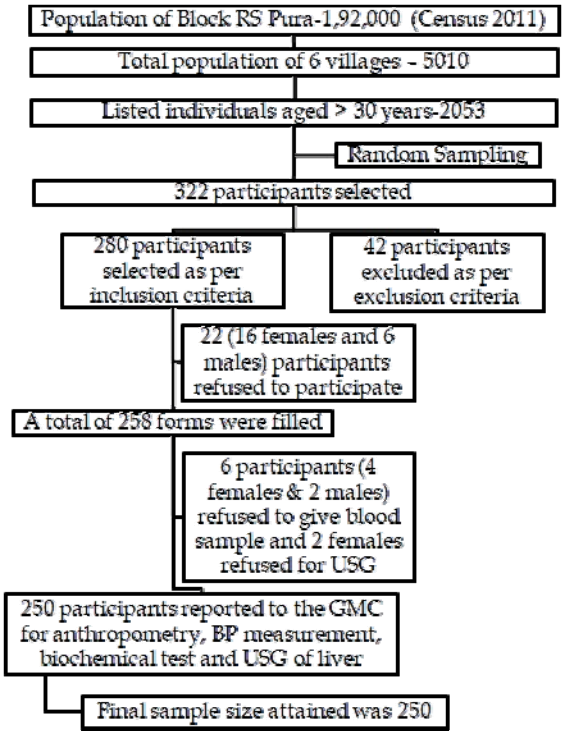

Fig. 2: Participant Flow

Height, Weight, waist and hip circumference, Waist hip ratio, BMI was noted. Seated blood pressure was measured with well-maintained equipment in a single visit after the patient observed standard precautions.

The participants then were communicated appointment for blood testing and sonography at GMCH Jammu and were asked to attend the same after overnight fasting on day convenient to the participant. A 12hr fasting venous sample was taken from each participant to measure biochemical parameters like Blood Sugar (F), liver function tests , lipid profile, CBC, Anti HBsAg and Antibodies to Hepatits C virus. All the participants were also subjected to abdominal Ultrasonography to investigate for the presence of fatty liver disease.

Statistical Analysis: Data was analysed using computer software Microsoft excel and IBM SPSS version 20 (Chicago Inc). The qualitative data were reported as proportions while mean (SD) shall be reported for quantitative variables. Prevalence was reported as point estimate along with 95% confidence intervals. A two tailed p value <0.05 was taken as significant. All p valves reported were two tailed.

RESULTS

Among 250 participants, maximum number of individuals i.e 183 (73.2%) belonged to age group of less than 50 years while 67 (26.8%) individuals were older than 50 years. NAFLD was present in 93 individuals with overall prevalence of 37.2% (31.4-43.3). .Individuals older than 70 years had highest (57.1%) prevalence of NAFLD among all age groups**. (Table 1)** Majority of participants had mild severity (57%) while severe NAFLD was present only in 16 (17.2%) individuals**. (Table 2)**

Table1 Age wise prevalence of NAFLD

Age (in years)	Cases with NAFLD	Total Subjects	Prevalence (95% CI)
30 - 40	37	98	37.7 (28.7-74.6)
40 - 50	34	85	40 (30.2-50.6)
50 - 60	10	41	24.3 (13.8-39.3)
60 - 70	8	19	42.1 (23.1-63.7)
≥70*	4	7	57.1 (25.0-84.1)
Total	93	250	37.2 (31.4-43.3)

*oldest respondent studied was male aged 75 years

Table 2 Severity of NAFLD according to age

Age(in years)	Mild (%)	Moderate (%)	Severe (%)
30-40	20 (54.0)	11 (29.7)	6 (16.2)
40-50	19 (55.8)	8 (23.5)	7 (20.5)
50-60	6 (60)	2 (20)	2 (20)
60-70	5 (62.5)	3 (37.5)	0 (0)
>70*	3 (75)	0 (0)	1 (25)
Total	53(57%)	24(25.8)	16(17.2)

(Figure in parenthesis are n-numbers, %-percentage)

