



## Structured Dietary Assessment in Population Based Liver Studies

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### DESCRIPTION

The rapid growth of chronic metabolic conditions across the United Kingdom has drawn increasing attention to the complex relationship between modern dietary patterns and liver health. Among these conditions, Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD) has emerged as one of the most common forms of chronic liver disease, affecting an estimated quarter of the adult population. Unlike traditional perceptions of liver disease as mainly alcohol-related, MASLD develops in individuals who consume little or no alcohol, with its onset driven largely by obesity, insulin resistance, dyslipidaemia and chronic low-grade inflammation. Diet is central to these processes, yet the typical approaches to analysing food intake often oversimplify what people actually eat. The development of a structured, food-group tree classification method offers a more refined way to capture dietary complexity and examine its associations with MASLD and other health outcomes in a UK population.

Traditional food frequency questionnaires and dietary scoring systems generally categorise foods by broad nutrient content or predefined groups, such as fruits, vegetables, grains and meats. While this approach provides a useful overview, it fails to reflect the way foods are consumed in combinations and patterns. For instance, whole grains and refined grains are frequently grouped together and processed foods may be scattered across multiple categories despite their shared industrial origin and metabolic implications. The tree classification system addresses this limitation by arranging food items into a hierarchical structure, beginning with fundamental categories and extending into increasingly specific sub-groups based on processing level, nutrient profile, preparation method and common consumption context. This model resembles a branching structure in which each food type belongs to a defined position that acknowledges both its biological origin and its transformation before consumption.

In the UK, where dietary intake includes a mixture of traditional cuisine and a high proportion of ultra-processed products, applying this hierarchical method helps to better capture real-

world eating patterns. For example, instead of grouping all dairy together, the classification separates full-fat milk, reduced-fat milk, cheese varieties, sweetened yoghurts and fermented products, each of which may have a different association with metabolic health. Similarly, meats can be separated into unprocessed red meat, processed meat products, poultry and plant-based alternatives. By doing so, researchers can detect more nuanced associations that would otherwise remain masked within broader categories.

One of the most valuable contributions of the tree classification system is its ability to represent dietary diversity in a quantitative manner. Instead of merely assessing how much is eaten from each group, the system can evaluate how balanced or imbalanced a person's diet is across the entire structure. Individuals whose consumption is concentrated in just a few narrow branches, particularly those containing calorie-dense and fibre-poor foods, often demonstrate higher rates of obesity, type 2 diabetes, hypertension and dyslipidaemia, all of which are strong predictors of MASLD.

The method also enhances the measurability of behaviour change over time. In longitudinal studies, researchers can track movement within the tree, identifying whether individuals shift from one set of branches to another. For example, a person moving away from branches dominated by sugar-sweetened beverages and processed snacks toward those containing vegetables and whole foods might demonstrate improved liver enzyme levels and reduced hepatic fat over time. This dynamic quality makes the classification system especially useful for evaluating public health interventions, dietary education and community-level initiatives aimed at reducing metabolic disease burden.

The development of the food-group tree classification method also aligns with advances in data science and machine learning. Its hierarchical nature integrates effectively with computational approaches that identify clusters, associations and predictive patterns. When combined with genetic, microbiome and lifestyle data, the system offers a comprehensive platform for studying interactions between diet and metabolic health. This could

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support the identification of individuals at higher risk of MASLD and related conditions, even before symptoms become apparent.

In conclusion, the food-group tree classification method represents an innovative approach for analyzing dietary patterns in relation to metabolic dysfunction-associated steatotic liver disease and other health outcomes in the UK population. By capturing the complexity of modern eating habits, it allows for

more accurate identification of harmful and beneficial dietary behaviours. Its ability to integrate biological, social and cultural dimensions makes it a valuable resource for researchers, clinicians and policymakers who aim to address the growing burden of metabolic disease. As its application continues to expand, this method may contribute to more informed dietary strategies and, ultimately, to improved population health.