Journal of Clinical and Medical Images

Research Article

ISSN: 2640-9615 | Volume 8

Nutrition In NAFLD – Non-Alcoholic Fatty Liver Disease With Laboratory Monitoring NAFLD And Obesity In Mediterian Country - A New Pandemic Diseases?

Melanija Ražov Radas[1,2*], Karla Kalcina Saric[3] and Franka Radas[4]

[1]Clinic for Internal Medicine, Department of Gastroenterology, Zadar General Hospital, Zadar, Croatia

[2]Department of Health Studies, University of Zadar, Zadar, Croatia

[3]Special Orthopedic Hospital Biograd na Moru, Biograd na Moru, Croatia

[4]Faculty of Medicine, University of Rijeka, Rijeka, Croatia

[*]Corresponding author:

Melanija Ražov Radas,
Clinic for Internal Medicine, Department of Gastroenterology, Zadar General Hospital, 23000 Zadar, Croatia

Received: 16 Jan 2025

Accepted: 29 Jan 2025

Published: 03 Feb 2025

J Short Name: JCMI

Citation:

Melanija Ražov Radas, Nutrition In NAFLD – Non-Alcoholic Fatty Liver Disease With Laboratory Monitoring NAFLD And Obesity In Mediterian Country - A New Pandemic Diseases?. J Clin Med Img. 2025; V8(7): 1-11

Keywords:

Case Report; Bone Regeneration; Dental Implants; Esthetics; Dental Prosthesis

1. Abstract

Non-alcoholic fatty liver disease (NAFLD) is the most common chronic liver disease, affecting a quarter of the global population and is considered a serious public health issue. Approximately 90% of those with NAFLD also suffer from metabolic syndrome, including obesity, type 2 diabetes, and dyslipidemia. NAFLD is a multisystem disease, often associated with kidney disease, cardiovascular diseases, and diabetes. It can progress from simple steatosis to more severe forms like non-alcoholic steatohepatitis (NASH), whichcanlead to cirrhosis or hepatocellular carcinoma. The research showed that education on proper nutrition did not significantly improve laboratory findings in patients with NAFLD, considering the absence of statistically significant differences in liver enzyme values between the first and control visit. Although the measures taken were aimed at promoting healthy eating patterns, the results indicate difficulties in adopting the recommended changes. A new term used in the literature is MASLD – Metabolic dysfunction-associated steatotic liver disease.

2. Introduction

Non-alcoholic fatty liver disease (NAFLD) is the most common chronic liver disease and affects a quarter of the world's population; it became a global public health problem. It is believed that NAFLD could become the most common indication for liver transplantation by 2030 [1,2]. About 90% of NAFLD patients also suffer from at least one component of the metabolic syndrome (MetS). The metabolic syndrome itself includes: obesity, diabetes mellitus type 2, dyslipidemia, and arterial hypertension [3]. NAFLD is not a disease that only affects the liver, but also affects non-hepatic diseases, for this reason it is now considered a multi-system disease and is most often associated with with kidney diseases, cardiovascular diseases and diabetes mellitus type 2. NAFLD is divided into non-alcoholic fatty liver disease, simple steatosis (NAFLD) as a milder form of the disease and non-alcoholic fatty liver disease steatohepatitis (NASH) is a more severe form of the disease [4]. Although NAFLD was thought to be a harmless disease characterized by benign changes in the liver parenchyma with a very low risk of liver failure and fibrosis, recent studies show that these patients have a higher risk of disease progression to the development of cirrhosis and hepatocellular carcinoma (HCC) [5, 6]. NASH occurs due to increased fat accumulation and when lipids damage hepatocytes, the so-called lipotoxicity. Patients with NASH are often middle-aged and obese, with concomitant diabetes or hyperlipidemia, but NASH also occurs in younger, otherwise healthy individuals and even in children. Also, NASH can result in liver cancer and cirrhosis, while HCC is more often diagnosed at an older age already in an advanced stage [7,3].

2.1. Epidemiology

The current prevalence of NAFLD is 30% of the world's popula-

tion [8]. According to data from the World Health Organization, around 1 billion people worldwide are currently obese. NAFLD affects as many as 55-95% of obese people, while 15-55% have NASH. About 330 million people in the world today suffer from diabetes mellitus type 2, and 60-80% of them suffer from NAFLD, while 20-75% have NASH. Considering the rate of increase in the incidence of some of the diseases of the metabolic syndrome of the liver in the next 10 years, NAFLD and NASH will become the main end-stage diseases of hepatology, while that place is currently held by alcoholic liver disease and hepatitis C [3]. People with excess body weight have 7 times greater chance of developing NAFLD [9]. As many as 7% of people of normal body weight get NAFLD, and it occurs more often in women, younger people, and people with insulin resistance and hypercholesterolemia [10]. Regardless of the increase in the prevalence of the disease itself, diagnosis and treatment are not at a sufficient level in medical practice [6]. The prevalence of NAFLD and NASH is higher in men in the reproductive period compared to women. The highest prevalence in men is between 41-50 years, and in women >60 years [11].