Table 3 Distribution of NAFLD according to Sex and sociodemographic variables

Sociodemographic characteristics	Cases with NAFLD	Total subjects	Prevalence (95%CI)	P value
Sex				
Male	63	172	36.6 (29.7-44.5)	0.07
Female	30	78	38.4 (28.4-49.5)	
Education Status				
Illiterate	29	73	39.7 (29.2-51.1)	0.5
Primary and Middle	5	21	23.8 (10.6-44.0)	
Higher Secondary	47	120	39.1 (30.9-48.1)	
Graduation	12	36	33.3 (20.2-49.6)	
Religion				
Hindu	76	213	35.6 (29.5-42.3)	0.5
Muslim	6	15	40(19.8-64.2)	
Sikh	11	22	50 (30.7-69.2)	

Table 4: Distribution of NAFLD according to personal history

Gender	Mild (%)	Moderate (%)	Severe (%)	Cases of NAFLD /Total subjects	Prevalence (95%CI)	P value
Dietary history						
Veg	20 58.8)	10 (29.4)	4 (11.7)	34/118	28.8(21.4-37.3)	P=0.9
Non-veg	33 (55.9)	19 (32.20)	7 (11.8)	59/132	44.6(36.4-53.2)	
Total calorie intake						
Adequate	36 (60)	19 (31.6)	5 (8.3)	60/142	42.2(34.4-50.4)	P=0.5
Excess	13 (48.8)	9 (33.3)	5 (18.5)	27/45	60 (45.4-72.9)	
Deficient	4 (66.6)	1 (16.6)	1 (16.6)	6/63	9.5 (4.4-19.2)	
Sig Family history						
Yes	22 (53.6)	13 (31.7)	6 (14.6)	41/95	43.1(33.6-53.1)	P<0.01
No	31 (59.6)	156 (33.3)	5 (9.6)	52/155	33.5(26.5-41.3)	

Table 5 Distribution of NAFLD according to behavioural risk factors

Risk factors	Mild (%)	Moderate (%)	Severe (%)	Cases of NAFLD /Total subjects	Prevalence (95%CI)	P value
Smoker						
Yes	11 (64.7)	1 (5.8)	5 (29.4)	17/54	31.4 (20.6-44.7)	
No	42 (55.2)	23 (30.2)	11 (14.4)	76/196	38.7 (32.2-45.7)	
Blood Pressure						
Hypertensive	8 (42.1)	11 (57.8)	0 (0)	16/40	40 (21.3-44.2)	<0.01
Normotensive	45 (60.8)	18 (24.3)	11 (14.8)	77/210	36.6 (32.3-46.0)	
PaQ met score (physical activity**)**						
Low	40 (54.5)	25 (33.7)	9 (22.2)	74/112	66.7 (56.9-74.1)	0.8
Moderate	11 (64.7)	4 (23.5)	2 (11.7)	17/131	12.9 (37.7-70.8)	
Vigrous	1 (50)	1 (50)	0 (0)	2/7	28.5 (8.2-64.1)	
BMI						
Normal	10 (76.9)	3 (23.07)	0 (0)	4/24	16.6 (5.5-37.5)	<0.01
Overweight	16 (27.11)	18 (30.5)	25 (42.3)	61/161	26.2(21.5-35.4)	
Obese	4 (19.0)	6 (28.5)	11 (52.3)	28/65	43.07(56.4-79.0)	
High Waist Hip Ratio						
Men	35 (55.5)	22 (34.9)	6 (9.5)	63/172	36.6 (29.7-44.0)	0.04
Women	18 (60)	7 (23.3)	5 (16.6)	30/78	38.4 (28.4-49.5)	

Table 6 Distribution of NAFLD according to Lab Parameters

Lab Parameters	Cases of NAFLD /Total subjects	Prevalence (95%CI)	value
Blood sugar			
Normal 70-100	67/171	39.1 (32.1-46.6)	0.7
Pre-Diabetes 101-125	16/46	34.7 (22.6-49.2)	
Diabetes > 126	10/34	29.4 (6.8-46.1)	
Total cholesterol			
Desirable 200	58/185	31.3 (25.7-38.3)	0.1
Borderline High 200-220	20/37	54.0 (38.3-68.9)	
High>220	15/28	53.5 (35.8-70.4)	
SGOT			
Desirable 15-37IU/L	39/71	45.7(43.4-65.9)	<0.01
HIGH >37IU/L	54/179	69.8(23.9-37.2)	
SGPT			
Desirable 30-65IU/L	70/197	35.5 (29.1-42.4)	0.4
High >65IU/L	23/53	43.5 (3.9-56.7)	
S.ALKP			
Desirable 50-136 IU/L	83/227	36.5 (30.5-43)	0.6
High >136 IU/L	10/23	43.4 (25.6-63.1)	
S.HDL			0.5
Desirable 30-70 mg%	90/245	36.7(30.9-42.9)	
High >70 mg%	3/5	60 (23.0-88.2)	
S.LDL			
Desirable up to 150	26/146	17.8(12.4-24.8)	0.01
High >150	67/104	64.4(54.8-72.9)	
Triglyceride			
Desirable <150	40/110	36.3 (27.9-45.6)	0.8
Borderline high 150-200	35/87	40.2 (30.5-50.7)	
High 200-450	18/53	33.9 (22.6-47.4)	

