Original Research Article

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Non-alcoholic fatty liver disease in general paediatric population - associated factors and screening by Ultrasonography

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ABSTRACT

Background: Ultrasonography(USG) is an easily available and non-invasive method for screening the general paediatric population for prevalence of non-alcoholic fatty liver disease (NAFLD).

Methods: This was a cross-sectional descriptive study conducted in the Paediatric Out Patient Department on 100 randomly selected children of school going age group (5-15 years). A detailed history regarding diet and lifestyle, anthropometric measurements of the children like height, weight, BMI and waist – hip ratio and blood pressure was correlated with USG of general paediatric population.

Results: There were 4 cases of NAFLD of which one case was of normal weight. The study shows that the mean weight of normal population was 33.36 kgs. while the mean weight of children with fatty liver was 56.38 kgs. The mean value of systolic and diastolic blood pressure in normal population is 98.46 mmHg and 57.48 mmHg respectively while in that of children with NAFLD, it was 119.00 mmHg and 78.50 mmHg respectively. Among the dietary factors, increased intake of non-veg food, fast food, soft drinks and decreased intake of eggs and fish food is seen in children with NAFLD. Children with decreased physical activity also showed to have increased NAFLD.

Conclusions: As NAFLD is seen even in children with normal weight, all children of general pediatric population can be screened for NAFLD by an easily available and non-invasive method like USG for an early intervention to prevent morbidity associated with NAFLD.

Keywords: Body Mass Index(BMI), Diet, Exercise, Non-Alcoholic Fatty Liver Disease (NAFLD), Ultrasonography (USG)

INTRODUCTION

Non-Alcoholic Fatty Liver Disease (NAFLD) is a condition in which fat gets accumulated in the hepatocytes (>5 to 10% by weight) in the absence of any pathology known in the liver or excessive consumption of alcohol. NAFLD shows an asymptomatic involvement of liver which if left untreated, can progress into chronic liver disease. NAFLD is the commonest aetiology of chronic liver disease in paediatric population in western countries. Prevalence of NAFLD in children of normal-

weight is found to be 3-10% and in overweight and obese children, it is between 8-80%.

Various studies have been conducted to estimate the prevalence of NAFLD in adults and children with obesity. ^{5,6} However, there is very little information available regarding the prevalence of NAFLD in general paediatric population. Also, there is a paucity of studies correlating NAFLD with factors like exercise and dietary habits in Indian paediatric population. This study was done to ascertain the prevalence of NAFLD in general

paediatric population and the importance of screening for fatty liver in general population by an easily available and non-invasive method like USG. The study also established the relation between NAFLD and risk factors of metabolic syndrome in children. Control of risk factors of metabolic syndrome and early detection of NAFLD may help in the prevention of progression of NAFLD to chronic liver disease in later years.

METHODS

This was a cross-sectional descriptive study conducted in the Paediatric Outpatient Department of a 999-bedded large multi-speciality hospital in New Delhi. It was performed on 100 randomly selected children of school going age group (5-15 years) who reported to the OPD for any non-specific illnesses or for regular health check-up.

A detailed medical history was obtained to exclude any chronic medical illness (cardiac, pulmonary, renal), any use of medications for a long period of time, any past surgical interventions(cardiac, pulmonary or abdominal), subjects undergoing any program for physical conditioning pertaining to obesity or having syndromes associated with obesity like Prader-Willi syndrome, Laurence- Moon-Biedl syndrome, etc. or any syndromes associated with endocrine dysfunction such as Cushing's syndrome, hypothyroidism, etc.

After excluding all the diseases mentioned above, subjects were selected for the study. A written informed consent from the parents of the participants of the study was taken. A detailed history regarding diet and lifestylenumber of eggs and soft drinks per week, no of days of fish food, non-veg food and fast food per week and number of hours of play per week was taken.

Anthropometric measurements of the children like height (in cm), weight (in kgs.), BMI (in kg/m²) and waist-hip ratio was taken. For measurement of weight, a standard portable weighing machine was used. The weight was measured with the children wearing light clothing and without footwear. Weight was recorded in kg and rounded off to the closest 0.5 kg. For measurement of height, a stature meter was used. Height was measured without footwear and recorded in cm and rounded off to the nearest 1 cm.

