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Prevalence of non-alcoholic fatty liver disease in adolescentboys and its association with obesity and lifestyle factors in rural Tamil Nadu

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ABSTRACT:

Context: Non-alcoholic fatty liver disease (NAFLD) is characterized by hepatic fat accumulation with no apparent aetiology and shows high prevalence among children and adolescents. If left unaddressed causes cirrhosis by adulthood. Initially, considered a liver disease with benign course, however, it is currently known to be a complex disease which involves environmental factors, genetic predisposition and lifestyle changes.

Aims: To determine the prevalence of non-alcoholic fatty liver disease among adolescent boys in our local population and study its association with obesity and lifestyle factors.

Settings and Design: Population-based cross sectional, descriptive study

Methods and Material: A population-based cross sectional, descriptive study was conducted among 500 adolescent boys studying 8th, 9th and 10th in the government schools in town of Ambur, Tamilnadu. Ultrasonography was the diagnostic tool usedto identify NAFLD.

Statistical analysis used: Data was entered in Microsoft excel worksheet 2013 and analysed using SPSS trial version 21.

Results: The prevalence of fatty liver disease is 4.2% in the adolescent boys. On comparison of the risk factors, it was found that neither BMI nor Abdominal circumference had any significant association with NAFLD. While modifiable lifestyle factors like intake of soft drinks, consumption of non-veg, junk food and hours engaged in watching TV were significantly higher in NAFLD patients, compared to normal group. And the mean hours engaged in physical activity were lower in NAFLD group, and this difference was found to be statistically significant.

Conclusions: The school children, whether obese or not have to be made aware of the primary preventive measures like adoption of healthy eating behaviours and increased physical activity and impart them early in life in order to manage NAFLD.

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Key-words: Non-alcoholic fatty liver disease, Adolescents, lifestyle, obesity,Tamilnadu

INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) has high prevalence in children but rarely recognised because of paucity of clinical features and radiological tests performed in children. It is characterized by fat accumulation in the hepatocytes without an apparent etiology. NAFLD is defined as the spectrum of chronic liver disease that occurs in persons without any known secondary causes of accumulation of fat in the liver, such as genetic or metabolic disorders, excessive alcohol consumption, hepatitis C, malnutrition, steatogenic medication like amiodarone, valproate etc, lipodystrophy, or inborn errors of metabolism. [1] NAFLD encompasses the abnormalities ranging from steatosis (increased liver fat without inflammation) to non-alcoholic steatohepatitis (NASH), where there is increased liver fat with inflammation, and advanced fibrosis, leading to cirrhosis and resulting in endstage liver disease and hepatocellular carcinoma. [2] NAFLD is considered to be a significant health problem which has substantially risen over the last few decades, with an estimated global prevalence as high as 1 billion. [3] Even recent studies have shown that the prevalence has been rising in children mainly in the adolescent age group (15-19 years) due to the role of pubertal hormones and obese children. [4, 5, 6] Boys seem to be affected more commonly than girls due to the fact that oestrogens may be protective, or androgens aggravate non-alcoholic steatohepatitis.

Though, NAFLD is not a recognized component of metabolic syndrome, many of the risk factors of NAFLD are closely associated with the constituents of metabolic syndrome, including abdominal obesity, hyper triglyceridemia, insulin resistance, diabetes, and hypertension as well as with polycystic ovary syndrome and obstructive sleep apnea, independent of the degree of obesity. [7, 8] The increasing prevalence of unhealthy eating habits and sedentary lifestyle also play an importantrole in its causation. [9] The prevalence of NAFLD in normal-weight children is reported to range about 3-10% whereas in overweight/obese children, it is estimated to be 8-80%, which is alarmingly high. [10]

This increasing burden of childhood obesity and related comorbidities has drawn the attention of treating physicians and documentation of the resultant effects is warranted. There is limited information about the prevalence and natural history of the problem of NAFLD among the adolescent children in south India. We undertook the current study to determine the prevalence of NAFLD and its association with obesity and other lifestyle factors among the adolescent school boys in our local population.

METHODOLOGY

Study design: This is a population-based cross sectional, descriptive study conducted to estimate the prevalence of non-alcoholic fatty liver among adolescentboys.