2.2. Pathogenesis

The liver has a unique role in lipid metabolism because it is the site of lipid intake, synthesis, oxidation and distribution of lipids in the surrounding tissues [12]. The theory of «two hits» is the most accepted when understanding the histopathology of NAFLD. The «first hit» refers to the accumulation of fat, especially fatty acids and triglycerides, as a result of insulin resistance. The «second blow» is characterized by B oxidation of fatty acids with the articulation of anti-inflammatory cytokines, which consequently leads to inflammation, apoptosis or necrosis of hepatocytes [6]. Due to increased energy intake and reduced consumption, all excess energy is stored in the form of lipids. Excess lipids in such an unbalanced state accumulate in other parts of the body. Insulin plays a major role in the treatment of NAFLD because it has an antilipolytic effect, is a very important mediator in the storage of triglycerides in adipose tissue, and promotes the esterification and storage of fatty acids [12]. Fatty acid is stored in the form of lipid droplets. It works on the principle of a «battery» in which excess energy is stored, which is then released as needed. When insulin resistance occurs, the antilipolytic effect of insulin is lower and white adipose tissue is broken down. The breakdown of adipose tissue leads to a large release of fatty acids, which are then stored in the liver as triglycerides. In this way, they create ectopic lipid deposits and cause NAFLD [2]. Western lifestyle, reduced physical activity and diet enriched with calories are considered the most important factors for the development of NAFLD. The accumulation of fat in the liver and the development of NAFLD include the entry of fatty acids into the liver, synthesis of lipids, oxidation and export of triglycerides in the form of very low density lipoproteins [13, 14]. Most patients suffering from NAFLD do not show any symptoms of the disease. The disease is most often discovered accidentally during an abdominal ultrasound, where hepatomegaly and steatosis are detected [15]. A certain part of patients complains of fatigue and discomfort in the upper right quadrant and weakness. Diagnoses such as NASH or NAFLD are often detected in laboratory findings due to deviations in the findings of liver enzyme aminotransferases, ALT-alanine aminotransferases with an expected increase of 1.5-5 times above the reference values, and an increase in GGT-gamma-glutamyl transferases. Although NAFLD can be suspected by the laboratory finding of abnormal reference values of ALT and GGT, there are exceptions in which aminotransferase values are normal and NAFLD and NASH are present [10]. Reference values ALT (12-48), AST (11-38), GGT (11-55) (General Hospital Zadar). From 48 to 100% of patients with NASH do not have any symptoms and are discovered during medical tests for other diseases. Critical factors for the development of NAFLD and NASH are: obesity, diabetes mellitus TYPE II, insulin resistance, age > 50 years. When taking anamnestic data, it is very important to rule out the consumption of alcohol, drugs, medications (which can lead to toxic liver damage), sudden weight loss, and the presence of viral hepatitis [15]. Symptoms are usually associated with metabolic syndrome disorders: obesity, hypertension, diabetes mellitus TYPE II and dyslipidemia and complications of the disease itself such as fibrosis, liver cirrhosis, HCC and hyperlipidemia [2]. Initially, a healthy liver develops NAFLD with hepatocellular steatosis as the main feature. If left untreated, NAFLD can progress to a more serious form known as nonalcoholic steatohepatitis (NASH), which involves inflammation and fibrosis in addition to hepatocellular steatosis. As the disease progresses, NASH can lead to cirrhosis and then to hepatocellular carcinoma (HCC) (Figure 1).

2.3. Biochemical Tests

LDL is increased and HDL is decreased, there is also an increased level of glucose in the blood as well as glycosylated hemoglobin (HbA1c) [16]. The European Society for Liver Diseases (EASL) has determined the limits of alcohol consumption per day, which is 20 g per day for women and 30 g for men, and thus determined the limits for determining liver disease caused by alcohol [10].

Table 1: Value - ALT – all subjects.

t-Test: Paired Two Sample for Means		
	ALT - first visit	*ALT - control*
Mean	42,575	48
Variance	774,5070513	823,0769231
Observations	40	40
Pearson Correlation	0,726143179	
Hypothesized Mean Difference	0	
df	39	
t Stat	-1,639344093	
P(T<=t) one-tail	0,054592378	
t Critical one-tail	1,684875122	
P(T<=t) two-tail	0,109184756	
t Critical two-tail	2,02269092	

Difference between first visit and control: t-statistic: -1.639, p-value (two-tail): 0.109. That is, there is no statistically significant difference between the ALT values at the first visit and the control (Table 1).

Table 2: Value - ALT - difference according to gender.

ftestfor variance	0,938196	
t-Test: Two-Sample Assuming Equal Variances		
gender	*Male*	*Female*
Mean	8,740741	-1,46154
Variance	424,4302	427,9359
Observations	27	13
Pooled Variance	425,5373	
Hypothesized Mean Difference	0	
df	38	
t Stat	1,465048	
P(T<=t) one-tail	0,075567	
t Critical one-tail	1,685954	
P(T<=t) two-tail	0,151133	
t Critical two-tail	2,024394	

Gender difference: t-statistic: 1.465, p-value (two-tail): 0.151. That is, there is no significant difference in ALT changes between men and women(Table 2).

Table 3: Value- ALT - according to age.

ftestfor variance	0,651569478	
t-Test: Two-Sample Assuming Equal Variances		
age	*< 55*	*> 55*
Mean	8,941176471	2,826087
Variance	383,6838235	480,8775
Observations	17	23
Pooled Variance	439,9538296	
Hypothesized Mean Difference	0	
df	38	
t Stat	0,911502052	
P(T<=t) one-tail	0,183888641	
t Critical one-tail	1,68595446	
P(T<=t) two-tail	0,367777283	
t Critical two-tail	2,024394164	

Difference according to age: t-statistic: 0.911, p-value (two-tail): 0.368. That is, there is no significant difference in ALT changes between people younger and older than 55 years (Table 3).