The Body Mass Index (BMI) or Quetelet Index was calculated as weight (in kg)/height (in meters²) for all subjects. In the present study, we have used age and sexspecific BMI cut-offs for Indian children, based on a reference population of urban Indian affluent children, such that the cut-offs are linked to the adult accepted BMI of 23 and 28 kg/m² for overweight and obesity for Asians.⁷ Waist circumference was measured using a non-stretchable tape above the upper iliac border horizontally.

Evaluation of primary cardiovascular risk factors such as high systolic blood pressure (SBP), high diastolic blood

pressure (DBP) was done. Arterial blood pressure was measured manually by using sphygmomanometer. An appropriate cuff size for each participant was used. BP was recorded after a period of 5 minute rest and in the supine position. SBP was determined by the onset of the tapping Korotkoff sound. DBP was determined after the disappearance of the Korotkoff sound. The fourth Korotkoff phase is considered to be the diastolic blood pressure. The average with three measurements a mercury sphygmomanometer was used for all the analytical purposes. Ultrasonography (USG) of liver was done by using Philips Logic P5 machine with a curvilinear transducer of 5-8 MHz. Ultrasound findings were categorized into absent, mild, moderate and severe fatty liver disease according to Needleman criteria.8

Consent for the second part of the study was taken from the parents of the children with fatty liver on ultrasound. For estimation of lipid profile and liver function tests, blood samples (i.e., 3 ml of blood) was collected from each subject in the laboratory of the department between 8 to 10 am and evaluated for fasting blood sugar, aspartate transaminase (AST), alanine transaminase (ALT), triglycerides, high-density lipoprotein on a fully automated analyser.

Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) >40 IU/L were considered as raised levels. Metabolic syndrome was defined by abnormality of any three of the parameters: fasting glucose >100 mg/dL, triglyceride >110 mg/dL, high-density lipoprotein (HDL) <38 mg/dL, hypertension (blood pressure >95th percentile for systolic blood pressure/diastolic blood pressure/mean arterial blood pressure).6 Serum ceruloplasmin estimation and Hepatitis B antigen (HBsAg) and Anti-hepatitis C (HCV) assays were done by ELISA using kits where indicated.

Statistical analysis was done using Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). For continuous data, descriptive analyses used was mean and standard deviation (SD). p-values below 0.05 were considered as significant.

RESULTS

Demographic details

Out of the 100 children taken in the study, 60 children (60%) were boys and 40 children (40%) were girls. Among the 4% children with NAFLD, 2 out of 60 boys and 2 out of 40 girls had NAFLD but p value was not significant and hence not showing any greater sex preference (Table 1).

Out of the total 100 children, 69 children (69%) were from urban area and 31 children (31%) were from rural area. Among the 4% children with NAFLD, all the

children were from urban area and none from rural area (Table 1). However, the p-value did not show any statistical significance. The children with NAFLD in the

age groups 0f 5-6 yrs, 7-8 yrs, 9-10 yrs, >10 yrs were found to be 0,1,0,3 respectively (Table 2).

Table 1: Demographic data of prevalence of children with Fatty Liver.

Demographic data		USG Liver		Total	Pearson Chi-Square	p-value
		Normal	Fatty Liver Grade 1			
Sex	Boy	58	2	60	0.174	0.677
	Girl	38	2	40	0.174	
Area of Residence	Urban	65	4	69	1.872	0.171
	Rural	31	0	31	1.872	

Table 2: Children with fatty liver in different age groups.

Age Group (in years)	Fatty Liver	Normal	Total
5 - 6	0	12	12
7 - 8	1	28	29
9 - 10	0	31	31
>10	3	25	28
Total	4	96	100

Based on Khadilkar et al, the total population was classified into three groups based on their BMI - Group 1 (obese), Group 2 (overweight) and Group 3 (normal) and the values of each of these groups were found to be 7%, 4% and 89% respectively. Among the group with normal, overweight and obese BMI 1, 1 and 2 subjects were found to have NAFLD respectively (Figure 1).

