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(Research Article)

Liver enzyme physiological response to various dietary habits

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Abstract

The purpose of this cross-sectional analytical research was to measure the physiological reaction of liver enzymes to various dieting plans and determine the relation between body mass index and physical activity and liver enzyme activity. The participants (n=90) of the study were 20-60 years old and their dietary patterns were evaluated in the structured Food Frequency Questionnaire, and stuck into the specific groups of dietary patterns. The alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, and gamma-glutamyl transferase serum levels were determined by conventional enzyme colorimetric techniques. Anthropometrics were taken (body mass index) and physical activity was measured by use of International Physical Activity Questionnaire. The suitable parametric tests and Pearson correlation analysis were used to perform the statistical analysis. The results showed that significant changes were observed in liver enzyme levels with unhealthy eating behaviors showing increased activities of the certain liver enzymes and healthier eating behaviors and increasing physical activity was found to have more desirable enzyme patterns. Moreover, body mass index and some liver enzymes were positively correlated significantly, which showed that there may be some dependence between body composition and subclinical liver changes. These results indicate that the quality of the diets and the lifestyle of a person play a crucial role in ensuring that the liver functions normally and averts the occurrence of early metabolic and hepatic upset.

Keywords: Liver; Enzyme; Body; Aminotransferase

1. Introduction

Liver is seen as one of the most important organs of the body which plays an important role in energy metabolism, balancing the concentration of proteins, fats, and carbohydrates, as well as its crucial role in detoxification and maintenance of the chemical balance of the blood[1]. The combination of physiological and metabolic functions is the determinant of the integrity and functioning of the liver, and violation of these processes may result in changes of the serum liver enzymes, which are the delicate signs of the hepatocellular integrity and liver activity[2].

The liver enzymes, including the alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP) and gamma-glutamyl transferase (GGT) are important biochemicals that indicate the physiological condition of the liver[3]. The enzymes are affected by various factors, among them being eating habits, lifestyle habits, exercising habits, and general metabolic condition like the body mass index (BMI)[4]. Variation of such factors may lead to slow deviations of the liver functional capacity before the emergence of clinical symptoms, which explains the significance of comprehension of the linkage between life style and hepatic functionality[5].

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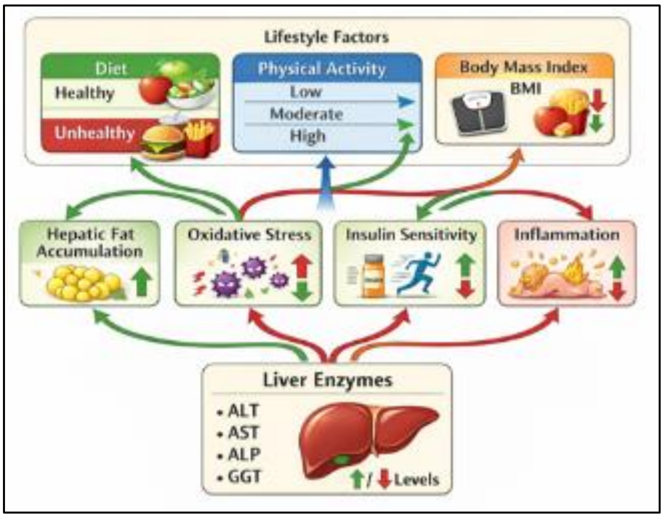

Figure 1 Impact of Dietary Habits on Liver Enzymes

When it comes to the liver, dietary practices are important in regulating the liver function[6]. The unhealthy eating habits coupled with excessive consumption of saturated fatty acids and simple sugars have been linked to the accumulation of hepatic fat, oxidative stress, and cell membrane permeability changes, which result in the release of liver enzymes into the bloodstream[7]. On the contrary, vegetarian diets combined with fruits and antioxidant substances can lessen the oxidative stress, promote the integrity of hepatocellular structures, and increase the metabolism of lipids and carbohydrates, which can have a positive effect on the levels of liver enzymes[8].

Besides diet, exercise plays a very important role in the physiological functioning of the liver, as it enhances insulin sensitivity, fatty acid oxidation, fat deposition in the liver, and systemic inflammation[9]. The interaction of diet, exercise and metabolic condition indicates how the liver enzyme level may be used as an indicator of the hepatic physiology reactions in a healthy environment[10].

