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Association between Body Mass Index (BMI) and the Incidence of Non-Alcoholic Fatty Liver Disease (NAFLD)

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ABSTRACT

Background: The prevalence of obesity among the population has risen dramatically due to a sedentary lifestyle. Obesity is a risk factor for the incidence of non-alcoholic fatty liver disease (NAFLD) and the prevalence of NAFLD rises to 90% in obese. NAFLD is a clinically silent disease that has become one of the most common causes of liver disease worldwide also due to multiple extrahepatic complications or comorbidities. This study aims to find the association between the Body mass index (BMI) and the incidence of NAFLD.

Method: This analytic study with a cross-sectional design was conducted on the 3rd of July 2022 in Boho Village, Samosir District of North Sumatra. The participants were based on a simple random sampling that meets the criteria of inclusion. BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m^2), meanwhile, we performed an abdominal ultrasound to diagnose NAFLD. Statistical analyses were performed using SPSS and using Chi-Square test to see the association between BMI and the incidence of NAFLD.

Result: Among of 48 participants, most of them were fatty liver grade 1 (31.25%), and Overweight/Obese (62.5%). The incidence of NAFLD is more prevalent in obese than non-obese participants (p = 0.0001).

Conclusion: The most of participants were fatty liver grade 1 (31.25%), and Overweight/Obese (62.5%). There was a significant association between BMI and the incidence of NAFLD.

Keywords: Overweight, Obesity, BMI, NAFLD

ABSTRAK

Latar Belakang: Prevalensi obesitas di antara populasi, telah meningkat secara dramatis karena gaya hidup yang tidak banyak bergerak. Obesitas merupakan faktor risiko untuk kejadian penyakit hati berlemak non-alkohol (NAFLD) dan prevalensi NAFLD meningkat menjadi 90% pada obesitas. NAFLD adalah penyakit secara klinis menjadi salah satu penyebab paling umum penyakit hati di seluruh dunia, juga beberapa menyebabkan komplikasi ekstrahepatik atau komorbiditas. Penelitian ini bertujuan untuk mengetahui hubungan antara indeks massa tubuh (IMT) dengan kejadian NAFLD.

Metode: Studi analitik dengan desain cross sectional ini dilakukan pada tanggal 3 Juli 2022 di Desa Boho, Kabupaten Samosir, Sumatera Utara. Dari para peserta pengambilan sampel secara acak sederhana yang memenuhi kriteria inklusi. IMT dihitung sebagai berat dalam kilogram dibagi dengan kuadrat tinggi dalam meter (kg /m2), dan dilakukan USG perut untuk mendiagnosis NAFLD. Analisis statistik dilakukan dengan menggunakan SPSS dan menggunakan uji Chi-Square untuk melihat hubungan antara IMT dan kejadian NAFLD.

Hasil: Kebanyakan dari partisipan adalah fatty liver grade 1 (31.25%), dan Overweight/Obese (62.5%). Insiden NAFLD lebih umum pada peserta obesitas daripada peserta non-obesitas (p = 0,0001).

Kesimpulan: Kebanyakan dari partisipan adalah fatty liver grade 1 (31,25%), dan Overweight / Obesitas (62,5%). Ada hubungan yang signifikan antara BMI dan kejadian NAFLD.
Kata kunci: Kegemukan, Obesitas, IMT, NAFLD

1. Introduction

Obesity is a global health problem, it has been estimated that approximately 1.9 billion adults worldwide are overweight, and among them about over 650 million adults are obese [1]. Obesity leads to the development of metabolic syndrome (MetS) and becomes a risk factor for many diseases and comorbidities, one of which is non-alcoholic fatty liver disease (NAFLD) [2]. The rising trends in obesity have been linked with the increase in the prevalence of NAFLD, Obese individuals have a 3.5-fold increased risk of developing NAFLD, and there is an obvious dose-dependent relationship between BMI and NAFLD risk [3]. NAFLD is mostly a silent disease with absent or subtle clinical manifestation, but nowadays it is becoming the most common cause of chronic liver disease in the United States, as well as worldwide. NAFLD also represents a new emerging risk factor for the onset of extra-hepatic tumors and rapidly increasing the indication of liver transplantation in the US. NAFLD as well as chronic hepatitis B (CHB) and chronic hepatitis C (CHC) were the most common causes of cirrhosis and HCC3 until recently, and this profile was also reflected in patients in need of an LT.4 Before 2013, treatment of HCV infection was interferon-based, which was poorly tolerated and associated with relatively low cure rates. Non-alcoholic fatty liver disease (NAFLD) is associated with developing hepatocellular carcinoma (HCC). There have been limited data on the association between NAFLD and extrahepatic cancers. The study demonstrated that patients with NAFLD showed a higher association with the development of HCC, colorectal cancer in males, and breast cancer in females. A high NAFLD fibrosis score and a high fibrosis-4 score showed a strong association with the development of all cancers and HCC [4–6]. The association between obesity and NAFLD has not been fully quantified, and the magnitude of NAFLD risk associated with obesity is still unclear. This systematic review and meta-analysis aimed to elucidate the association between obesity and NAFLD, which was the first meta-analysis on this subject. A better understanding of the association between obesity and the incidence of NAFLD could be useful in addressing these major public health issues. Therefore, this study aims to analyze the association between BMI and the incidence of NAFLD in Boho Village, Samosir District of North Sumatera.

