

JAMA Insights

Metabolic Dysfunction–Associated Steatotic Liver Disease in Children and Adolescents

Jake P. Mann, MD; Christopher D. Byrne, MB, PhD; Giovanni Targher, MD

Metabolic dysfunction–associated steatotic liver disease (MASLD) is the most common cause of chronic liver disease in children and adolescents worldwide.^{1,2} Presentation of MASLD ranges in severity, including isolated steatosis and metabolic dysfunction–associated steatohepatitis (MASH), defined histologically by hepatic steatosis and inflammation, and severe, progressive liver fibrosis. MASLD is typically asymptomatic, but early diagnosis is important because MASLD is potentially reversible with lifestyle modifications and may be associated with improved hepatic and extrahepatic cardiometabolic outcomes.



Related article



CME at jamacmelookup.com

Epidemiology and Risk Factors

Based on a population-based autopsy analysis of 742 US children who died of accidental causes, the histological prevalence of MASLD was 9.6% among children aged 2 to 19 years.³ MASLD prevalence increased with age (0.7% at 2–4 years, 3.3% at 5–9 years, 11.3% at 10–14 years, and 17.3% at 15–19 years), was higher in boys (11.1%) than girls (7.9%), and was significantly higher in those with obesity (38%).³ Histologically defined MASH is more common in children with obesity and more severe metabolic dysfunction.^{1,2} In a cross-sectional study of 242 US children with severe obesity (mean body mass index [BMI] of 51.6 [calculated as weight in kilograms divided by height in meters squared]) undergoing bariatric surgery, 59% had histological evidence of MASLD, and 35% of those patients had borderline or definite MASH.⁴ In a population-based cohort study of 6083 US adolescents, the overall prevalence of MASLD, detected by elevated serum alanine aminotransferase (ALT) levels, was 16.5%, with a significantly higher rate in those with obesity (39.5%).⁵ However, MASLD can affect children and adolescents without overweight or obesity (usually <10% of cases in Western countries).^{1,2}

Similar to MASLD in adults,⁶ MASLD in children and adolescents is associated with greater consumption of ultra-processed, energy-dense foods and sugar-sweetened beverages and metabolic disorders, including abdominal adiposity, insulin resistance, type 2 diabetes, increased blood pressure, and hyperlipidemia, which may increase the long-term risk of cardiovascular disease.^{1,2} In a prospective cohort study of 892 US children with obesity and biopsy-confirmed MASLD (mean age, 13 years; mean BMI, 32), 63 of 892 (7%) had type 2 diabetes at baseline and an additional 97 (11%) developed type 2 diabetes during 3.8 years of follow-up.⁷

Screening

American Association for the Study of Liver Diseases (AASLD) guidelines¹ recommend screening for MASLD with annual measurement of serum ALT level starting at age 10 years in children with obesity, defined as a BMI at or above the 95th percentile compared with sex- and age-matched children; in children with overweight, defined as BMI in the 85th to 95th percentile for sex- and

Table. Criteria for Diagnosis of MASLD in Children and Adolescents

Criterion	Definition
Hepatic steatosis (required)	Imaging methods (abdominal ultrasonography or, ideally, MRI-PDFF $\geq 5\%$ hepatic fat fraction) or liver histology demonstrating hepatic steatosis in $\geq 5\%$ hepatocytes
At least 1 of the following cardiometabolic criteria	
Elevated BMI or waist circumference	BMI ≥ 85 th percentile for age and sex (z score ≥ 1) or waist circumference ≥ 95 th (ethnicity-adjusted) percentile
Prediabetes or type 2 diabetes	Fasting glucose ≥ 5.6 mmol/L (≥ 100 mg/dL), random glucose ≥ 11.1 mmol/L (≥ 200 mg/dL), 2-hour postload glucose ≥ 7.8 mmol/L (≥ 140 mg/dL), diagnosis of type 2 diabetes, or glucose-lowering treatment
Hypertension	<13 y: BP ≥ 95 th percentile or $\geq 130/80$ mm Hg (whichever is lower); ≥ 13 y: BP $\geq 130/85$ mm Hg or antihypertensive treatment
Increased plasma triglycerides	<10 y: Plasma triglycerides ≥ 1.15 mmol/L (≥ 100 mg/dL); ≥ 10 y: plasma triglycerides ≥ 1.7 mmol/L (≥ 150 mg/dL) or lipid-lowering treatment
Low plasma HDL cholesterol	Plasma HDL ≤ 1.0 mmol/L (≤ 40 mg/dL) or lipid-lowering treatment

Abbreviations: BMI, body mass index; BP, blood pressure; HDL, high-density lipoprotein cholesterol; MASLD, metabolic dysfunction–associated steatotic liver disease; MRI-PDFF, magnetic resonance imaging proton density fat fraction.