The given background shows scientific importance of studying the physiological response of liver enzymes in the conditions of different food habits as it may help to identify the protective role of healthy food habits and active physical exercises in preserving liver functioning and avoiding premature metabolic disruption[11].

2. Materials and Methods

2.1. Study Design

This was a cross-sectional analytical study that was used to compare the physiological response of liver enzymes in people based on the various dieting habits. The research was conducted between January 18, 2025, and May 19, 2025, in health centers located at Kirkuk city.

2.2. Study Population and Sample

A total of 90 fairly healthy adult participants of both sexes (between 20 and 60 years old) were used in the study. Simple random sampling was used to sample the participants who were selected among visitors in the health centers.

Participants who had a known chronic liver disease, viral hepatitis, individuals taking drugs that affect liver, or alcoholic people were not included in the study.

2.3. Dietary habits Classification

An Food Frequency Questionnaire (FFQ)[12] was used to determine dietary habits. According to the major patterns of dieting that the participants were practicing, they were grouped into the following categories:

- High-fat saturated diet and sugar rich diet.
- Balanced diet
- Healthy diet based on vegetables and fruits.

- High-protein diet

2.4. Biological Sample Collection

The blood samples were taken (5 mL) of the participants after 8 -10 hours of fasting in the venous blood. Adequate tubes without anticoagulants were used to sample the samples. Centrifugation was performed at 3000 rpm in 10mL centrifuge tubes and the serum kept in -20C till analysis..

2.5. Liver Enzyme analysis in biochemistry

Serum ALT, AST, ALP, and GGT were caused as the indicators of liver physiological functioning and integrity. The standard enzyme colorimetric methods were used and the optical density of each enzyme was determined using a spectrophotometer at wavelengths of each particular enzyme. Diagnostic reagents were commercial approved and all procedures were performed as per what the manufacturer explained with a lot of care to the quality control that ensures that there is accuracy and reliability of the results[13].

2.6. Physiological and Clinical Variables

The general health history, physical activity level, age, and gender, as well as the body mass index (BMI), were the basic physiological and clinical variables recorded. The BMI was calculated as the weight (measured on a calibrated scale) divided by height (measured on a stadiometer) (kg/m 2), height and weight [14].

2.7. Physical Exercise Evaluation

The short version of the International Physical Activity Questionnaire (IPAQ) was used to assess physical activity: the survey questions covered the frequency and duration of light, moderate, and vigorous physical activities over the last week. According to standard IPAQ guidelines, the total scores were used to classify the participants into low, moderate, or high physical activity levels[15].

2.8. Statistical Analysis

The SPSS statistical software was used to analyze the data. The means were reported as mean standard deviation (SD) and t-tests were applied to compare the means across various groups of diets with Pearson correlation being applied to determine the relationship between liver enzymes and dietary habits. A p-value of less than 0.05 was deemed as being significant.

3. Results

3.1. Demographic and Physiological Characteristics of the Study Sample.

The demographic and physiological characteristics of the participants of the study are given in Table 1. Continuous variables are captured in the form of mean and standard deviation (SD), whilst the categorical variables are captured in the form of counts and percentages. No significant difference was found between dietary groups in terms of age, gender, or body mass index (BMI) ($P > 0.05$) which demonstrates that the sample is homogeneous and it allows the comparisons made later to be considered valid.

Table 1 Demographic and physiological characteristics of participants

Variable	Value
Number of participants	90
Age (years)	41.3 ± 9.8
Gender (Male/Female)	46 / 44
Body Mass Index (kg/m^2)	26.1 ± 3.4
Low physical activity (%)	38.9
Moderate physical activity (%)	34.4
High physical activity (%)	26.7

The distribution of the demographic characteristics and physical activity levels of the participants in relation to one another is displayed in Figure 2.