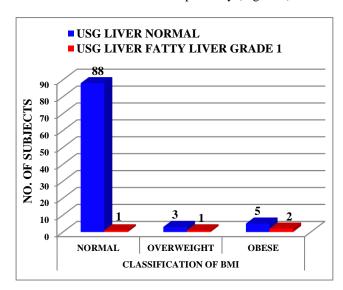


Figure 1: Fatty liver in normal, overweight and obese children as per BMI.

When dietary habits were analysed, it was found that NAFLD decreased with intake of fish food for >4

days/week and intake of >2 eggs/week. It is also found that NAFLD increased with intake of >4 soft drinks/week, fast food for >4 days/week and non-veg food >2 days/week (Figure 2).

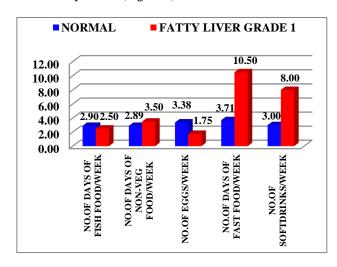


Figure 2: Bar Diagram depicting mean values of dietary factors in normal and fatty liver subjects.

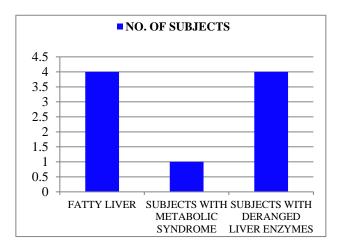


Figure 3: Subjects with fatty liver, metabolic syndrome and deranged liver enzymes.

Table 3: Mean values and standard deviations of various parameters in children with normal liver and fatty liver on USG.

Hec I i	Normal		Fatty Liver Grade		Total	
USG Liver	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Age (In Years)	9.48	1.98	11.00	2.83	9.54	2.02
Weight (In Kg)	33.36	8.21	56.38	20.67	34.28	9.91
Height (In M)	1.40	0.14	1.50	0.17	1.41	0.15
BMI	16.67	1.89	24.00	5.23	16.97	2.52
Waist: Hip Ratio	0.81	0.04	0.88	0.03	0.81	0.04
Blood Pressure Systolic (In mm Hg)	98.46	5.18	119.00	10.89	99.28	6.76
Blood Pressure Diastolic (In mm Hg)	57.58	5.78	78.50	10.76	58.42	7.25
Hours of Play/Week	10.15	2.32	6.00	0.82	9.98	2.42
Days of Fish Food/Week	2.90	1.37	2.50	0.58	2.88	1.34
Days of Non-Veg Food/Week	2.89	1.26	3.50	1.29	2.91	1.26
Eggs/Week	3.38	1.52	1.75	0.96	3.31	1.54
Days of Fast Food/Week	3.71	1.31	10.50	1.29	3.98	1.87
Soft drinks/Week	3.00	1.21	8.00	0.82	3.20	1.54
High Density Lipoproteins (HDL)			31.00	7.62	31.00	7.62
Triglycerides			102.00	8.91	102.00	8.91
Fasting Blood Sugar (FBS)			97.00	15.36	97.00	15.36
ALT			49.95	7.39	49.95	7.39
AST			51.80	7.41	51.80	7.41

The mean value of hours of play/week in normal children and those with fatty liver were found to be 10.15 hrs and 6.00 hrs respectively (Table 3).

Relation between NAFLD, metabolic syndrome and deranged liver enzymes

Among the cases with fatty liver, all 4 of them were found to have deranged liver enzymes (both AST and ALT levels) and 1 of the subjects was found to have metabolic syndrome (Figure 3).

DISCUSSION

The study was a cross-sectional study done among 100 children with ages between 5-15 years with a mean of 9.54 years and standard deviation of 2.02 years. Out of the 100 children screened for NAFLD, 4 of them were found to have mild fatty liver on ultrasonography. These cases were further examined for NAFLD by analysing their liver enzymes and all 4 of them were found to have deranged liver enzymes. Based on the results mentioned above, it was found that the ratio of normal children to children with NAFLD is 29:1 in boys and 19:1 in girls which implies that fatty liver is more prevalent in girls, however p-value was not significant (Table 1). This is not in accordance with another Indian study, 2 where NAFLD was seen more in males than females. This might be due to the geographical variation and different distribution of population taken up for these two studies.