Table 4: Value - AST- all subjects.

t-Test: Paired Two Sample for Means		
	AST-first visit	*AST-control*
Mean	38,7	36,225
Variance	775,9589744	460,1275641
Observations	40	40
Pearson Correlation	0,40074057	
Hypothesized Mean Difference	0	
df	39	
t Stat	0,568860741	
P(T<=t) one-tail	0,28635613	
t Critical one-tail	1,684875122	
P(T<=t) two-tail	0,57271226	
t Critical two-tail	2,02269092	

Difference between first visit and control: t-statistic: 0.568, p-value (two-tail): 0.572. There is no statistically significant difference between the AST values at the first visit and control(Table 4).

Table 5: Values according to gender.

ftestfor variance	0,223477595	
t-Test: Two-Sample Assuming Equal Variances		
gender	*Male*	*Female*
Mean	-2,111111111	-3,23077
Variance	918,5641026	469,6923
Observations	27	13
Pooled Variance	776,8151147	
Hypothesized Mean Difference	0	
df	38	
t Stat	0,119000877	
P(T<=t) one-tail	0,452950773	
t Critical one-tail	1,68595446	
P(T<=t) two-tail	0,905901545	
t Critical two-tail	2,024394164	

Gender difference: t-statistic: 0.119, p-value (two-tail): 0.905. There is no significant difference in AST changes between men and women (Table 5).

Table 6: Differences AST according to age.

ftestfor variance	0,062518361	
t-Test: Two-Sample Assuming Equal Variances		
age	*< 55*	*>55*
Mean	-0,722222222	-3,90909
Variance	426,6830065	1055,991
Observations	18	22
Pooled Variance	774,4586656	
Hypothesized Mean Difference	0	
df	38	
t Stat	0,360315251	
P(T<=t) one-tail	0,360303259	
t Critical one-tail	1,68595446	
P(T<=t) two-tail	0,720606518	
t Critical two-tail	2,024394164	

Difference according to age: t-statistic: 0.360, p-value (two-tail): 0.720. There is no significant difference in AST changes between people younger than and older than 55 years(Table 6).

Table 7: GGT values- all subjects.

t-Test: Paired Two Sample for Means		
	GGT - first visit	*GGT - control*
Mean	108,9655172	116,3793103
Variance	20018,24877	19007,3867
Observations	29	29
Pearson Correlation	0,97312	
Hypothesized Mean Difference	0	
df	28	
t Stat	-1,225259488	
P(T<=t) one-tail	0,115342379	
t Critical one-tail	1,701130934	
P(T<=t) two-tail	0,230684757	
t Critical two-tail	2,048407142	

Difference between first visit and control: t-statistic: -1.225, p-value (two-tail): 0.231. There is no statistically significant difference between the GGT values at the first visit and the control (Table 7).

Table 8: GGT values according to gender.

ftestfor variance	0,02403	
t-Test: Two-Sample Assuming Unequal Variances		
gender	*Male*	*Female*
Mean	8,578947	5,2
Variance	603,5906	2087,733
Observations	19	10
Hypothesized Mean Difference	0	
df	12	
t Stat	0,217865	
P(T<=t) one-tail	0,415598	
t Critical one-tail	1,782288	
P(T<=t) two-tail	0,831195	
t Critical two-tail	2,178813	

Gender difference: t-statistic: 0.218, p-value (two-tail): 0.831. There is no significant difference in GGT changes between men and women(Table 8).

Table 9: GGT values according to age.

ftestfor variance	0,820132	
t-Test: Two-Sample Assuming Equal Variances		
gender	*< 55*	*>55*
Mean	-0,75	13,17647
Variance	959,4773	1113,154
Observations	12	17
Pooled Variance	1050,545	
Hypothesized Mean Difference	0	
df	27	
t Stat	-1,13959	
P(T<=t) one-tail	0,132233	
t Critical one-tail	1,703288	
P(T<=t) two-tail	0,264465	
t Critical two-tail	2,051831	

Difference according to age: t-statistic: -1.139, p-value (two-tail): 0.264. There is no significant difference in GGT changes between people younger than and older than 55 years (Table 9).

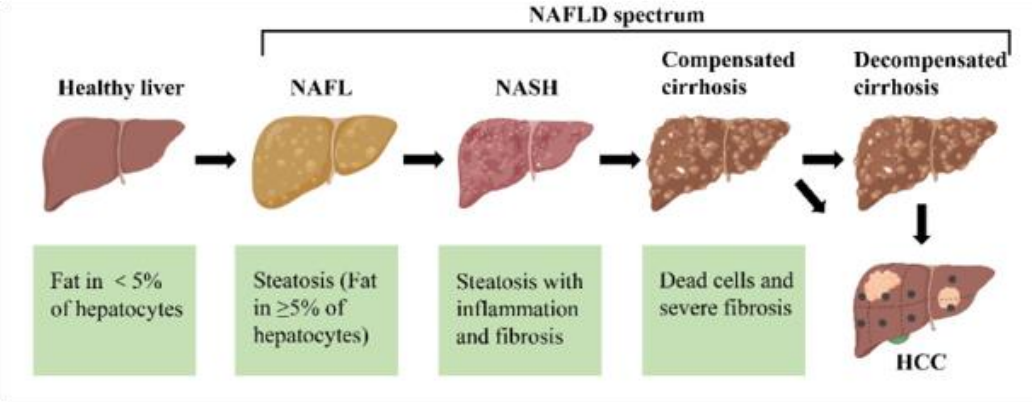

Figure 1: Different stages of non-alcoholic fatty liver disease.
Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9779435/pdf/ijms-23-15489.pdf Retrieved: 15.05.2024.