Study population and sampling: For the purpose of the current study, a convenient sample of 500 adolescent boys are selected from the government schools in rural town of Ambur, Tamilnadu.

Inclusion criteria: All the boys of 8^{th}, 9^{th} and 10^{th} classes studying in government school in Ambur who gave consent to participate in the study.

Exclusion criteria: Age > 18 years and students who did not give consent to participate in the study. Children with other primary liver disorders that could account for steatosis were also excluded.

All the study participants denied consumption of alcohol and use of steatogenic medications

Study period: June to July 2019

Study tools and variables: A self-designed, pretested semi structured questionnaire was used to collect the information. To evaluate the dietary habits, one soft drink was considered as a

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serving of 200 ml. One Junk food was taken as a serving of 100 gms of processed sugar rich foods and one Non veg was considered as a serving of 100 grams.

A detailed medical history and anthropometric measurements were taken. Abdominal circumference was measured at the midpoint of the line between the lower costal margin and iliac crest in the mid-axillary line using a measuring tape. The cut-off points suggested by Taylor RW et al [11] were used to identify abdominal obesity. Height was measured in standing position using a stadiometer and weight was taken on an electronic weighing scale by the same observer. Body Mass Index (BMI) was calculated as weight in kilograms divided by square of height in meters. The students were classified as "overweight" or "obese" based on Indian Academy of Pediatrics (IAP) age and gender-specific BMI guidelines.[12] Diagnosis of fatty liver was based on ultrasonography. Ultrasonography was done using Toshiba Appolo 500 expert machine using 2-5 MHz convex probe by a senior radiologist with 15 years of experience in doing Liver imaging. Ultrasound findings were categorized as follows: normal - homogenous texture, exhibited fine-level echoes and was minimally hyperechoic or isoechoic compared with normal renal cortex; Grade 1-characterized by mild increase in liver echogenicity and clear picture of hepatic and portal vein walls; Grade 2- increase in liver echogenicity obscuring the hepatic and portal vein walls; and Grade 3- increase in liver echogenicity and significant posterior shadowing that impairs evaluation the diaphragm.[13]

Ethical considerations: Ethical approval was obtained from the Departmental Ethics Committee of Medical Gastroenterology, Sri Ramachandra Institute of Higher Education and Research (SRMC), Chennai before the study was commenced. Permission was obtained from the school authorities and parents of the children after explaining the purpose and method of study and informed consent in the local language Tamil was taken from all the study participants before including them in the study.

Data analysis: Data was entered in Microsoft excel worksheet 2013 and analysed using SPSS trial version 21. Categorical variables were represented as proportions/percentages and quantitative variables were represented as mean ± standard deviation.

Independent student t test was used to determine the significant difference between the means of two groups. Chi-square test has been used to compare the discrete variables in regard to anthropometric measurements like BMI and Abdominal circumference with NAFLD. P value less than 0.05 is considered as statistical significance at 95% confidence intervals.

RESULTS:

A total of 500 adolescent boys were enrolled in the study. The mean (± standard deviation) age of the study participants was 15.44 (± 1.3) years with the minimum age of 12 years and maximum of 18 years. The descriptive statistics of the anthropometric measurements were presented in table 1. Regarding lifestyle factors, the mean intake of soft drinks per week was 1.38 in the study population. While the mean consumption of junk food and non-veg per week were 3.64 and 1.61 respectively. The study population reported an average time of 2.23 hours per day spent on watching TV. And the mean time engaged in physical activity was 2.37 hours (Table 1). The overall prevalence of overweight was observed to be 9.4% and obesity was only 3% in the study population. While abdominal obesity was noted in 34.6% (173 students).

The prevalence of NAFLD in the study group was estimated to be 4.2% (21 adolescents). All of them had grade 1 fatty liver findings on ultrasonography as shown in Figure 1. Regarding BMI, this study found that, only 6.7% adolescents who were obese had NAFLD, and 4.3% adolescents who were overweight were diagnosed with NAFLD. And abdominal obesity was noted in 2.9% of the children having NAFLD. On applying the Chi-square test, neither BMI

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nor Abdominal circumference had any significant association with NAFLD (Table 2). In the current study, on comparison of the risk factors in both the groups of normal and NAFLD patients, it was found that lifestyle factors like intake of soft drinks, consumption of non-veg and junk food and hours engaged in watching TV were significantly higher in NAFLD patients, compared to normal group. And the mean hours engaged in physical activity were lower in NAFLD group, and this was statistically significant, P = 0.0001* (Table 3).

