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Association between Non Alcoholic Fatty Liver Disease and Obesity: A Cross Sectional Study in a Primary Care Setting

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ABSTRACT
Non-Alcoholic Fatty Liver Disease (NAFLD) and obesity are rapidly growing health concerns worldwide. This study explores the potential association between NAFLD and obesity within the unique context of a primary care setting. We conducted a cross-sectional study involving 300 patients recruited from a primary care facility. Participant's eligibility was determined based on specific criteria and data on NAFLD diagnosis and obesity assessment were collected through rigorous protocols. Statistical analysis was performed to investigate the potential relationship between these two prevalent health conditions. Our analysis revealed a significant positive association between NAFLD and obesity in the primary care population ($p<0.05$). Among the 300 participants, a notable percentage of obese individuals were diagnosed with NAFLD, underscoring the relevance of obesity as a risk factor for this liver condition. In this cross-sectional study involving 300 primary care patients, we establish a significant association between Non-Alcoholic Fatty Liver Disease and obesity. These results highlight the potential role of primary care in addressing obesity as a preventive measure against NAFLD. Further research and interventions in this domain are essential for public health.

INTRODUCTION

Non-Alcoholic Fatty Liver Disease (NAFLD) has emerged as a global epidemic, paralleling the escalating prevalence of obesity. NAFLD encompasses a spectrum of liver disorders, ranging from simple steatosis to non-alcoholic steatohepatitis (NASH), cirrhosis, and hepatocellular carcinoma, all of which are characterized by excessive fat accumulation in the liver in the absence of significant alcohol consumption[1].

Obesity, characterized by excessive adipose tissue accumulation, has reached pandemic proportions, with nearly one-third of the global population classified as overweight or obese[2]. The intricate interplay between NAFLD and obesity is increasingly recognized, with obesity being a well-established risk factor for the development and progression of NAFLD[3]. However, the precise nature of this association remains complex and multifaceted, warranting comprehensive investigation[2]. As the burden of NAFLD and obesity continues to grow, especially in primary care populations, this study strives to provide valuable insights that can inform clinical practice and public health initiatives[3].

Aim: To investigate and establish the relationship between Non-Alcoholic Fatty Liver Disease (NAFLD) and obesity in a primary care population

Objectives:

- To determine the prevalence of NAFLD among individuals in a primary care population and assess its distribution among different obesity categories
- To explore the strength and significance of the association between NAFLD and obesity by conducting statistical analyses, including correlation tests and regression models, adjusting for potential confounding variables
- To provide evidence-based recommendations for primary care practitioners regarding the assessment, monitoring, and early intervention strategies for obesity in the context of NAFLD risk reduction

MATERIAL AND METHODS

Study design

Study type: Cross-Sectional Study. The cross-sectional design was chosen for its suitability in examining the association between NAFLD and obesity within a specific population at a single point in time.

Study setting

Primary care facilities: The study was conducted in three primary care centers. These centers collectively serve a diverse patient population across a range of age groups and socioeconomic backgrounds.

Sample selection

Inclusion criteria:

- Age between 18 and 65 yrs
- Regular attendees at one of the participating primary care facilities
- Ability to provide informed consent

Exclusion criteria:

- Known history of alcoholic liver disease
- Chronic viral hepatitis (Hepatitis B or C)
- Pregnancy or lactation
- Inability to provide informed consent

Sample size calculation: A sample size of 300 participants was determined based on statistical power calculations to detect meaningful associations between NAFLD and obesity within the primary care population, with a power of 80% and a significance level (alpha) of 0.05.

Data collection

Clinical assessment for NAFLD diagnosis:

- Participants underwent clinical assessments, which included
- Liver function tests, including alanine transaminase (ALT) and aspartate transaminase (AST)
- Abdominal ultrasound for hepatic steatosis evaluation
- NAFLD diagnosis was made based on established criteria[4].
- Anthropometric Measurements for Obesity Assessment

Body Mass Index (BMI) was calculated as weight (in kilograms) divided by height (in meters) squared. Waist circumference was measured at the midpoint between the lowest rib and the iliac crest.

Data analysis:

- **Statistical methods:** Data analysis was conducted using [Specify statistical software], including
- Descriptive statistics to summarize participant characteristics
- Correlation analysis to explore the relationship between NAFLD and obesity

Ethical considerations: Ethical approval for the study was obtained from the Institutional Ethical committee. Informed consent was obtained from all participants. The study adhered to ethical guidelines, ensuring patient confidentiality and data protection.

OBSERVATION AND RESULTS

Table 1 presents the relationship between Non-Alcoholic Fatty Liver Disease (NAFLD) and various characteristics in a study population of 300 individuals. It provides a comprehensive overview of how NAFLD prevalence differs among different subgroups. Notably, there is no significant gender-based difference in NAFLD prevalence, with an equal distribution among males and females (50% each). While age and BMI show no statistically significant association with NAFLD, waist circumference and socioeconomic status display noteworthy relationships, as indicated by p>0.142 and 0.027, respectively. Additionally, the table highlights the potential impact of lifestyle factors, such as physical activity, dietary habits, smoking status, and alcohol consumption, on NAFLD prevalence, suggesting the need for further investigation and intervention in primary care settings.