2.4. Diagnostics

Diagnostic methods are divided into invasive and non-invasive [17]. Liver biopsy (invasive method) is considered the most important examination in the diagnosis of NAFLD and is performed in two ways; endoscopic ultrasound and percutaneous approach [17]. In endoscopic ultrasound, an endoscope is introduced into the digestive tract through the patient's mouth. Using ultrasound, the doctor can precisely locate the liver and guide the biopsy needle through the wall of the stomach or duodenum into the liver. This method is especially useful for patients in whom percutaneous biopsy is not suitable or carries a higher risk, and allows taking samples from hard-to-reach parts of the liver [18]. Percutaneous access is performed with the help of a needle that takes a sample of liver tissue for analysis under a microscope. It serves to determine the degree of steatosis and the stage of fibrosis. The test itself has a very low risk of complications, and is the most reliable when determining the level of activity of inflammation in the liver [17, 3]. Non-invasive methods are divided into physical and biochemical. Non-invasive physical methods include: ultrasound (US), computed tomography (CT), magnetic resonance (MR) and magnetic resonance proton spectroscopy [20]. Abdominal ultrasound (US) is the first and most accessible method of imaging the liver. In cases where the percentage of steatosis is less than 20%, the sensitivity of the method is low. It's difficult presentation in obese persons. Any negative finding does not exclude the possibility of the presence of mild steatosis. The use of magnetic resonance (MR) and computerized tomography is limited by the high cost, while with CT, people are exposed to radiation. The best method for diagnosing fatty liver is magnetic resonance proton spectroscopy [10]. Laboratory blood tests can often reveal elevated values of alanine aminotransferase (ALT), and the ratio between ALT and AST (aspartate aminotransferase) is less than 1. Gamma-glutamyl transferase (GGT) is also elevated, while the increase in ALT ranges from 1.5- 4 times over reference values. In cases of liver cirrhosis, there is an increase in serum albumin, prothrombin time and bilirubin. Moderate elevation of ferritin occurs in 20-50% of all patients. The values of HDL(High-density lipoprotein) and LDL(Low-density lipoprotein) also vary depending on the disease itself, so if the level of HDL cholesterol is lowered while the level of LDL cholesterol is raised [21]. Fibro Scan is a device that applies vibration-controlled transient elastography (VCTE) to measure the elasticity of the liver, thus enabling the assessment of the degree of fibrosis. This technology is often used as a non-invasive alternative to liver biopsy to evaluate fibrosis and cirrhosis in patients with NAFLD [22].

2.5. Treatment

NAFLD requires a variety of treatment approaches, including lifestyle changes, medications, surgery, and comorbidity management [23]. Lifestyle changes are key, including weight loss and physical activity, while medications and surgery are used for patients who they do not achieve adequate results by changing their lifestyle [24]. For patients diagnosed with non-alcoholic steatohepatitis (NASH), it is recommended to reduce body weight by 7-10%. Body weight reduction is achieved through diet and physical activity [23]. Studies have shown that increased physical activity can reduce liver fat and reduce blood levels of ALT (alanine aminotransferase), an indicator of liver health. Most patients with NAFLD are inactive, and regular physical activity can significantly reduce hepatic steatosis [23]. Regular physical activity improves the metabolic profile and reduces cardiovascular risks, reduces visceral fat and total body weight, risks in patients with NAFLD [25, 26]. It also improves insulin sensitivity, reduces inflammation and helps mobilize and oxidize fat, which reduces hepatic steatosis [26]. Pharmacological treatment of NAFLD includes various drugs aimed at reducing inflammation, oxidative stress, insulin resistance and fibrosis. Pharmacological therapy is recommended for patients who do not achieve satisfactory results with lifestyle changes, have biopsy-proven non-alcoholic steatohepatitis (NASH) with liver fibrosis (stage ≥ 2) or have risk factors for the development/progression of fibrosis (age over 50 years, diabetes, metabolic syndrome, elevated ALT level, histologically