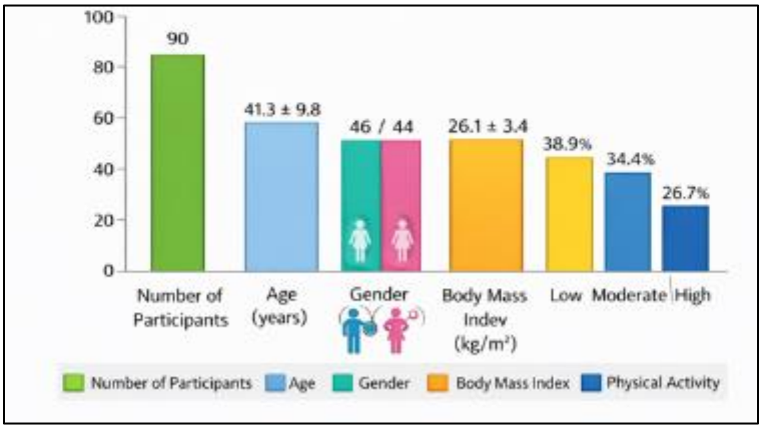

Figure 2 Demographic characteristics and physical activity levels

3.2. Participants by Dietary Habits Distribution

Table 2 presents the desegregation of respondents as per the individual dieting patterns in accordance with the Food Frequency Questionnaire (FFQ). The data is given in the form of counts and percentages where there has been a relatively equal representation of the four dietary groups**.**

Table 2 The participants by the dietary pattern

Dietary Pattern	Number of participants	Percentage (%)
High fat and sugar	24	26.7
Balanced diet	23	25.6
Rich in fruits and vegetables	22	24.4
High protein	21	23.3

The participants in the study sample are distributed in different patterns of diets which are as shown in figure 3.

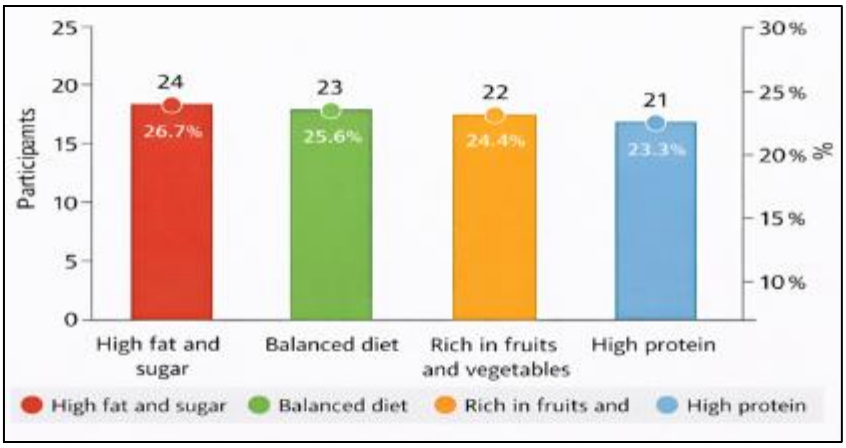

Figure 3 Distribution of participants by dietary pattern

3.3. Liver Enzyme Levels As per Dietary Habits

Table 3 indicates the dietary pattern levels of liver enzymes. Values are reported in mean plus SD, and the intergroup comparison was done by use of one way ANOVA. A notable variation in the levels of ALT, AST, and GGT was noted among the groups of diets ($p < 0.05$), whereas the ALP showed no significant difference.

Table 3 The liver enzymes levels based on dietary pattern (mean SD)

Dietary Pattern	ALT (U/L)	AST (U/L)	ALP (U/L)	GGT (U/L)
High fat and sugar	41.6 ± 7.9	38.2 ± 6.8	96.5 ± 14.2	52.3 ± 9.6
Balanced diet	30.8 ± 6.1	28.7 ± 5.4	92.1 ± 13.6	39.5 ± 7.8
Rich in fruits/vegetables	24.9 ± 5.3	23.4 ± 4.7	89.8 ± 12.9	31.2 ± 6.5
High protein	34.5 ± 6.9	31.6 ± 5.9	94.2 ± 14.1	43.1 ± 8.3
p-value	<0.001	<0.001	0.21	<0.001

