DOI: 10.31082/1728-452X-2026-246-2-2-12
УДК: 616.379-008.64:616.36-003.826

KNOWLEDGE, DIAGNOSTIC PRACTICES, AND MANAGEMENT STRATEGIES OF METABOLIC DYSFUNCTION-ASSOCIATED STEATOTIC LIVER DISEASE (MASLD) AMONG ENDOCRINOLOGISTS IN KAZAKHSTAN: A MULTICENTER CROSS-SECTIONAL STUDY

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SUMMARY

Background. Metabolic dysfunction-associated steatotic liver disease (MASLD) is highly prevalent in patients with type 2 diabetes mellitus (T2DM) and obesity. Assessing endocrinologists' clinical awareness, screening practices, and therapeutic strategies is essential to address gaps in multispecialty care.

Objective. This study evaluated endocrinologists' knowledge, diagnostic preferences, and management approaches to MASLD across Almaty, Almaty region, Zhambyl region, North Kazakhstan region, and Aktobe region.

Materials and methods. We conducted a multicenter, cross-sectional survey of 172 practicing endocrinologists from November 2025 to February 2026. A structured questionnaire assessed professional profiles, screening protocols, diagnostic modalities (ultrasonography, elastography with controlled attenuation parameter [CAP], liver biopsy), therapeutic interventions (lifestyle modifications, ursodeoxycholic acid [UDCA], e.g., Ursosan Forte, 500 mg), and clinical barriers. Data were analyzed in RStudio using descriptive statistics, Chi-squared, Fisher's exact, and Kruskal-Wallis tests.

Results and discussion. The cohort of 172 physicians was predominantly female (90.7%) and held MD degrees (81.4%). Most respondents prioritized targeted screening for T2DM (91.9%) and obesity (88.4%), underscoring continued reliance on conventional risk-based approaches. Liver ultrasonography (94.2%) and liver enzymes (ALT: 73.3%, AST: 70.9%) were the primary diagnostic modalities, while advanced tools such as elastography with CAP (27.9%) and liver biopsy (19.8%) were used less frequently, highlighting a clear implementation gap in advanced non-invasive diagnostics. Lifestyle interventions remained central, with 89.5% recommending dietary modifications and 58.1% targeting 10% weight reduction. UDCA was prescribed by 74.4% of respondents primarily to improve liver enzymes (46.6%) and mitigate fibrosis (20.3%), though risk perceptions varied significantly across qualifications ($p = 0.0222$). Low patient adherence was the main clinical barrier (41.9%), further limiting implementation.

Conclusion: Endocrinologists actively prioritize metabolic risk screening and lifestyle management across the surveyed regions, but substantial gaps persist in advanced non-invasive diagnostics and pharmacological standardization, requiring unified guidelines and enhanced multidisciplinary collaboration.

Keywords: metabolic dysfunction-associated steatotic liver disease, type 2 diabetes mellitus, endocrinologists, survey.

For citation: Sultanova BP, Aldan ZhA, Zinullina AA, Sadyrova GA, Chiposhina TA, Batyrbayeva AZh, Zhekeyeva ME, Muratbekova MM. Knowledge, diagnostic practices, and management strategies of metabolic dysfunction-associated steatotic liver disease (MASLD) among endocrinologists in Kazakhstan: a multicenter cross-sectional study. *Meditsina (Almaty) = Medicine (Almaty)*. 2026;2(246):2-12. (In Russ.). doi: 10.31082/1728-452X-2026-246-2-2-12

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Получена: 19.06.2026
Принята: 26.06.2026

ТҰЖЫРЫМ

ҚАЗАҚСТАН ЭНДОКРИНОЛОГТАРЫ АРАСЫНДАҒЫ МЕТАБОЛИЗМДІК ДИСФУНКЦИЯМЕН БАЙЛАНЫСТЫ СТЕАТОЗДЫ БАУЫР АУРУЫ (МДБСБА) БОЙЫНША БІЛІМ, ДИАГНОСТИКАЛЫҚ ТӘЖІРИБЕ ЖӘНЕ БАСҚАРУ СТРАТЕГИЯЛАРЫ: КӨПСАЛАЛЫ КӨЛДЕНЕҢ ЗЕРТТЕУ

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Кіріспе. Метаболизмдік дисфункциямен байланысты стеатозды бауыр ауруы (МДБСБА) 2-типті қант диабетімен (2ТҚД) және семіздікпен ауыратын науқастар арасында өте кең таралған. Эндокринологтардың клиникалық хабардарлығын, скринингтік тәжірибесін және терапиялық стратегияларын бағалау мультидисциплинарлық көмектегі олқылықтарды жою үшін маңызды болып табылады.