pronounced strong inflammatory component) [23]. Bariatric surgery is advised for patients with obesity and NAFLD who fail to achieve the desired results with lifestyle changes. This procedure reduces the risk of cardiovascular diseases and improves histological changes in the liver [24]. Liver transplantation is an option for patients with cirrhosis caused by NASH. Transplantation outcomes in these patients are comparable to outcomes in other indications, although there is a greater risk of complications due to the presence of comorbidity [24]. Several types of diet have shown significant benefits [28]. The dietary regimen for liver diseases is not the same for all patients, as it differs in the amount of protein and caloric value. However, there are general guidelines that apply to all liver diseases except portal encephalopathy [30]. According to hospital nutrition standards, most calories should come from carbohydrates (60-65%), which are found in grains, fruits, vegetables and honey. Proteins should make up 12-15% of the daily energy intake, i.e. 1.0-1.2 g/kg body weight, and the recommended sources of protein are lean meat, lean cheese, skimmed milk, eggs and fish [30]. The amount of fat should be reduced to 40-60 grams per day, with an emphasis on vegetable fats such as olive oil. Vegetables and fruits can be eaten raw or cooked, while salads are prepared with a few drops of olive oil and lemon juice [30]. Salting of food should be moderate, and in case of edema or fluid accumulation in the abdominal cavity (ascites), a salt-free diet is recommended. It is recommended to avoid smoking because of its harmful effects, also, the consumption of alcohol is strictly prohibited. [30] Excessive consumption of food and drinks forces the liver to work «overtime», making the fatty liver less efficient in detoxifying harmful substances [31]. Malnutrition occurs in most patients with liver diseases, often caused by less food intake due to symptoms such as vomiting and nausea. Dietary therapy should provide enough macro nutrients and micro nutrients to avoid malnutrition [30].The Mediterranean diet (MD) consists of a high intake of vegetables, fruits, whole grains, nuts, legumes, olive oil and fish. It leads to reduced liver fat, improved metabolic health, anti-inflammatory effects, and better insulin sensitivity [32]. MD is recommended as an effective dietary pattern for people with NAFLD. Although there is substantial evidence to support the use of MD, further research is needed to confirm its long-term efficacy in the prevention and treatment of NAFLD [32]. A high-protein diet may also be beneficial for people with NAFLD, especially those with type 2 diabetes. Studies have shown that high-protein diets can reduce intrahepatic lipid content (IHLC) and improve metabolic parameters [28]. A hypo-caloric diet, which is based on a caloric deficit regardless of the specific composition of the diet, has also shown significant benefits. Reducing caloric intake by 500-1000 kcal per day can lead to a reduction in body weight, total body fat, visceral fat and IHLC, and a reduction in liver fat. [28, 29]. Low-carbohydrate diets (LCDs) and very low-calorie diets (VLCDs) have been shown to be effective in reducing IHLC and improving metabolic parameters in patients with NAFLD. These diets are usually low in carbohydrates and high in fat. Intermittent caloric restriction, including methods such as alternate day fasting (ADF) and time-restricted feeding (TRF), has shown promising results in reducing IHLC and improving liver biomarkers. These methods make it possible to achieve a caloric deficit through periodic periods of reduced calorie intake [28]. Restriction of fructose intake, especially from sugar-sweetened beverages (SSB), has shown positive effects on reducing IHLC and improving metabolic parameters. Fructose and sugar increase the synthesis of fatty acids in the liver, while glucose has no such effect [28]. Education of patients with non-alcoholic fatty liver disease (NAFLD) is crucial for successful treatment and management. The first step in this process is to inform the patient in detail about the disease itself, its development and potential complications, with a special emphasis on the connection with obesity, type 2 diabetes and lipid metabolic disorders [33]. Patients should receive advice on a healthy diet and the importance of regular physical activity. Reducing the intake of saturated fat and sugar and increasing the intake of fruits, vegetables and fiber can significantly help control the disease [34]. It is important to include the family and the social environment in the treatment process in order to provide additional support to patients [35] Psychological support is equally important because negative emotional states can negatively affect the outcome of treatment.It is crucial to motivate patients to actively participate in their own treatment and decision-making in order to achieve positive results [33].

3. Results

Aim of the research: To investigate the influence of proper nutrition on the values of laboratory findings of people suffering from NAFLD. Hypothesis: Proper nutrition affects better values of laboratory findings in people suffering from NAFLD.

3.1. Research Materials and Methods

The research was conducted retrospectively in the period from March to May 2024. in Zadar General Hospital at the Department of Gastroenterology and Gastroenterology polyclinic. People who were patients of the Gastroenterology department and the Gastroenterology polyclinic participated in the research. A retrograde search of electronic medical records was used. General information's were taken; age, sex, and specific data on laboratory findings at the first visit and laboratory findings at the control visit after the application of proper nutrition. The final data were then compared. The research instruments included the medical records of patients who were treated in the Gastroenterology polyclinic at the Gastroenterology department, and then the patients were examined during a follow-up period. Division of collected and processed data into general (age, gender) and specific (ALT, AST, GGT).

3.2. Ethics Approval

Conducting research for the purpose of writing a thesis entitled:

«Nutrition in NAFLD - non-alcoholic fatty liver disease with control of laboratory findings» was approved by the Ethics Committee of Zadar General Hospital at the 11th session held on March 29, 2024, under approval number: 01- 2658/24-3/24.

3.3. Materials and Methods

In a retrospective study, the electronic medical documentation in Zadar General Hospital was reviewed. The findings of the patients who were first processed and educated, and then examined during the follow-up period, were analyzed. The following elements were analyzed in the findings: general data (age, sex), laboratory findings of ALT, AST, GGT at the first and control examination, in the period from 2018 to 2022. Fifty respondents participated in the research. Of these, 15 respondents were female, or 30% of all respondents, and 35 were male, or 70% of the total number of respondents. Analyzing the age groups of people under 30 years of age, there were 2 or 4% of the total number of respondents, 6 (12%) of people in the 30-40 age range, 9 (18%) of 41-50 year olds. persons in the range of 51-60 years 12 (24%), persons in the range of 61-70 years 12 (24%), persons in the range of 71-80 years 7 (14%) and person over 81 years 1 person (2%) from the total number of respondents. During the first visit, the ALT value of the subjects was measured in 47 of the total number of subjects (N=50), while it was measured in 43 subjects during the control visit. The largest number of subjects had ALT- values within the reference values, 33 of them during the first visit, or 70.2%, while at the control visit, 22 of them, or 51.1%. (Figure 2). During the first examination, the AST value was measured in 45 subjects out of the total number of subjects (N=50), while at the control examination, the AST value was measured in 43 subjects. The largest number of respondents is within the reference values, 31 of them during the first examination, or 68.9%, while at the control examination, the number of respondents within the reference values is 28 respondents, or 65.1%. (Figure 3). During the first examination, the GGT value was measured in 40 subjects out of the total number of subjects (N=50), while it was measured in 41 subjects at the control examination. The largest number of respondents during the first examination had a GGT value within the reference values, 18 of them, or 45%, also during the control examination, the largest number of respondents had a value within the reference values, 17 of them, or 41.5%. (Figure 4).