age-matched children plus at least 1 cardiometabolic risk factor such as hyperlipidemia, elevated blood pressure, or prediabetes/diabetes; and in children with a family history of MASLD. Screening for MASLD may be considered in children younger than 10 years with cardiometabolic risk factors, particularly insulin resistance, type 2 diabetes, or hyperlipidemia, even if they do not have overweight or obesity.¹ Imaging is not recommended as a screening test for pediatric or adolescent MASLD.^{1,2} However, guidelines recommend that children and adolescents with incidentally detected hepatic steatosis on imaging undergo serum ALT testing.^{1,2} Asymptomatic children and adolescents with serum ALT levels less than 2 times the upper limit of normal (ULN) should undergo repeat ALT testing within 3 months; those with higher ALT (>2 times the ULN) or persistently elevated ALT levels for more than 3 months should be evaluated by a hepatologist.^{1,2} Sex-specific serum ALT thresholds (ALT >22 U/L for females; ALT >26 U/L for males) have a specificity of 92% to 96% for the diagnosis of MASLD but only 32% to 48% overall sensitivity, compared with magnetic resonance imaging proton density fat fraction (MRI-PDFF) as the reference standard.⁸

Diagnosis

The diagnosis of MASLD is made based on presence of hepatic steatosis (confirmed by ultrasonography or, ideally, MRI-PDFF $\geq 5\%$ or histology) in children and adolescents with at least 1 cardiometabolic risk factor (Table).¹ However, ultrasonography has only 50% to 65% sensitivity in detecting mild hepatic steatosis.¹ Controlled attenuation parameter, measured with vibration-controlled transient elastography, has not been validated for diagnosis of pediatric or adolescent MASLD.¹

Children and adolescents with overweight or obesity and suspected MASLD who have no concerning features for decompensated liver disease, such as hypoglycemia, splenomegaly, or jaundice, should be assessed for cardiometabolic risk factors and undergo a limited evaluation to exclude alternative diagnoses (Wilson disease, celiac disease, and hypothyroidism). Conversely, those with concerning features should be referred to a hepatologist.^{1,2} Children and adolescents with suspected MASLD who do not have overweight or obesity should be assessed for viral hepatitis B and C, autoimmune liver disease, Wilson disease, celiac disease, hypothyroidism, and alpha-1 antitrypsin deficiency.^{1,2} After these diagnoses have been excluded, the diagnosis of MASLD among children and adolescents without overweight or obesity should be made by a hepatologist.^{1,2}

Liver biopsy is recommended for children and adolescents with persistently elevated ALT levels (≥ 2 times the ULN), ALT greater than or equal to 3 times the ULN or splenomegaly, or positive autoantibodies (eg, high-titer antismooth muscle antibody) or elevated IgG, which suggest autoimmune hepatitis.^{1,2}

Management

Healthy diet and regular exercise (aerobic or resistance exercise at least 3 times per week for a total of 420 minutes) are guideline-recommended treatments for pediatric and adolescent MASLD.^{1,2} Although data are insufficient to recommend any specific diet, reducing added sugars and avoiding sugar-sweetened beverages may decrease hepatic steatosis and serum aminotransferase levels; these dietary measures are recommended for all children and adolescents with MASLD.^{1,2}

No pharmacotherapy is currently approved for pediatric or adolescent MASLD or MASH.^{1,2} Some adolescents (aged ≥ 12 years) with MASLD meet criteria for incretin-based therapy (eg, semaglutide) based on BMI (≥ 95 th percentile). However, studies have not evaluated incretin-based therapy for MASLD.

Data are limited on the efficacy of bariatric surgery for pediatric or adolescent MASLD.^{1,2} Bariatric surgery may be considered for children with severe obesity (BMI $\geq 120\%$ of the 95th percentile plus metabolic comorbidities) and for those with biopsy-confirmed MASH, especially stage 2 to 3 liver fibrosis, but its safety in those with cirrhosis is unknown.^{1,2}

Prognosis

Analyses of 339 US children who underwent sequential liver biopsies for MASLD as part of placebo groups in 2 clinical trials, and of a separate cohort of 478 children with biopsy-proven MASLD, reported that over 2 years, approximately 25% had increased hepatic inflammation and/or fibrosis, approximately 50% remained stable, and approximately 25% improved.⁹ Factors associated with MASLD histologic improvement included weight loss, reductions in circulating total cholesterol, glucose and liver enzyme levels, and improved insulin resistance.^{1,2,9} In a retrospective cohort study of 1096 US children (mean age, 13 years; 67% males; mean BMI, 32) with biopsy-confirmed MASLD, 36% developed hyperlipidemia (incidence rate, 36.6 per 1000 person-years), 7% developed type 2 diabetes (9.1 per 1000 person-years), 4.7% developed cirrhosis (5.7 per 1000 person-years), and 3.4% died (mortality rate of 4 per 1000 person-years; nearly half of these deaths were liver-related) over a mean follow-up of 8.5 years.¹⁰

Conclusions

MASLD is the leading cause of chronic liver disease among children and adolescents worldwide. Recommended treatment includes weight-reducing dietary modifications (eg, avoiding ultra-processed, energy-dense foods and sugar-sweetened beverages) and regular physical activity, which may decrease hepatic steatosis and inflammation.