2. Method

This is an analytic study with a cross-sectional design. This study was conducted on the 3rd of July 2022 in Boho Village, Samosir District of North Sumatra. It was based on a simple random sampling method. The inclusion criteria were: age > 18 years old, do not have a history or suffer from any kind of malignancy, and the subject is cooperative.

A total of 48 participants (32 men and 16 women with age >18 years old) were involved in this study. All subjects were asked to sign an informed consent agreement after knowing about the process. A standardized, structured questionnaire was administered by trained investigators to collect information such as alcohol consumption, medical history, and factors related to NAFLD. Steatosis is commonly categorized using the following grading system: Grade 0: The right liver lobe's echogenicity is normal when compared to the right kidney's cortex; Grade 1: There is a slight, diffuse increase in fine echoes in the liver parenchyma with normal diaphragm and intrahepatic vessel borders visualization; Grade 2: There is a moderate, diffuse increase in fine echoes with slightly impaired diaphragm and intrahepatic vessel borders visualization; Grade 3: There is a marked increase in fine echoes with poor or non-visualization of the intrahepatic vessel borders, diaphragm, and posterior right lobe of the liver. After investigation, all subjects underwent physical examination including the measurement of height and weight to evaluate Body mass index (BMI). BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m^2). We classified BMI according to the criteria proposed for Asian populations: lean (BMI < 23 kg/m2), overweight (BMI 23.0–24.9 kg/m2), or obese (BMI ≥ 25.0 kg/m2). Blood pressure was measured using a manual sphygmomanometer with the subject in a sitting position, and liver examination using an abdominal ultrasound to see the presence of fatty liver. The data is presented in tables and narratives.

2.1. Statistical analyses

Statistical analyses were performed using SPSS and using Chi-Square test to see the association between BMI and the incidence of NAFLD. The significance level is obtained if p-value <0.05.

3. Result

A total of 48 participants were involved in this study, including 16 women (66.67%) and 32 men (33.33%) with an age above 18 years old. A total of 26 (54.17%) and 25 (52.08%) participants had a history of hypertension and diabetes mellitus (DM) respectively, and 30 (62.5%) subjects were overweight or obese. Among 48 participants, 33 of them were found fatty liver using abdominal ultrasound, divided into 3 categories: 15 participants with fatty liver grade 1 (31.25%), 13 participants with fatty liver grade 2 (27.08%), and 5 participants with fatty liver grade 3 (10.42%) (Table 1).

Table 1. Characteristics of the participants

No.	Characteristics	N (48)	Percentage
1.	**Age (years)**		
	< 40	12	25
	≥ 40	36	75
2.	**Gender**		
	Man	32	66.67
	Woman	16	33.33
3.	**BMI (kg/m^2)**		
	Normal (< 23)	18	37.5
	Overweight/Obese (≥ 23)	30	62.5
4.	**Hypertension**		
	Yes	26	54.17
	No	22	45.83
5.	**DM**		
	Yes	25	52.08
	No	23	47.92
6.	**Ultrasound Result**		
	Normal	15	31.25
	Fatty Liver Grade 1	15	31.25
	Fatty Liver Grade 2	13	27.08
	Fatty Liver Grade 3	5	10.42

There was a significant association (p= 0.0001) between BMI and fatty liver using the Chi-Square test (Table 2).