Regarding sex distribution, there were 172 (68.8%) males and 78 females (31.2%) in the study. The prevalence of NAFLD was more in females i.e. 38.4% (28.4-49.5) as compared to males in whom prevalence was 36.6% (29.7-44.5). However more males i.e. 11 (17.4%) had severe NAFLD as compared to females 5 (16.6%) out of 16 individuals with severe NAFLD. The prevalence of NAFLD was nearly same both in illiterates and individuals with higher secondary education status. Hindus were maximum in number followed by sikh population. However, the prevalence (50%) was maximum in Sikhs followed by Muslims (40%).**(Table 3)** As per dietary history, non vegetarians , persons with excess calorie intake and significant family history had maximum prevalence and severity of NAFLD **(Table 4).**

Persons with low physical activity and high BMI (both overweight and obese persons) had maximum prevalence of NAFLD 66.7%, 26.2% and 43.07% respectively. It was also more severe in these categories as well. Among non smoker and hypertensive, the prevalence was slightly higher. The findings were not significant.(p>0.05) .Women who had higher waist hip ratio had more prevalence of NAFLD as compared to men. **(Table 5)**.Higher prevalence of NAFLD was seen in subjects having normal blood sugar (39.1%) followed by Pre-Diabetes (34.7%). The prevalence was found to be higher in subjects having Borderline high cholesterol (54.0%) followed by High cholesterol level (53.5%). The prevalence was higher in subjects having borderline high triglyceride levels (150-200) followed by high triglyceride levels (200-450). Regarding liver enzymes, SGOT, SGPT, alkaline phophatase levels, serum LDL the prevalence of NAFLD was higher in subjects having high SGOT levels (69.8) , high SGPT levels >65IU//L (43.5%), high serum alkaline phosphates level (43.4%), high level of serum LDL.(64.4%)**(Table 6)**

DISCUSSION

NAFLD has gained prominence over the past few decades and its prevalence in general population has been on increase both in developing and developed nations. It is likely to pose great challenges for health care as the factors responsible for its occurrence are deeply embedded in social and environmental milieu. More and more people are likely to fall prey to NAFLD and its consequences in times to come. Wide exposure to risk factors such as low physical inactivity, unhealthy diet, overweight and obesity early in childhood and adolescence would undo benefits accrued in ensuring that population lead longer and healthier lives.

The present study reported the overall prevalence of 37.2%. Wide variation in the prevalence of NAFLD have been reported (8.7-64.2%) [9, 10]. The variations can be attributed to differences in age group (e.g., lower estimates in studies involving younger age groups), eligibility criteria (e.g., different alcohol cut-offs)[9,11] and presence/absence of other risk factors (e.g., higher estimates in persons with obesity, altered lipids, metabolic syndrome and diabetes)[12]. Most researchers reported it between 30-40% [4,13,14,15] including hospital based studies.[16,17] Relatively higher estimate has been reported from outside India.[18] Our reported prevalence is slightly higher than figures reported from Haryana.[10] Few researchers have reported lower prevalence with age.[16,19] However, high to moderate quality evidence from 3 cohort studies showed that age is not a significant predictor of NAFLD in adults. These studies reported adjusted ORs ranging from 0.95-0.99 in studies conducted on large number of subjects (n=2029 to 6905).[20,21]

Prevalence was higher in females (38.4%) as compared to males.(36.6%) Inconsistency prevails as far as prevalence of NAFLD with gender is concerned. Though many researchers have reported NAFLD to be 3 to 5 times commoner in men[10,11], few others have reported higher prevalence among women.[11,13,14,15] .Reason for the inconsistency are not clear alcohol intake differences in BMI may have produced conflicting results.