ARTICLE INFORMATION

Author Affiliations: Department of Immunology & Immunotherapy, School of Infection, Inflammation and Immunology, College of Medicine and Health, University of Birmingham, Birmingham, United Kingdom (Mann); Liver Unit, Birmingham Women's and Children's NHS Foundation Trust, Birmingham, United Kingdom (Mann); National Institute for Health and Care Research, Southampton Biomedical Research Centre, University Hospital Southampton and University of Southampton, Southampton, United Kingdom (Byrne); Department of Medicine, University of Verona, Verona, Italy (Targher); Metabolic Diseases Research Unit, IRCCS Sacro Cuore - Don Calabria Hospital, Negrar di Valpolicella, Italy (Targher).

Corresponding Author: Giovanni Targher, MD, Metabolic Diseases Research Unit, IRCCS Sacro Cuore - Don Calabria Hospital, Viale L. Rizzardi, 4, 37024 Negrar di Valpolicella (VR), Italy (giovanni.targher@univr.it).

Published Online: October 21, 2026.
doi:10.1001/jama.2026.16766

Conflict of Interest Disclosures: Dr Mann reported being supported in part by Action Medical Research (grant GN4039) and receiving personal fees from Inventiva, Novo Nordisk, and Eli Lilly outside the submitted work. Dr Byrne reported being supported in part by the Southampton National Institute for Health and Care Research Biomedical

Research Centre (NIHR203319) and receiving grants from Echosens paid to his university outside the submitted work. Dr Targher reported being supported in part by grants from the University of Verona School of Medicine.

REFERENCES

1. Xanthakos SA, Ibrahim SH, Adams K, et al. AASLD Practice Statement on the evaluation and management of metabolic dysfunction-associated steatotic liver disease in children. *Hepatology*. 2025; 82(5):1352-1394. doi:10.1097/HEP.0000000000001368
2. Mann JP, Lefere S, Buytaert M, et al. European Society for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) position paper on screening, diagnosis and investigation of paediatric metabolic dysfunction-associated steatotic liver disease. *J Pediatr Gastroenterol Nutr*. 2026;83(3): 555-576. doi:10.1002/jpn3.70490
3. Schwimmer JB, Deutsch R, Kahen T, Lavine JE, Stanley C, Behling C. Prevalence of fatty liver in children and adolescents. *Pediatrics*. 2006;118(4): 1388-1393. doi:10.1542/peds.2006-1212
4. Xanthakos SA, Jenkins TM, Kleiner DE, et al; Teen-LABS Consortium. High prevalence of nonalcoholic fatty liver disease in adolescents undergoing bariatric surgery. *Gastroenterology*. 2015; 149(3):623-634. doi:10.1053/j.gastro.2015.05.039
5. Mischel AK, Liao Z, Cao F, et al. Prevalence of elevated ALT in adolescents in the US 2011-2018. *J Pediatr Gastroenterol Nutr*. 2023;77(1):103-109. doi:10.1097/MPG.0000000000003795
6. Tilg H, Petta S, Stefan N, Targher G. Metabolic dysfunction-associated steatotic liver disease in adults: a review. *JAMA*. 2026;335(2):163-174. doi:10.1001/jama.2025.19615
7. Newton KP, Wilson LA, Crimmins NA, et al; Nonalcoholic Steatohepatitis Clinical Research Network. Incidence of type 2 diabetes in children with nonalcoholic fatty liver disease. *Clin Gastroenterol Hepatol*. 2023;21(5):1261-1270. doi:10.1016/j.cgh.2022.05.028
8. Schwimmer JB, Dunn W, Norman GJ, et al. SAFETY study: alanine aminotransferase cutoff values are set too high for reliable detection of pediatric chronic liver disease. *Gastroenterology*. 2010;138(4):1357-1364. doi:10.1053/j.gastro.2009.12.052
9. Newton KP, Jayasekera D, Blackford AL, et al; NASH CRN. Longitudinal response to standard of care in pediatric metabolic dysfunction-associated steatotic liver disease. *Hepatology*. 2025;82(5): 1198-1210. doi:10.1097/HEP.0000000000001216
10. Schwimmer JB, Thai NQN, Noon SL, et al. Long-term mortality and extrahepatic outcomes in 1096 children with MASLD. *Hepatology*. 2026;83(3):561-574. doi:10.1097/HEP.0000000000001357