Мақсаты. Бұл зерттеу Алматы қаласында, Алматы облысында, Жамбыл облысында, Солтүстік Қазақстан облысында және Ақтөбе облысында эндокринологтардың МДБСБА бойынша білімін, диагностикалық артықшылықтарын және емдеу тәсілдерін бағалады.

Материал және әдістері. Біз 2025 жылдың қарашасы мен 2026 жылдың ақпаны аралығында 172 тәжірибелік эндокринологтың қатысуымен көпсалалы көлденең сауалнама жүргіздік. Құрылымдық сауалнама кәсіби профильдерді, скрининг хаттамаларын, диагностикалық әдістерді (бауырдың ультрадыбыстық зерттеуі, өшу параметрін бақылайтын эластометрия [CAP], бауыр биопсиясы), терапевтік шараларды (өмір салтын өзгерту, урсодезоксихол қышқылы (УДХҚ, мысалы, Урсосан Форте, 500 мг)) және байқалатын клиникалық кедергілерді бағаланды. Деректер RStudio көмегімен сипаттамалық статистика, хи-квадрат критерийі, Фишердің дәл критерийі және Краскел-Уоллис критерийі арқылы талданды.

Нәтижелері және талқылау. 172 дәрігерден тұратын когортаның негізгі бөлігін әйелдер (90,7%) және жоғары медициналық білімі барлар (81,4%) құрады. Респонденттердің көпшілігі 2ТҚД (91,9%) және семіздікке (88,4%) мақсатты скрининг жасауға басымдық берді. Бауырдың УДЗ (94,2%) және бауыр ферменттері (АЛТ: 73,3%, АСТ: 70,9%) негізгі диагностикалық әдістер болды, ал CAP көмегімен эластометрия (27,9%) және бауыр биопсиясы (19,8%) сияқты озық әдістер сирек қолданылды. Өмір салтын өзгерту негізгі шара болып қала берді: 89,5% диеталық өзгерістерді ұсынса, 58,1% дене салмағын 10%-ға азайтуды мақсат етіп қойды. УДХҚ респонденттердің 74,4% пайызымен негізінен бауыр ферменттерінің көрсеткіштерін жақсарту (46,6%) және фиброзды азайту (20.3%) үшін тағайындалды, дегенмен қауіп-қатерлерді қабылдау кәсіби біліктілікке байланысты айтарлықтай ерекшеленді (p = 0.0222). Науқастардың емге төмен деңгейде бағынуы басты клиникалық кедергі ретінде атап өтілді (41,9%). Бұл нәтижелер дәстүрлі скринингтің жақсы жүзеге асырылғанын көрсетеді, бірақ озық инвазивті емес диагностикалық әдістерді енгізудегі олқылықтардың бар екенін айқындайды.

Қорытынды. Зерттелген аймақтарда эндокринологтар метаболикалық қауіптерге скрининг пен өмір салтын басқаруға белсенді түрде басымдық бергенімен, озық инвазивті емес диагностика және фармакотерапияны стандарттауда елеулі олқылықтар сақталуда, бұл бірыңғай клиникалық нұсқаулықтарды әзірлеуді және пациенттердің нәтижелерін жақсарту үшін мультидисциплинарлық ынтымақтастықты күшейтуді талап етеді.

Негізгі сөздер: метаболизмдік бұзылулармен байланысты стеатозды бауыр ауруы, 2-типті қант диабеті, эндокринологтар, сауалнама.

Дәйексөз үшін: Султанова Б.П., Алдан Ж.А., Зинуллина А.А., Садырова Г.А., Чипошина Т.А., Батырбаева А.Ж., Жекеева М.Е., Муратбекова М.М. Қазақстан эндокринологтары арасындағы метаболизмдік дисфункциямен байланысты стеатозды бауыр ауруы (МДБСБА) бойынша білім, диагностикалық тәжірибе және басқару стратегиялары: көпсалалы көлденең зерттеу // Медицина (Алматы). 2026;2(246):2-12. doi: 10.31082/1728-452X-2026-246-2-2-12

РЕЗЮМЕ

ЗНАНИЯ, ДИАГНОСТИЧЕСКАЯ ПРАКТИКА И СТРАТЕГИИ ВЕДЕНИЯ МЕТАБОЛИЧЕСКОЙ ДИСФУНКЦИИ, АССОЦИИРОВАННОЙ СО СТЕАТОЗОМ ПЕЧЕНИ (МАЖБП), СРЕДИ ЭНДОКРИНОЛОГОВ КАЗАХСТАНА: МНОГОЦЕНТРОВОЕ ПОПЕРЕЧНОЕ ИССЛЕДОВАНИЕ

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Введение. Метаболически ассоциированная жировая болезнь печени (МАЖБП) широко распространена среди пациентов с сахарным диабетом 2 типа (СД2) и ожирением. Оценка клинической осведомленности эндокринологов, их практики скрининга и терапевтических стратегий имеет важное значение для устранения пробелов в многопрофильной медицинской помощи.