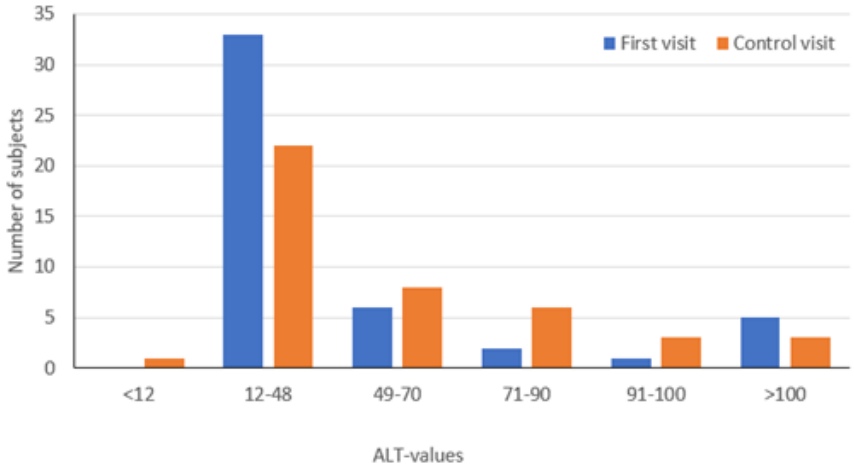

Figure 2: ALT-values.

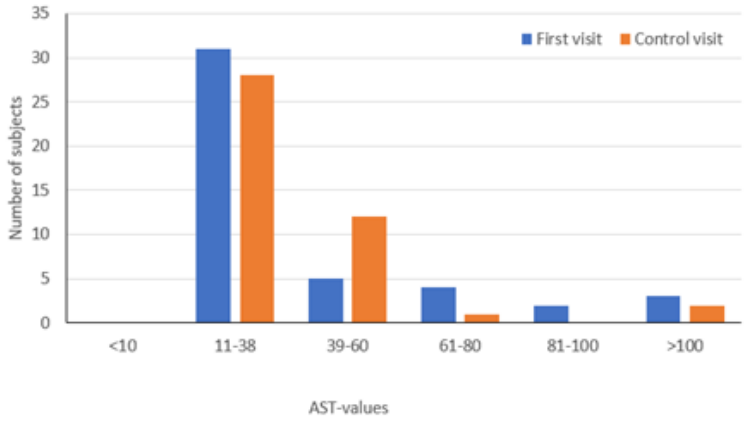

Figure 3: Value – AST.

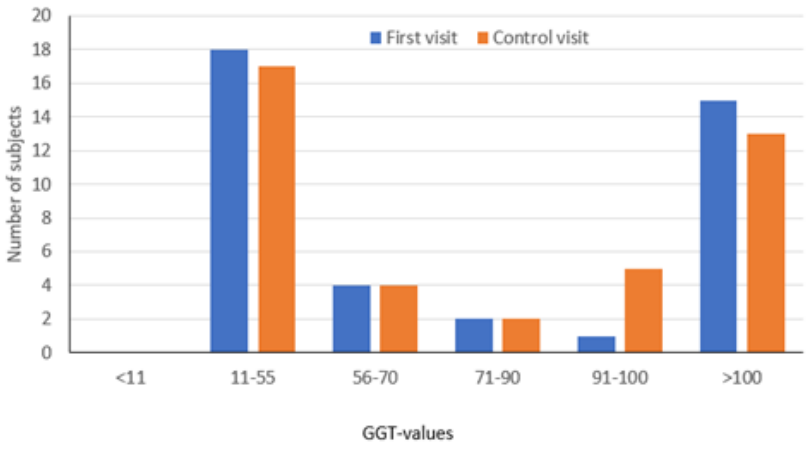

Figure 4: GGT values.