Figure 4 shows the variations in average liver enzyme levels among diets

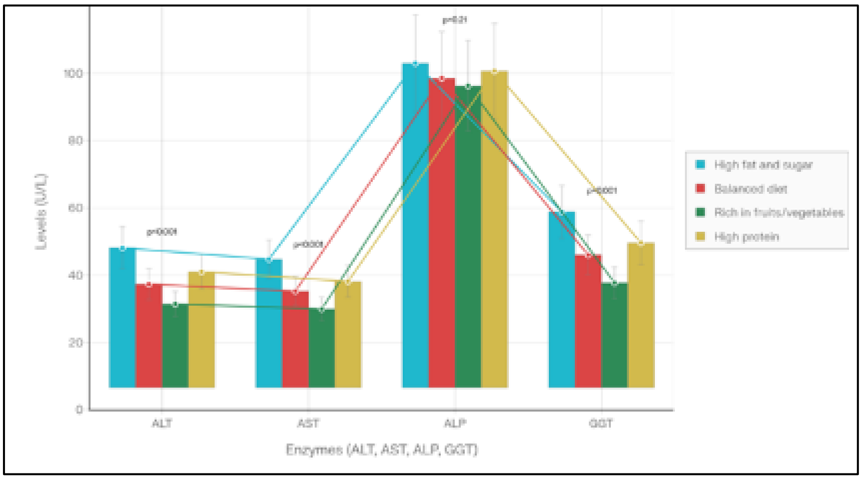

Figure 4 Effect of dietary patterns on liver enzymes

3.4. Correlation of Body Mass Index and Liver Enzymes

Table 4 depicts the Pearson correlation analysis of the liver enzyme levels and BMI. The correlation between the BMI and ALT, AST, and GGT was found to be significantly positive and no significant correlation was found with ALP**.**

Table 4 Pearson correlation between BMI and liver enzymes

Enzyme	r	p-value
ALT	0.42	<0.001
AST	0.39	0.002
ALP	0.15	0.14
GGT	0.46	<0.001

Figure 5 illustrates the correlation between BMI and liver enzyme levels.

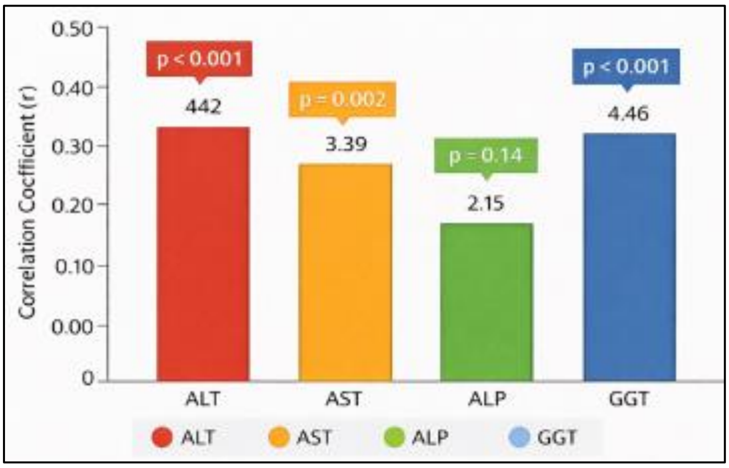

Figure 5 Correlation between body mass index and liver enzymes

3.5. Physical activity Effect on Liver Enzymes

The result of physical activity on the levels of liver enzymes is presented in Table 5. The values are given in the form of mean Standard Deviation and the comparison was done using one way ANOVA. Highly active participants had low and insignificant levels of ALT, AST, and GGT in comparison to lowly active participants ($p < 0.05$).

Table 5 Liver enzyme levels according to physical activity level

Physical Activity Level	ALT (U/L)	AST (U/L)	GGT (U/L)
Low	39.8 ± 7.4	36.5 ± 6.3	50.6 ± 8.9
Moderate	31.7 ± 6.2	29.4 ± 5.6	40.1 ± 7.2
High	25.6 ± 5.1	24.1 ± 4.8	32.4 ± 6.4
p-value	<0.001	<0.001	<0.001

Figure 6 depicts how the various levels of physical activities influence the average liver enzyme levels.