Цель. В данном исследовании оценивались знания эндокринологов, диагностические предпочтения и подходы к ведению пациентов с МАЖБП в городе Алматы, Алматинской области, Жамбылской области, Северо-Казахстанской области и Актюбинской области.

Материал и методы. Мы провели многоцентровое поперечное анкетирование 172 практикующих эндокринологов в период с ноября 2025 года по февраль 2026 года. Структурированная анкета оценивала профессиональные профили, протоколы скрининга, методы диагностики (ультразвуковое исследование печени, эластометрию с контролем параметра затухания [CAP], биопсию печени), терапевтические вмешательства (модификацию образа жизни, урсодезоксихолевую кислоту (УДХК, например, Урсосан Форте, 500 мг)) и воспринимаемые клинические барьеры. Данные анализировались с помощью RStudio с использованием описательной статистики, критерия хи-квадрат, точного критерия Фишера и критерия Краскела-Уоллиса.

Результаты и обсуждение. Когорта из 172 врачей состояла преимущественно из женщин (90,7%) со степенью кандидата наук / доктора медицины (81,4%). Большинство респондентов уделяли первоочередное внимание целевому скринингу на СД2 (91,9%) и ожирение (88,4%). Ультразвуковое исследование печени (94,2%) и показатели ферментов печени (АЛТ: 73,3%, АСТ: 70,9%) были основными методами диагностики, в то время как передовые методы, такие как эластометрия с CAP (27,9%) и биопсия печени (19,8%), использовались реже. Вмешательства в образ жизни оставались центральными: 89,5% рекомендовали диетические изменения, а 58,1% ставили целью снижение массы тела на 10%. УДХК назначалась 74,4% респондентов в основном для улучшения профиля печеночных ферментов (46,6%) и уменьшения фиброза (20,3%), хотя восприятие рисков существенно различалось в зависимости от профессиональной квалификации ($p = 0,0222$). Низкая приверженность пациентов к лечению была названа главным клиническим препятствием (41,9%). Эти результаты отражают надежный традиционный скрининг, но подчеркивают явный пробел в внедрении передовых неинвазивных методов диагностики.

Выводы. Хотя эндокринологи активно уделяют приоритетное внимание скринингу метаболических рисков и управлению образом жизни в исследуемых регионах, сохраняются существенные пробелы в передовых неинвазивных методах диагностики и стандартизации фармакотерапии, что требует разработки единых клинических рекомендаций и усиления междисциплинарного сотрудничества.

Ключевые слова: метаболически ассоциированная жировая болезнь печени, сахарный диабет 2 типа, эндокринологи, анкетирование.

Для цитирования: Султанова Б.П., Алдан Ж.А., Зинуллина А.А., Садырова Г.А., Чипошина Т.А., Батырбаева А.Ж., Жекеева М.Е., Муратбекова М.М. Знания, диагностическая практика и стратегии ведения метаболической дисфункции, ассоциированной со стеатозом печени (МАЖБП), среди эндокринологов Казахстана: многоцентровое поперечное исследование // Медицина (Алматы). 2026;2(246):2-12. doi: 10.31082/1728-452X-2026-246-2-2-12

Introduction

Liver health has historically received insufficient attention within metabolic care, despite the global rise in type 2 diabetes (T2DM) and obesity [1]. Metabolic dysfunction-associated steatotic liver disease (MASLD), previously termed nonalcoholic fatty liver disease (NAFLD) [2], is now the most common chronic liver disorder, affecting an estimated 32.4% (95% CI 29.9–34.9) of the global population [3]. In individuals with T2DM, MASLD prevalence exceeds 70%, with approximately half developing metabolic dysfunction-associated steatohepatitis (MASH) and nearly one in five progressing to advanced liver fibrosis [4]. These overlapping conditions substantially increase the risk of cirrhosis, hepatocellular carcinoma, cardiovascular morbidity, and all-cause mortality [5].

