Impact of Nutrition and Obesity on Chronic Liver Disease

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KEYWORDS

• Malnutrition • Obesity • Chronic liver disease • Protein-calorie malnutrition
• Nonalcoholic fatty liver disease

KEY POINTS

- The liver is a central organ in total body nutrition, playing a role in the metabolism of all major macronutrient groups as well as multiple micronutrients
- Malnutrition has been implicated in causing liver disease and is a common complication, seen in up to 90% of patients with liver disease.
- Obesity is associated with the formation of nonalcoholic fatty liver disease (NAFLD), considered to be the hepatic manifestation of metabolic syndrome, and has been shown to be a risk factor for progression of chronic liver disease.
- Assessment of nutritional status is still a topic of debate, but measures commonly used include clinical signs, blood tests, and anthropometric assessments such as hand-grip strength.
- The management of obesity and malnutrition is important, as it has been shown to increase insulin sensitivity, decrease hepatic steatosis, and have a positive impact on the management of other liver diseases.

INTRODUCTION

Malnutrition, or undernutrition, and obesity are at opposite ends of a spectrum that has an enormous impact on all aspects of liver diseases. Patients with chronic liver disease develop some form of malnutrition that becomes more recognizable as the liver disease progresses.[1–3] Cases of malnutrition can be found in 65% to 90% of all patients with advanced liver disease and in almost 100% of liver transplantation candidates.[4,5] Specific micronutrient deficiencies are common in patients with liver disease, albeit less obvious than signs seen in protein deficiencies such as muscle wasting.[6]

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Micronutrients, such as fat-soluble and water-soluble vitamins or various minerals, which are seen to be deficient in liver disease, lead to unique complications based on specific deficiencies.[7–13] These micronutrients and other nutrient deficiencies are being increasingly recognized as sequelae of liver disease.[14,15]

At the opposite end of the spectrum, obesity has also been shown to have significant effects on different stages of liver disease. The rate of obesity in the United States has been increasing over the past 3 decades. Obesity in adults has more than doubled in the period between 1970 and 2008, from 15% in the 1970s to 35% in 2008.[16] Equally important, obesity has almost tripled in the pediatric population from 15% in the 1970s to 48% in 2008.[16] These trends have been used to explain the exponential increase in nonalcoholic fatty liver disease (NAFLD) as a common cause of liver disease worldwide in both adult and pediatric populations.[12,17] Not only does obesity cause fatty liver, it also has been shown to increase morbidity and mortality in other existing liver conditions such as viral hepatitis or liver transplantation, and weight loss by itself has been shown to improve treatment outcomes in various hepatic conditions.[18] Indeed, morbid obesity is seen as such a poor prognostic factor for liver transplantation that many transplantation centers use a cutoff value above which they will not consider such candidates.

The myriad effects of the opposing ends of the nutrition spectrum have led to a wealth of research aimed at elucidating the exact mechanisms of how they cause liver damage. In this article, the role of the liver in nutrient and energy metabolism is discussed, as well as the known and possible effects of specific nutrient deficiencies and obesity.

ROLE OF THE LIVER IN NUTRIENT METABOLISM

In metabolism, the liver serves as an intermediary between dietary and endogenous sources of energy and the extrahepatic organs that use such energy.[19] The liver accomplishes this role by contributing to the synthesis, storage, or breakdown of most of the major macronutrients used by the body. In Western society these major macronutrient groups include carbohydrates, fats, and protein, and the major micronutrient groups include electrolytes, trace elements, and vitamins.[20] The liver also plays a role in the transport and storage of multiple micronutrients, and has various other functions (**Table 1**).

Gluconeogenesis, cholesterol synthesis, fatty acid oxidation, amino acid oxidation, ureagenesis, and bile acid production comprise just a fraction of the many functions performed by the liver.[19,21–23] The heterogeneity of these functions requires the liver to be organized in a heterogeneous pattern, allowing for different areas of the liver to specialize in a few of these functions so that other sites can specialize in various other functions.[24]

MALNUTRITION AND CHRONIC LIVER DISEASE

The fundamentals of how malnutrition occurs in and causes liver disease are 3-fold in nature. Chronic liver disease increases the energy and nutritional requirements of the body because liver disease can induce a hypermetabolic state that increases the resting expenditures of the body.[25–31] Patients with liver disease also have issues with increased nutrient losses from the body because of malabsorption resulting from decreased bile production, diarrhea, or other causes (**Table 2**). The third fundamental cause of malnutrition in patients with liver disease arises from patients having either a decreased intake of nutritional substances or an absolute decrease in food intake.[32,33] Mechanisms through which patients have decreased dietary intake are