Table 1: Descriptive statistics of the study population

Variable	Minimum	Maximum	Mean	Standard deviation
1. Anthropometric findings				
Height (cms)	133	185	159.88	10.55
Weight (kgs)	25	90	46.818	10.66
BMI (kg/m^2)	10.4	29.4	18.16	2.98
Abdominal circumference (cms)	35	121	76.26	11.52
2. Lifestyle factors				
Intake of soft drinks per week	0	7	1.38	1.132
Junk food consumed per week	0	30	3.64	4.150
Non-veg consumed per week	0	22	1.61	1.468
Number of hours watching TV perday	0	8	2.23	1.197
Number of hours engaged in physica activity per day	0	6	2.37	1.312

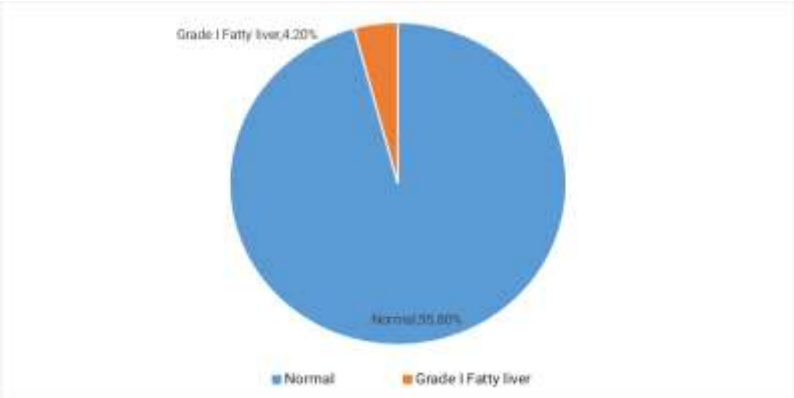

Figure 1: Ultrasonography findings

Table 2: Association between Anthropometric measurements and NAFLD

Variable	Normal	NAFLD	Total	P-value
1. BMI				
Underweight	292 (96.1%)	12 (3.9%)	304	
Normal	128 (95.5%)	6 (4.5%)	134	
Overweight	45 (95.7%)	2 (4.3%)	47	
Obese	14 (93.3%)	1 (6.7%)	15	0.960
2. Abdominal circumference				
Normal	311 (95.1%)	16 (4.9%)	327	
Abdominal obesity	168 (97.1%)	5 (2.9%)	173	0.288
Total	479	21	500	

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Table 3: Comparison of the means of the study variables in the two groups using independent samples t-test

Variables	N	Mean	SD	P value
1. Intake of soft drinks per week	479	1.35	1.116	
Normal NAFLD	21	1.95	1.359	**0.017***
2. Junk food consumed per week	479	3.29	3.475	
NormalNAFLD	21	11.67	8.392	**0.0001***
3. Non-veg consumed per week	479	1.54	1.374	
Normal NAFLD	21	3.14	2.455	**0.0001***
4. Number of hours watching TV perday	479	2.17	1.169	
Normal NAFLD	21	3.50	1.162	**0.0001***
5. Number of hours engaged in physicalactivity per day	479	2.42	1.299	**0.0001***
NormalNAFLD	21	1.29	1.157	