4. Discussion

Retrospective research was made at the Department of Gastroenterology, Zadar General Hospital. The aim of the research was to determine the impact of proper nutrition on the improvement of laboratory findings in patients with NAFLD. In the research, the values of the liver enzymes ALT, AST and GGT were monitored at the first visit and at the control after education on proper nutrition. A similar study conducted by Ammar Salehi-Sahlabadi and his team involves the collaboration of researchers from multiple institutions, including Isfahan University of Medical Sciences in Iran. It was published in 2021 in the journal BMC Gastroenterology, and the main goal of the research was to examine how different dietary patterns affect the risk of developing non-alcoholic fatty liver disease. The conclusion of this research emphasizes the importance of dietary patterns in the development of non-alcoholic fatty liver disease (NAFLD). Research has shown that the «Western eating pattern», which includes a high intake of processed foods, red meat and sugary drinks, significantly increases the risk of this disease. On the other hand, a «healthy eating pattern», rich in fruits, vegetables, fish and nuts, is associated with a lower risk of developing NAFLD. These findings suggest that changes in dietary habits may be key to the prevention of NAFLD, and interventions should promote healthier dietary choices [36]. In our research, 50 subjects participated. All subjects had the necessary data in the hospital IT system to conduct this research. The very sample of 50 subjects is a consequence of the Covid-19 global pandemic, which limited preventive and control visits and therefore led to negligence on the part of patients, which consequently led to a lack of data or incomplete data of patients as well as those diagnosed with NAFLD after the established diagnoses were not at the control visit. Regarding the gender distribution of respondents, 15 respondents are female, or 30% of all respondents, and 35 are male, or 70% of the total number of respondents. The age distribution indicates that there were 2 persons under the age of 30, i.e. 4% of the total number of respondents, there were 6 (12%) persons in the 30-40 age range, 9 (18%) persons in the 41-50 age range), persons aged 51-60 12 (24%), persons aged 61-70 12 (24%), persons aged 71-80 7 (14%) and a person over 81 years old, 1 person (2%) from the total number of respondents. Comparing the values of liver enzymes AST, ALT, GGT at the first and follow-up visit, after education on proper nutrition, the following was observed. The largest number of subjects had ALT values within the reference values, 33 of them during the first visit, i.e. 70.2%, while at the control visit 22 of them, i.e. 51.1%, and it was observed that between the first visit and the control (p-value (two -tail): 0.572), that is, that there is no statistically significant difference between the AST value at the first visit and the control, taking into account all subjects as well as gender and age distribution. With the AST values, the largest number of subjects were within the reference values, 31 of them during the first visit, or 68.9%, while at the control visit, the number of subjects within the reference values was 28 subjects, or 65.1%, statistically speaking it was observed that there is no statistically significant difference between the first visit and the control: t-statistic: 0.568, p-value (two-tail): 0.572. Also, there is no difference between men and women (t-statistic: 0.119, p-value (two-tail): 0.905), just as there is no difference regarding the age of the subjects in the first and second act of measurement (t-statistic: 0.360, p-value (two-tail): 0.720). GGT values with respect to age, sex and overall also show no statistically significant difference between the first and second act of measurement (t-statistic: - 1.225, p-value (two-tail): 0.231). The above data show us that despite the implemented interventions in the form of education, there was no improvement in the parameters, and that there was no change between the first and second act of measurement. This kind of data shows us that the measures taken are not sufficient and/or are insufficient in encouraging the individual to adopt healthy behavior that is encouraged during the educational process. Non-adoption of health-acceptable behavior is absent due to the patient's lack of understanding of the entire situation, potential non-acceptance of the diagnosis, denial that this is happening to him/her, use of medical terminology that causes fear and discomfort in the individual, inability of the in-

dividual to financially secure the recommended diet, but also the very lifestyle that is accelerated, stressful and in which it is not possible to use healthy eating patterns. Nutrition education is an extremely demanding part, a part that requires the involvement of a multidisciplinary team (a gastroenterologist, a nutritionist, a nurse/technician, the patient's family), each individual, in addition to the primary disease, most often suffers from other comorbidity in which there are also dietary restrictions, and care must also be taken obstacles due to other comorbidity, dietary restrictions due to food allergens, religious and other restrictions, The conducted research contributed to the potential direction to change the current educational models, but also the direction to the implementation of health promotion, screening among the general population with the aim of identifying the disease at an earlier stage in order to prevent the progression of the disease not only by pharmacological treatment, but also by changing the style and lifestyle. The disadvantage of the research is the small number of subjects and the short time between the two controls. A preventive program that would promote healthy forms of nutrition, as well as screening among the population with the aim of detecting diseases at an early stage. It is important to adapt educational programs to the individual, to include family members, to ensure that the patient copes with the disease by accepting the diagnosis, mastering and adopting dietary patterns.

5. Conclusion

The research showed that education on proper nutrition did not significantly improve laboratory findings in patients with NAFLD, considering the absence of statistically significant differences in liver enzyme values between the first and control visit. Although the measures taken were aimed at promoting healthy eating patterns, the results indicate difficulties in adopting the recommended changes. Potential reasons include misunderstanding of the diagnosis, emotional resistance, financial obstacles, and stressful life circumstances that make it difficult to stick to healthier eating habits. Education on proper nutrition requires a multidisciplinary approach and adaptation to the individual needs of patients, with a greater focus on social, emotional and physical support. It is recommended to carry out further research with a larger number of subjects and to develop preventive programs that would promote healthy forms of nutrition and early detection of NAFLD through screenings in the general population.