Based on the area of residence, it was found that NAFLD is more prevalent in urban areas than rural area. The present study showed that NAFLD was nil in rural areas, but this might be due to the small sample size of the study. In this study it is seen that prevalence of NAFLD increases with increase in age and there is a significant increase in fatty liver after the age of 10 years. This study shows that the mean weight of normal population is 33.36 kgs. while the mean weight of children with fatty liver is 56.38 kgs. which shows that fatty liver increases with increase in weight of the children.

It has also been found that the mean height of normal population and that with fatty liver is 1.40 m and 1.50 m respectively which implies that with increasing height there is an increase in NAFLD. Since NAFLD is seen more with increasing age, increased mean value of height in the population is expected. Therefore, the implication that increase in NAFLD occurs with increase in height cannot be considered significant. Based on BMI, it was found that 1 subject had fatty liver in the normal BMI category while 1 subject and 2 children were found to have fatty liver in the overweight and obese category respectively. This shows that the incidence of NAFLD increases with increase in BMI. This is in accordance with other studies, which also states the same and that NAFLD may be present in children with normal BMI also. 9.10

In this study there was 18.9% prevalence of NAFLD in normal weight children which is not in accordance to the present study. ¹⁰ This might be due to the small sample

size and difference in population taken up for the study. The mean value of waist: hip ratio in normal population and that with fatty liver was found to be 0.81 and 0.88 respectively which implies that fatty liver increases with increase in waist: hip ratio.

Another study stated that waist circumference and BMI are significant predictors of NAFLD and metabolic syndrome whereas this study found that waist: hip ratio is a predictor of both NAFLD and metabolic syndrome.¹¹

The mean value of systolic and diastolic blood pressure in normal population is 98.46 mmHg and 57.48 mmHg respectively while in that of children with NAFLD, it was 119.00 mmHg and 78.50 mmHg respectively. This implies that fatty liver incidence increases with increase in both systolic and diastolic blood pressure. According to a study, systolic hypertension is an independent factor correlating with NAFLD which is in accordance to this study. This study also states that diastolic hypertension can also be considered as a factor correlating with NAFLD.

The mean value of hours of play/week in normal children and those with fatty liver were found to be 10.15 hrs and 6.00 hrs respectively which implies that with decrease in no. of hours of play/week there is an increase in incidence of NAFLD. When dietary habits were analysed, it was found that NAFLD decreased with intake of fish food for >4 days/week and intake of >2 eggs/week.

It is also found that NAFLD increased with intake of >4 soft drinks/week, fast food for >4 days/week and non-veg food >2 days/week. According to a study, increased intake of sweetened beverages, fatty food and meats showed an increased prevalence of NAFLD which is in accordance with present study. 12 Another study, states that increased intake of sweetened beverages and diet soda shows increased prevalence of NAFLD which is in accordance to this study. 13 This study also shows that all the cases with fatty liver on ultrasonography were found to have deranged liver enzymes and 1 of the children among those with fatty liver had metabolic syndrome.

Limitation of this study is the small sample size. If a larger population is studied, the validity and reliability of the study would have improved. Liver biopsy which is a gold standard for diagnosing NAFLD was not done being an invasive procedure.

CONCLUSION

The present study concluded that increased age, weight, BMI, waist: hip ratio, systolic and diastolic hypertension are factors correlating with increased incidence of NAFLD in children of age group 5-15 years. Among the dietary factors, increased intake of non-veg food, fast food, soft drinks and decreased intake of eggs and fish food is seen in children with NAFLD. Children with decreased physical activity also shows to have increased NAFLD. This study also concludes that those with fatty

liver on ultrasonography also had deranged liver enzymes and some of them had metabolic syndrome.

As NAFLD is seen even in children with normal weight, all children of general pediatric population can be screened for NAFLD by an easily available and non-invasive method like USG for an early intervention to prevent morbidity associated with NAFLD.

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