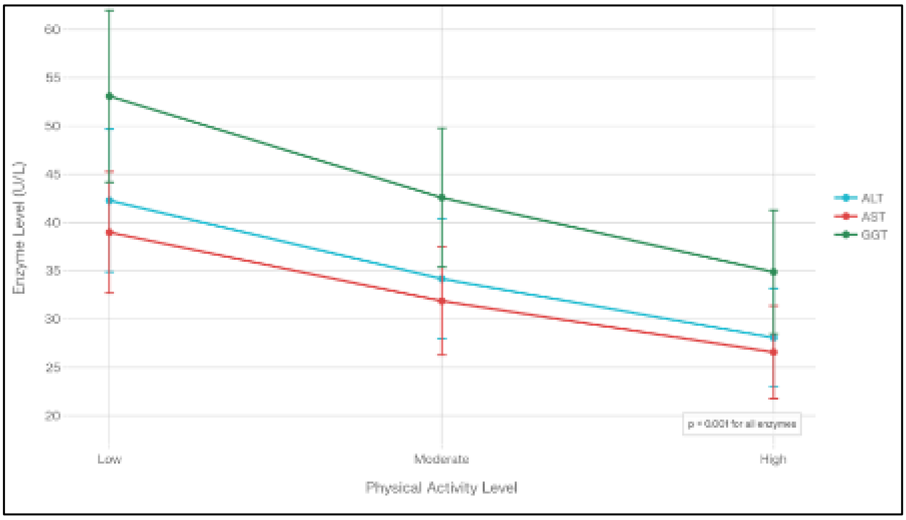

Figure 6 Declining liver enzyme levels with activity (low to high)

4. Discussion

The liver enzymes are some of the most delicate biochemical markers of physiological and metabolic alterations within the body, which are indicative of hepatocellular integrity and the effectiveness of critical metabolic processes with reference to fats, carbohydrates and proteins[16]. In the diet and lifestyle, these enzymes are directly and indirectly affected and thus they are to be considered as a significant instrument to comprehend the interplay between nutrition and liver health[17].

Liver is a tissue that is subjected to physiological alterations by unbalanced diets, especially saturated fats and simpler sugars, which cause the body to produce more metabolic load and store fat in the body cells[18]. This is also coupled with changes of membrane permeability and augmented oxidative activities which is portrayed on high serum liver enzyme activities[19]. High sugar consumption, particularly fructose, activates hepatic lipogenesis pathways and predisposes oxidative stress and generation of harmful by-products that influence the integrity of hepatocytes[20].

On the other hand, vegetable and fruit-based diets exhibit a reactive effect on liver functioning because of their antioxidants and micronutrients which stimulate cell protection and lessen inflammation[21]. Dietary fiber also has an important role to play in enhancing the insulin sensitivity and lipid metabolism to lower the hepatic fat deposition and balance physiological action of enzymes[22].

The high protein diets may put strain on the liver because of the increased levels of deamination and nitrogen turnover especially when they are not combined with the other nutrients[23]. This is important to note that the balance in diet is necessary to avoid functional liver stress despite what may be perceived to be a healthy diet[24].

BMI is one of the key determinants in the explanation of physiological alterations with regard to liver functioning. Heightened fatness, especially visceral fat, is linked to an augmented inflammatory modulators and insulin resistance[25], which cause hepatic metabolic imbalances and a poor atmosphere in which hepatocytes may be kept[26]. This is the reason why an increase in the BMI is strongly correlated with an increase in liver enzyme activity despite the lack of clinically evident liver disease[27]. Exercise plays an important role in adjusting these adverse effects, increasing metabolic rates, increasing fat oxidation, and decreasing hepatic fat deposition that occurs[28]. Exercise also lowers the oxidative stress and systemic inflammation, which has a positive impact on liver enzyme stability[29]. These results highlight the integrating value of nutrition and exercise in keeping liver healthy[30].

All in all, liver enzymes are functionally modified by some complex interactions of diet, metabolic condition, and physical activity[31]. This is a profound reason why a holistic approach is essential to the interpretation of biochemical liver markers and not isolating them to interpret them as independent of lifestyle and accompanying physiological aspects[32].

5. Conclusion

This paper has shown that liver enzymes are delicate physiological factors of changes in nutrition and lifestyles, even in seemingly healthy persons. Dietary habits, BMI, and physical activity levels have a visible impact on the liver enzyme physiology and therefore, it may be asserted that these variables are some of the causes of subclinical liver disturbances at an early age.

Healthy and balanced eating habits, as well as regular exercise, could be the factors to protect liver functioning and decrease metabolic strain on the liver. These findings support the need to develop lifestyle awareness as a necessary element of primary prevention strategies to save liver health and avoid nutrition-based metabolic diseases.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

If studies involve use of animal/human subject, authors must give appropriate statement of ethical approval. If not applicable then mention 'The present research work does not contain any studies performed on animals/humans subjects by any of the authors'.

Statement of informed consent

"Informed consent was obtained from all individual participants included in the study."

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