References

1. Byrne CD, Targher G. NAFLD: A multisystem disease. Journal of Hepatology. 2015;62(1):S47-64.
2. Guo X, Yin X, Liu Z, Wang J. Non-Alcoholic Fatty Liver Disease (NAFLD) Pathogenesis and Natural Products for Prevention and Treatment. International Journal of Molecular Sciences [Internet]. 2022;23(24):15489.
3. Mikolašević I, Skenderević N, Bočkor D, Zubak Mokrović S, Mijić A. Nealkoholnamasnabolestjetreikadaučinitibiopsijujetre? Medicus [Internet]. 2020;29(1 Hepatologija danas):37-41.
4. Leoni S, Tovoli F, Napoli L, Serio I, Ferri S, Bolondi L. Current guidelines for the management of non-alcoholic fatty liverdisease: A systematic review with comparative analysis. World Journal of Gastroenterology [Internet]. 2018;24(30):3361-73.
5. Singh S, Allen AM, Wang Z, Prokop LJ, Murad MH, Loomba R. Fibrosis Progression in Nonalcoholic Fatty Liver vs Nonalcoholic Steatohepatitis: A Systematic Review and Meta-analysis of Paired-Biopsy Studies. Clinical Gastroenterology and Hepatology. 2015;13(4):643-654.e9.
6. Bukmir L, Smokrović H, Diminić-Lisica I, Ljubotina A, Popović B. Nealkoholnamasnabolestjetre. Pregled Acta Med Croatica [Internet]. 2015;69(No.5):305-10.
7. Machado MV, Diehl AM. Pathogenesis of Nonalcoholic Steatohepatitis. Gastroenterology. 2016;150(8):1769-77.
8. Younossi ZM, Golabi P, Paik JM, Henry A, Van Dongen C, Henry L. The global epidemiology of nonalcoholic fatty liver disease (NAFLD) and non alcoholic steatohepatitis (NASH): a systematic review. Hepatology. 2023.
9. Pafili K, Roden M. Non-alcoholic fatty liver disease (NAFLD) from pathogenesis to treatment concepts in humans. Molecular Metabolism. 2020;101122.
10. Virović Jukić L. Hrvatskesmjernice za dijagnostikuiliječenjenealkoholnebolestimasnejetre. Acta ClinicaCroatica. 2021;60(2).
11. Perumpail BJ, Khan MA, Yoo ER, Cholankeril G, Kim D, Ahmed A. Clinical epidemiology and disease burden of nonalcoholic fatty liver disease. World Journal of Gastroenterology. 2017;23(47):8263-76.
12. Tanase DM, Gosav EM, Costea CF, Ciocoiu M, Lacatusu CM, Maranduca MA. The Intricate Relationship between Type 2 Diabetes Mellitus (T2DM), Insulin Resistance (IR), and Nonalcoholic Fatty Liver Disease (NAFLD). Journal of Diabetes Research. 2020;2020:1-16.
13. Nassir F. NAFLD: Mechanisms, Treatments, and Biomarkers. Biomolecules. 2022;12(6):824.
14. Alves-Bezerra M, Cohen DE. Triglyceride Metabolism in the Liver. Comprehensive Physiology. 2017;8(1):1-22.
15. Targher G. NAFLD: A multisystem disease. Journal of Hepatology [Internet]. 2015.
16. Deprince A, Haas JT, Staels B. Dysregulated lipid metabolism links NAFLD to cardiovascular disease. Molecular Metabolism. 2020;101092.
17. Dyson JK, Anstee QM, McPherson S. Non-alcoholic fatty liver disease: a practical approach to diagnosis and staging. Frontline Gastroenterology [Internet]. 2013;5(3):211-8.
18. Rana S, Jearth V, Sundaram S. Diagnosticandinterventional EUS inhepatology: An updatedreview. EndoscopicUltrasound. 2022;11(5):355.

19. Informiranipristanak za biopsijujetara [Internet]. 2024.
20. Xiao G, Zhu S, Xiao X, Yan L, Yang J, Wu G. Comparison of laboratory tests, ultrasound, or magnetic resonance elastography to detect fibrosis in patients with nonalcoholic fatty liver disease: A meta-analysis. Hepatology. 2017;66(5):1486-501.
21. Mikolašević I, Orlić L, Štimac D, Mavrinac V, Colić M, Ostojić D. Pristupbolesniku s nealkoholnommasnombolestijetre. Liječničkivjesnik [Internet]. 2016;138(5-6):159-63.
22. Sanyal AJ, Foucquier J, Younossi ZM, Harrison SA, Newsome PN, Chan WK. Enhanced diagnosis of advanced fibrosis and cirrhosis in individuals with NAFLD using Fibro Scan-based Agilescores. Journal of Hepatology [Internet]. 2023;78(2):247-59.
23. Filipec Kanižaj T, Mijić M, Mikolašević I. Liječenjenealkoholnemasnebolestijetre (NAFLD). Medicus [Internet]. 2020;29(1 Hepatologija danas):49-52.
24. Mantovani A, Dalbeni A. Treatments for NAFLD: State of Art. International Journal of MolecularSciences [Internet]. 2021;22(5):2350.
25. St George A, Bauman A, Johnston A. Independent effects of physical activity in patients with nonalcoholic fatty liverdisease. Hepatology. 2009;50(1):68-76.
26. Vilar-Gomez E, Martinez-Perez Y, Calzadilla-Bertot L. Weight loss through lifestyle modification significantly reduces features of nonalcoholic steatohepatitis. Gastroenterology. 2015;149(2):367-78.
27. Raza S, Rajak S, Upadhyay A, Tewari A, Sinha RA. Current treatmentparadigms and emergingtherapies for NAFLD/NASH. Front Biosci (Landmark Ed). 2021;26:206-237.
28. Semmler G, Datz C, Reiberger T, Trauner M. Dietandexercisein NAFLD/NASH: Beyond the obvious. Liver International. 2021;41(10):2249-68.
29. Vranešić Bender D. Nutritional Status and Nutrition Quality in Patients with Non-Alcoholic Fatty Liver Disease. Acta ClinicaCroatica. 2017.
30. Martinis I, Pavić E, Oreč I, Kardum D. Dijetoterapijabolestijetre-Nutritionin Liver Disease. MEDICUS [Internet]. 2008;17(1):113-22.
31. Lê KA, Bortolotti M. Role of dietary carbohydrates and macronutrients in the pathogenesis of nonalcoholic fatty liver disease. Current Opinionin Clinical Nutritionand Metabolic Care. 2008;11(4):477-82.
32. Plaz Torres MC, Aghemo A, Lleo A, Bodini G, Furnari M. Mediterranean Diet and NAFLD: What We Know and Questions That Still Need to Be Answered. Nutrients. 2019;11(12):2971.
33. Kancijan, Ustanova za zdravstvenunjegu. Edukacijabolesnikaičlanovaobitelji [Internet]. 2024.
34. Medicinskileksikon. Edukacijabolesnika [Internet]. 2024.
35. izzi.digital. Zdravstveniodgojiedukacijabolesnika s bolestimažlijezda s unutarnjimizlučivanjem [Internet]. 2024.
36. Salehi-sahlabadi A, Sadat S, Beigrezaei S, Pourmasomi M, Feizi A. Dietary patterns and risk of non-alcoholic fatty liver disease. BMC Gastroenterology. 2021;21(1).