DISCUSSION

NAFLD is a multi-factorial disease as a result of a composite interaction between environmental factors, genetic background and nutritional factors like high-calorie diet, excess intake of saturated fats, refined carbohydrates and a high fructose intake along with sedentary behaviour which form the major contributors to the development of NAFLD. The paediatric NAFLD is an under-studied subject and remains unrecognized, though approximately 10-20% of the general paediatric population is affected.[14] Large gaps exist in the screening, diagnosis and management particularly during the transitional phase between paediatric and adult medical services. [15] Our study is one of its kind from South India which was designed to evaluate the prevalence of fatty liver in children, particularly in adolescents using ultrasonography as the sole diagnostic tool and to know its association with obesity and lifestyle factors adopted by them. Though cases of paediatric NAFLD are reported at a very young age, they are usually diagnosed clinically after the age of 10 years, as reported in the findings of Vajro P et al and Wildhalm K et al, where the mean age of diagnosis of NAFLD is reported to be 11-13 years. [15, 10] In the current study, the mean age of the study participants was estimated to be 15.44 (± 1.3) years. Among them, a total of 9.4% were overweight and only 3% were found to be obese. Abdominal obesity was noted in 34.6% children. On ultrasonography, fatty liver was documented in 4.2% of the selected children, of whom all had Grade-I liver changes. This is comparable to the findings of hospital based study from Delhi, where the prevalence was found to be 3% among 100 children aged 5-12 years. [16] Another study conducted on Kashmiri school children of age 4-18 years revealed NAFLD in 7.4% of all children (26% in obese children) . [17] A study in Haryana reported the prevalence of fatty liver in 22.4% children; 18.9% in normal-weight and 45.6% in overweight category. [18]

In our study, the prevalence of fatty liver in overweight and obese children was 6.7% and 4.3% respectively, while it was only 2.9% in children with high waist circumference. Neither BMI nor Abdominal circumference was found to have significant association with NAFLD. This finding was in contrast to the observationsmade by Irshad AP et al [17] and Das MK et al [18], where higher BMI and increased waist circumference were observed to be a statistically significant risk factors for fatty liver. This variation in the study findings could be due to difference in the age, gender and BMI criteria of the study population adopted in various studies. The data on association between lifestyle factors and NAFLD were limited, so we endeavoured to study them, so that the clinical management can be modified and unhealthy behaviours can be prevented in children accordingly. In the current study, on comparison of the lifestyle factors in both the groups of normal and NAFLDpatients, it was found that intake of soft drinks, consumption of non-veg diet and junk food and hours engaged in watching TV

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were significantly higher in NAFLD patients, compared to normal group. And the mean hours engaged in physical activity were lower in NAFLD group. This difference was statistically significant witha P value of 0.0001. This is consistent with the observations of Zelber-Sagi et al from his seven year prospective follow-up study, which showed that excess caloric consumption, unhealthy diet, sedentary lifestyle leading to obesity and related comorbidities are leading risk factors for NAFLD, regardless of baseline body mass index (BMI).[19] Another study conducted by Zelber-Sagi et al reported that NAFLD patients consume a larger quantity of soft drinks and meat than controls.[20] Several other previous studies also showed a significant association between meat (red meat) consumption and NAFLD. [21, 22] In the systemic review and meta-analysis conducted by K.Wijarnpreecha et al demonstrated a statistically significantassociation between sugar-sweetened soda consumption and NAFLD.[23]

Studies from various other countries like China [24], Israel [25] also reported similar results. In a recent review article by Mirmiran P et al concluded that there was a positive association between the Western dietary pattern like takeaway foods, red meats, processed meats, full-fat dairy products, fried potatoes, refined cereals,cakes and biscuits and confectionery and the risk of NAFLD.[26] This implies that lifestyle factors like unhealthy dietary pattern and sedentary lifestyle can be independent risk factors for the development of NAFLD in the adolescent children, irrespective of the baseline body mass index.

Limitations: The gold standard for diagnosis of fatty liver is liver biopsy, which is not done in the present study as it is not ethical to perform in healthy populations. The study results might vary if the study is conducted exclusively on overweight/obese children and included the private schools as well.

Conclusion: The results of the study indicate that the prevalence of fatty liver disease is 4.2% in the adolescent boys. On comparison of the risk factors, it was found that neither BMI nor Abdominal circumference had any significant associationwith NAFLD. While modifiable lifestyle factors like intake of soft drinks, consumption of non-veg, junk food and hours engaged in watching TV were significantly higher in NAFLD patients, compared to normal group. And the mean hours engaged in physical activity were lower in NAFLD group, and this difference was found to be statistically significant.

Recommendations:

- The school children, whether obese or not have to be made aware of the primary preventive measures and impart them early in life in order to achieve good results.
- A combination of dietary modifications like reduction in the consumption of saturated fatty acids, total fat, trans-fatty acids, and fructose and adequate consumption of diets rich in fruits and vegetables along with increased physical activity, which remains the mainstay of NAFLD management have to be adopted to have significant long-term benefits.

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