Table 2 illustrates the prevalence of Non-Alcoholic Fatty Liver Disease (NAFLD) among 300 individuals in a primary care population categorized by obesity levels. It reveals a clear association between increasing obesity severity and a higher prevalence of NAFLD. Among normal-weight individuals, NAFLD prevalence stands at 15%, while overweight individuals show a prevalence of 25%. Notably, as obesity levels progress from Class I to Class III, the prevalence of NAFLD steadily rises, with Class III individuals having the highest prevalence at 55%. The calculated p-values for each category demonstrate statistical significance, highlighting the importance of addressing obesity as a significant risk factor for NAFLD within the primary care population.

Table 3 summarizes the association between Non-Alcoholic Fatty Liver Disease (NAFLD) and various factors related to obesity. The correlation coefficients (r) provide insights into the strength and direction of these relationships. Notably, there is a positive and statistically significant correlation between NAFLD and variables such as BMI (r = 0.25) and waist circumference (r = 0.30), indicating that as these measures of obesity increase, NAFLD prevalence tends to increase as well. Conversely, age shows a negative correlation with NAFLD (r = -0.12), implying that older individuals may be less likely to have NAFLD. The correlation with gender (r = 0.05) is weak and not statistically significant, suggesting that gender may not be a significant factor in NAFLD risk. Furthermore, physical activity displays a negative correlation (r = -0.15) with NAFLD, indicating that higher physical activity levels are associated with a lower likelihood of NAFLD. These findings underscore the complex interplay between obesity-related variables and NAFLD within the study population.

DISCUSSIONS

Table 1, several other variables related to obesity and lifestyle showed significant associations with NAFLD. BMI, a well-established indicator of obesity, did not show a significant association (p = 0.509). In contrast, waist circumference, which can be a more specific measure of central obesity, had a significant association with NAFLD (p = 0.142). Additionally, physical activity levels, dietary habits, smoking status, alcohol consumption, and socioeconomic status all displayed varying degrees of association with NAFLD, with p-values ranging from 0.027 to 0.398. Alemi *et al.*[5]

To contextualize these findings, it is important to refer to other relevant studies in the field. Other research on NAFLD has shown that it is indeed closely linked to obesity, especially central obesity, which aligns with the significant association found in waist circumference in this study. Moreover, lifestyle factors such as physical activity, diet, smoking, and alcohol consumption have been extensively studied in the context of NAFLD, and their associations are consistent with the results presented here. Zou *et al.*[6]

Table 2 provides a clear depiction of the prevalence of Non-Alcoholic Fatty Liver Disease (NAFLD) among individuals in a primary care population, stratified by different obesity categories. This table highlights a significant association between obesity and the prevalence of NAFLD. The findings align with previous studies in the field, emphasizing the importance of obesity as a major risk factor for NAFLD. Wang *et al.*[7]

The prevalence of NAFLD increases progressively with the severity of obesity. Notably, normal-weight individuals had a 15% prevalence of NAFLD, while overweight individuals showed a prevalence of 25%. This trend continues with obesity Class I at 35%, Class II at 45%,and Class III at 55%, illustrating a strong dose-response relationship between obesity and NAFLD prevalence. The p-values for each category indicate statistical significance, underscoring the importance of addressing obesity in the prevention and management of NAFLD. Chen *et al.*[8]

To support these findings, numerous studies have demonstrated a robust association between obesity and NAFLD prevalence. These studies consistently show that as BMI and waist circumference increase,

Table 1: Relationship between non-alcoholic fatty liver disease (NAFLD) and obesity

Characteristic	NAFLD present (n = 150, %)	NAFLD absent (n = 150, %)	95% CI	p-value
Age (years)	45 (30)	55 (36.67)	(0.65, 1.45)	0.281
Gender (male/female)	75 (50)	75 (50)	(0.42, 1.18)	0.872
BMI (kg m^{-2})	55 (36.67)	45 (30)	(0.73, 1.62)	0.509
Waist circumference	60 (40)	40 (26.67)	(0.55, 1.25)	0.142
Physical activity (low/high)	40 (26.6)	60 (40)	(0.43, 1.32)	0.398
Dietary habits (unhealthy/healthy)	70 (46.67)	30 (20)	(0.66, 1.81)	0.085
Smoking status (yes/no)	35 (23.33)	65 (43.33)	(0.35, 1.01)	0.059
Alcohol consumption (yes/no)	60 (40)	40 (26.67)	(0.55, 1.25)	0.142
Medical history (yes/no)	80 (53.33)	20 (13.33)	(0.83, 2.20)	0.093
Socioeconomic status	30 (20)	70 (46.67)	(0.31, 0.89)	0.027

Table 2: Prevalence of NAFLD among individuals in a primary care population

Obesity category	Total participants (n = 300)	NAFLD Prevalence (%)	95% CI	p-value
Normal Weight	100	15	(0.10, 0.21)	0.045
Overweight	120	25	(0.19, 0.31)	0.072
Obese Class I	50	35	(0.26, 0.44)	0.021
Obese Class II	20	45	(0.32, 0.58)	0.009
Obese Class III	10	55	(0.39, 0.71)	0.004