Persons with higher BMI had maximum prevalence of NAFLD in the present study. The relationship of NAFLD with obesity has been an area of intense importance for investigators. Researchers have reported high prevalence of NAFLD in subjects with higher BMI and Waist circumference. Three cohort studies have reported higher risk of NAFLD with obesity.[22]. As far as physical activity and NAFLD is concerned, although we observed higher prevalence of NAFLD among persons with sedentary life style. Previous studies have shown that physical activity may have an important role in the prevention and treatment of NAFLD.[23,24]

Prevalence of NAFLD was higher having borderline high cholesterol, high triglycerides levels, prediabetic and hypertensive. These results corroborated with the results of other studies as well, which reinforced the well established clinical association of NAFLD with elements of metabolic syndrome (MetS) including dyslipidemia, hypertension and obesity.[2,25]

It is clear from above discussion, that multiple factors are responsible for NAFLD occurrence. Likewise wide variation in the prevalence of NAFLD can also be seen as a function of how putative variables are distributed at family and community level.

STRENGTHS AND LIMITATIONS

Strength of our study is that Community based studies are considered ideal to investigate disorder of this nature as opposed to hospital based studies. However, accurate inference are only possible if the sample drawn is of representative character and no selection bias is allowed to operate. We employed Simple random sampling to select our sample size to ensure representatives of our study sample.

However, there are certain limitations as well

1.The present cross sectional study is prone to various biases like recall bias regarding diet and physical activity, measurement error and interobserver variability in imaging .2.Persons not agreeing to undergo investigations can contribute to selection bias thus affecting external validity of study 3. Examination of sample characteristic revealed that we had studied a sample whose BMI was considerably higher as compared to reported literature. Therefore it is possible that we might have overestimated the prevalence of NAFLD. On the other hand, ultrasonography assessment of NAFLD has been shown to underestimate the prevalence of NAFLD.

There is urgent need for further exploring the risk factors of NAFLD in India. We can employ Routine USG done for different reasons as an opportunity for early detection of NAFLD. Since, no pharmacological treatment is available for the treatment of NAFLD and NAFLD can progress in severity to NASH/Fibrosis/Cirrhosis. It is recommended that more and more IEC shall be launched with focus on Consumption of healthy diet comprising of low fat/low carbohydrates and high fibre rich diet, Higher level of physical activity, No consumption of alcohol, tobacco and follow up at least on yearly basis to evaluate the progress of NAFLD.

CONCLUSION

There is higher prevalence of NAFLD in a rural population of Jammu.