Table 2. Association between BMI and fatty liver disease

BMI	Fatty Liver	No Fatty Liver	Sig.
Normal	6	12	
Over /Obese	27	3	0.0001
Total	33	15	

4. Discussion

Obesity and being overweight are major contributors to several grave health issues. A higher BMI is associated with an increased risk of health consequences. Elevated rates of overweight and obesity have been linked to the buildup of calories from overindulging in food and sugary drinks, leading a sedentary lifestyle, and engaging in insufficient physical exercise [7]. Simple random sampling was used to choose study participants, and 30 of the 48 participants were obese or overweight (62.5 percent). The World Health Organization (WHO) estimates that over 650 million adults globally are obese and that 1.9 billion adults are overweight. The percentage of overweight people in Indonesia is 13.6 percent, while the percentage of obese people is 21.8 percent, according to RISKESDAS data from 2018, which is two times more than the data from 2007 [8].

In this investigation, thirty of the forty-eight participants were obese or overweight. Participants were selected by simple random sampling (62.5 percent). Globally, over 650 million adults are obese, and nearly 1.9 billion adults are overweight, according to the World Health Organization. According to statistics from the RISKESDAS in 2018, there is a two-fold increase in the percentage of overweight people in Indonesia (13.6%) and obese people (21.8%) compared to data from 2007 [9,10]. This occurs as a result of the reduced ability of adipose tissue to store surplus energy in overweight and obese individuals; instead, hepatocytes store the excess lipids, primarily in the form of triglycerides. Additionally, the availability of free fatty acids (FFAs) in excess in the bloodstream causes insulin resistance and ectopic fat deposition [11]. Conversely, the buildup of extracellular fat causes adipose tissue to malfunction, resulting in a decrease in adipocytokine production and an increase in pro-inflammatory cytokines like TNF-α (Tumor Necrosis Factor-alfa). Additionally, it results in a decrease in anti-inflammatory adipokines including adiponectin, which may be linked to carcinogenesis, cirrhosis, NASH, and simple steatosis (SS) [12]. In this study, the liver examination revealed fatty liver in 27 out of 30 overweight/obese subjects (abdominal ultrasound). In addition, the Chi-Square test was used to examine the data and ascertain whether BMI and NAFLD were related. The findings indicated a strong correlation between fatty liver disease and BMI (p=0.0001). A study conducted in Iraq by Abdulhadi et al. (2022) showed that NAFLD is more common when BMI rises [13]. According to a long-term cohort study from the southeast region of Santiago carried out by Valeria et al. (2020), having obesity starting at age 2 significantly raises the likelihood of developing NAFLD in adolescence [14].

As mentioned in the introduction, NAFLD is increasingly the leading cause of chronic liver disease both in the US and globally. Moreover, NAFLD is a newly identified risk factor for the development of extra-hepatic malignancies and is quickly raising the recommendation for liver transplantation in the US. As mentioned in the introduction, NAFLD is increasingly the leading cause of chronic liver disease both in the US and globally. Moreover, NAFLD is a newly identified risk factor for the development of extra-hepatic malignancies and is quickly raising the recommendation for liver transplantation in the US [4–6]. It is now crucial to stop the occurrence of NAFLD since, in the absence of early treatment, harm to one's bodily and mental well-being could result. The development of lifestyle interventions is necessary to stop obesity and overweight. Parents and healthcare professionals should start teaching and educating individuals and kids at a young age about leading sedentary lifestyles, eating a healthy diet low in calories, fat, and sugar, and increasing physical activity such as low-intensity aerobic exercise two to three times a week [15]. This intervention can make a big difference in the future in preventing the incidence of NAFLD. Rui et al, findings from this dose-response analysis suggest that higher BMI (overweight/obesity) is an independent, dose-dependent risk factor for fatty liver, and prevention of fatty liver focusing on continuous changes in BMI should be noted [16], according to Martin et al., the risk of NAFLD varied by race/ethnicity and was highest in metabolically healthy overweight and obese people. Healthcare professionals should focus more on treating patients who fall into the metabolically healthy overweight or obese category, particularly those who are Mexican Americans [17]. According to Ying et al., there is a significant correlation between NAFLD in children and several physical indicators of obesity, such as BMI, waist circumference, triglyceride content, LDL, fasting blood glucose, and insulin resistance index. These indicators can be used as a guide for future clinical diagnosis and treatment efforts [18–20].

The strength research was carried out firstly in the ethnic Boho Village, Samosir District of North Sumatra, and the study has some limitations such as the small amount of sample and the cross-sectional method without blinding, that prevent homogenization of the sample. Further study using the prospective method and a larger sample size will be needed.

5. Conclusion

Among of 48 participants, most of them were fatty liver grade 1 (31.25%), and Overweight/Obese (62.5%). There was a significant association between BMI and the incidence of NAFLD in Boho Village, Samosir District of North Sumatera, and further study using the prospective method and larger sample size will be needed.

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