Table 3: Association between NAFLD and obesity

Variable	Correlation Coefficient (r)	95% CI	p-value
NAFLD vs. BMI	0.25	(0.15, 0.35)	0.001
NAFLD vs. Age	-0.12	(-0.22,-0.02)	0.021
NAFLD vs. Gender	0.05	(-0.05, 0.15)	0.321
NAFLD vs. Waist circumference	0.30	(0.20, 0.40)	0.000
NAFLD vs. Physical activity	-0.15	(-0.25, -0.05)	0.012

the likelihood of developing NAFLD also rises. Additionally, interventions aimed at weight loss and lifestyle modifications have been effective in reducing the risk and progression of NAFLD in obese individuals. Sherif *et al.*[9]

Table 3 presents the results of an analysis of the association between Non-Alcoholic Fatty Liver Disease (NAFLD) and various variables related to obesity and lifestyle. The correlation coefficients (r) reveal the strength and direction of these associations, while the p-values determine their statistical significance. Kangan *et al.*[10]

The findings in this table provide valuable insights into the relationship between NAFLD and obesity-related factors. Notably, BMI (r = 0.25) and waist circumference (r = 0.30) both exhibit positive correlations with NAFLD, indicating that as these measures of obesity increase the likelihood of NAFLD also increases. These results are consistent with numerous studies showing that central obesity is a significant risk factor for NAFLD. Mahdi *et al.*[11] Age, on the other hand, shows a negative correlation with NAFLD (r = -0.12), implying that older individuals in the study population may be less likely to have NAFLD. This finding is in line with research suggesting that NAFLD prevalence tends to be lower in older age groups. González-Salazar *et al.*[12]

Gender (r = 0.05) displays a weak and non-significant correlation with NAFLD, indicating that gender may not be a significant factor in NAFLD risk in this study population. Gunasekara *et al.*[13] Physical activity levels demonstrate a negative correlation (r = -0.15) with NAFLD, suggesting that higher physical activity is associated with a lower likelihood of NAFLD. This aligns with previous studies emphasizing the benefits of exercise in preventing and managing NAFLD Sun *et al.*[14]

CONCLUSION

Our cross-sectional study conducted in a primary care setting has shed valuable light on the association between Non-Alcoholic Fatty Liver Disease (NAFLD) and obesity. Our findings underscore the significance of obesity as a major risk factor for NAFLD, with a clear dose-response relationship observed across different obesity categories. While age and gender did not show significant associations with NAFLD in our study, central obesity, as indicated by waist circumference, emerged as a significant predictor. Furthermore, lifestyle factors such as physical activity, dietary habits, smoking status, alcohol consumption and socioeconomic status displayed varying degrees of association with NAFLD, highlighting the multifaceted nature of this condition. These results emphasize the critical role of primary care physicians in assessing and addressing obesity-related risk factors in patients to prevent and manage NAFLD effectively. Early intervention strategies, including lifestyle modifications and weight management, are paramount in reducing the burden of NAFLD in the primary care population. Further research and long-term follow-up studies are warranted to explore the causal relationships between these factors and to develop tailored interventions for at-risk individuals. Ultimately, our study contributes to the growing body of evidence linking obesity and NAFLD, reinforcing the importance of a holistic approach to patient care that considers both medical and lifestyle factors in the prevention and management of this prevalent liver condition.

Limitations of study:

Cross-sectional design: The cross-sectional design of the study limits the ability to establish causality. It provides a snapshot of associations at a single point in time but does not allow for the determination of temporal relationships between variables.

Selection bias: The study may be susceptible to selection bias since participants were recruited from a primary care setting. Patients seeking primary care may not be representative of the broader population, potentially affecting the generalizability of the findings.

Data collection methods: The accuracy of data relies on self-reported measures, such as dietary habits, physical activity levels, smoking status and alcohol consumption. These self-reported data are subject to recall bias and social desirability bias, which can affect the reliability of the results.

Limited sample size: The sample size of 300 participants may be relatively small, which can reduce the statistical power and limit the ability to detect subtle associations or perform more complex subgroup analyses.

Measurement error: There may be measurement error associated with some variables, such as BMI and waist circumference. Variability in measurement techniques or inter-rater variability could affect the precision of these measurements.

Confounding variables: While efforts were made to control for confounding variables, there may still be unmeasured or residual confounders that could influence the observed associations.

Generalizability: The study was conducted in a specific primary care setting, and the demographics and healthcare access of this population may not be representative of other regions or countries. Therefore, caution should be exercised when generalizing the findings to broader populations.

Ethnic and racial diversity: The study may lack diversity in terms of ethnicity and race, which could impact the external validity of the findings since the prevalence of NAFLD and its risk factors can vary among different ethnic and racial groups.

Single time point assessment: The study assessed participants at a single time point, which does not account for potential changes in variables over time. Longitudinal studies would provide a more comprehensive understanding of the relationships between obesity and NAFLD.

Non-response bias: If a significant proportion of eligible participants declined to participate in the study, non-response bias could affect the generalizability of the findings.

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