REFERENCES

1. Clark JM, Brancati FL, Diehl AM. The prevalence and etiology of elevated aminotransferase levels in the united states. AMJ Gastroenterology 2003; 98: 960-7.
2. Kalra S, Vithalani M, Gulati G, Kulkarni CM, Kadam Y, Pallivathukkal J et al. Study of prevalence of non-alcoholic fatty liver disease(NAFLD) in type 2 diabetes patients in India (SPRINT). J Assoc Physicians India .2013; (7):448-53.
3. Amarapurkar D, Kamani P, Patel N, Gupte P, Kumar P, Agal S et al. Prevalence of Non-alcoholic fatty liver disease: population based study. Ann Hepatol.2007; 6(3):161-3.
4. Mohan V, Farooq S, Deepa M, Ravikumar R, Pitchumoni CS. Prevalence of non-alcoholic fatty liver disease in urban south Indians in relations to different grades of glucose intolerance and metabolic syndrome. Diabetes research and clinical practice.2009; 84(1):84-91. 5.Marchesini G, Bugianesi E, Forlani G, Cerrelli F, Lenzi M, Manini R, *et al*. Non alcoholic fatty liver, steatohepatitis and the metabolic syndrome. *Hepatology* 2003;37(4):917-23.
5. Ali R, Cust k. New diagnostic and treatment approaches in non-alcoholic fatty liver disease (NAFLD). Ann Med 2009; 41:265-78.
6. Ratziu V, Giral P, Charlotte F, Bruckert E, Thibault V, Theodorou I, et al. Liver fibrosis in overweight patients. Gastroenterolgy 2000; 118(6):1117-23.
7. WHO Technical Report Series(WTRS). Physical status: the use and interpretation of anthropometry. WHO Technical Report series 995;854:427-33. www.who.int/childgrowth/publications/physical_ status/en/(accessed on 02 Sep 2018)
8. Das K, Mukherjee PS, Ghosh A, Ghosh S, Mridha AR, Dhibar T et al. Nonobese population in a developing country has a high prevalence of nonalcoholic fatty liver and significant liver disease. Hepatology.2010; 51(5):1593-602.
9. Majumdar A, Misra P, Sharma S, Kant S, Krishnan A, Pandav C S. Prevalence of Nonalcoholic Fatty Liver Disease in an Adult Population in a Rural Community of Haryana, India. .Indian J Public Health.2016; 60(1):26-33.
10. Amirkalali B, Poustchi H, Keyvani H, Khansari MR, Ajdarkosh H, Maadi et al. Prevalence of Non-Alcoholic Fatty Liver Disease and its Predictors in North of Iran. Iranian J Public Health 2014; 43(9):1275-83.
11. Angulo P. Nonalcoholic fatty liver disease. New England Journal of Medicine. 2002 18;346(16):1221-31.
12. Sharda M Yagnik D, Soni A, Nigam H. Non-Alcoholic Fatty Liver Disease (NAFLD) and its association with metabolic syndrome and cardiovascular disease. International Multispeciality Journal of Health.2015;1(8).
13. Rao V S, Sikariya K K. Prevalence and Risk Factors of Non-alcoholic Fatty Liver Disease in Type 2 Diabetes Mellitus in a Tertiary Care Centre In Western India. IOSR Journal of Dental and Medical Sciences. 2016;15(2):01-07.
14. Bedogni G, Miglioli L, Masutti F, Tiribelli C, Mar-chesini G, Bellentani S Prevalence of and risk factors for nonalcoholic fatty liver disease: the Dionysos nutrition and liver study. Hepatology. 2005; 42 (1): 44-52.
15. Singh SP, Nayak S, Swain M, Rout N, Mallik RN, Agrawal O et al. Prevalence of Nonalcoholic fatty liver diseases in coastal eastern India a preliminary ultrasonographic survey. Trop Gastroenterol 2004; 25(2):76-9.
16. Bajaj S, Nigam P, Luthra A, PandeyRM, Kondal D, Bhatt SP. A case control study on insulin resistance, metabolic covariates & predicition score in non-alcoholic fatty liver disease. Indian J Med Res.2009;129(3):285-92.
17. Dassanayake AS, Kasturiratne A, Rajindrajith S,Kalubowila U,Chakrawarthi S, De Silva AP et al. Prevalence and risk factors for non-alcoholic fatty liver disease among adults in an urban Srilankan population.J Gastroenterol Hepatol. 2009;24(7):1284-8.
18. Chen CH, Huang MH, Yang JC, Nien CK, Yang CC, Yeh YH, et al. Prevalence and risk factors of nonalcoholic fatty liver disease in an adult population of Taiwan: metabolic significance of nonalcoholic fatty liver disease in nonobese adults. J ClinGastroenterol.2006; 40 (8): 745-52.
19. Hamabe A, Uto H, Imamura Y, Kusano K, Mawatari S, Kumagai K et al. Impact of cigarette smoking on onset of

nonalcoholic fatty liver disease over a 10-year period. Journal of Gastroenterology.2011; 46(6):769-778.

20. Sung KC, Kim BS, Cho YK, Park DI, Woo S, Kim S et al. Predicting incident fatty liver using simple cardio-metabolic risk factors at baseline. BMC Gastroenterology.2012; 12:84.
21. Xu C, Yu C, Ma H, Xu L, Miao M, Li Y. Prevalence and risk factors for the development of non alcoholic fatty liver disease in a non obese Chinese population: the Zhejiang Zhenhai Study.
22. Arulanandan A, Ang B, Bettencourt R, et al. Association between quantity of liver fat and cardiovascular risk in patients with nonalcoholic fatty liverdisease independent of nonalcoholic steatohepatitis. Clin Gastroenterol Hepatol 2015.
23. Gerber L, Otgonsuren M, Mishra A, et al. Non-alcoholic fatty liver disease (NAFLD) is associated with low level of physical activity: a population-based study. Aliment Pharmacol Ther 2012;36:772–78.
24. Singh SP, Nayak S, Swain M, Rout N, Mallik RN, Agrawal O, et al. Prevalence of non-alcoholic fatty liver disease in coastal eastern India: A preliminary ultrasonographic survey. Trop Gastroenterol 2004;25:76-9.