The increasing prevalence of MASLD and its potential progression to severe complications underscore the critical role of endocrinologists in the early identification and intervention among patients with T2DM. Despite this importance, research on endocrinologists' knowledge, screening behaviors, and treatment approaches for MASLD in this high-risk population remains limited. Communication gaps, such as low disease awareness, inconsistent risk discussions with patients, and variable use of patient-reported outcomes, may undermine early detection efforts and adversely affect clinical management [6]. Assessing these domains clarifies where specialist-patient interactions are insufficient in addressing MASLD. Determining the extent to which endocrinologists recognize MASLD risk factors in patients with T2DM, integrate liver disease assessments into routine care, and apply evidence-based management strategies is essential for enhancing early detection and improving patient outcomes.

Objective - this study evaluates endocrinologists' awareness, risk assessment practices, and management strategies for patients with T2DM across key regions of Kazakhstan, including Almaty, the Almaty Region, the Zhambyl Region, the North Kazakhstan Region, and Aktobe. The objective is to identify gaps in clinical practice and inform targeted interventions to enhance MASLD treatment and care.

MATERIALS AND METHODS

Study design and population

We conducted a cross-sectional, multicenter study to evaluate how endocrinologists across Kazakhstan approach the screening and management of MASLD. The study was carried out from November 2025 to February 2026. Our study comprised 172 practicing endocrinologists recruited from five diverse regions: Almaty city, Almaty region, Zhambyl region, North Kazakhstan region, and Aktobe region. Our recruitment strategy encompassed outpatient, inpatient, and academic medical settings, allowing us to capture a comprehensive spectrum of clinical practice across the country.

Survey instrument

To ensure the study's validity and clinical relevance, we adapted existing validated survey instruments, tailoring them to reflect both current international standards (European Association for the Study of the Liver (EASL), American Association for the Study of Liver Diseases (AASLD), and American Diabetes Association (ADA) guidelines) and local clinical protocols in Kazakhstan. The questionnaire was translated into Kazakh by a panel of endocrinology specialists to ensure linguistic accuracy and correct use of medical terminology. Prior to full-scale dissemination, we conducted a pilot test with a select group of specialists to confirm the clarity, accuracy, and clinical relevance of the questions in the local context. Participants from this pilot phase were subsequently excluded from the final study group. The finalized questionnaire was comprised of two distinct sections:

Section 1: Professional Profile: We collected essential demographic and professional data, including gender, age, primary professional position, academic qualifications, clinical category, and total years of clinical experience.

Section 2: Clinical Practice and MASLD Management: We designed 23 closed-ended questions to probe deeper into MASLD screening protocols, diagnostic modalities (e.g., ultrasound and elastography with controlled attenuation parameter (CAP), and therapeutic decision-making—specifically regarding the use of ursodeoxycholic acid (UDCA e.g., Ursosan Forte, 500 mg), lifestyle interventions, and pharmacological treatments. We also included questions to identify the specific barriers clinicians face in managing these patients.

Data collection. We administered the survey electronically via Google Forms between November 2025 and February 2026. We disseminated the survey through professional networks and regional medical associations to reach as many specialists as possible. Participation was strictly voluntary, and by completing and submitting the questionnaire, participants provided implied consent to participate in this research.

Ethical considerations: This study was conducted in accordance with the Declaration of Helsinki. The survey involved endocrinologists and focused exclusively on their professional practice patterns. As the study was non-interventional, collected no personal health information or sensitive patient data, and all responses were fully anonymized, formal institutional review board oversight was not required according to the institutional guidelines for educational and professional surveys.

Statistical analysis: We processed and analyzed all data using RStudio (version 4.x). We present categorical variables as frequencies and percentages, supplemented by 95% confidence intervals (CI) to illustrate the precision of our estimates. To assess potential variations in clinical approach across professional subgroups (stratified by years of experience and qualification status), we used the Chi-squared or Fisher's exact tests. Furthermore, we employed the Kruskal-Wallis test to evaluate differences in annual patient volume across categories. We set the threshold for statistical significance at $p < 0.05$.

RESULTS

Sample characteristics

The study included 172 physicians, with a focus on endocrinologists. The median age of the group was 34.0 years (range 25.0–54.0 years) (Table 1). The majority of the participants were female (n=156, 90.7%), while male participants accounted for 9.3% (n=16). Regarding professional qualifications, the majority held an MD degree (81.4%), followed by MSc (10.5%) and PhD (8.1%). Clinical experience was distributed as follows: 46.5% of participants had <5 years of experience, 8.1% had 5–10 years, 12.8% had 11–15 years, 11.6% had 15–20 years, and 20.9% had >20 years of experience. The distribution of professional categories was: no category (46.5%), second category (7.0%), first category (14.0%), and highest

category (32.6%). Outpatient physicians constituted the largest professional group (69.8%), followed by medical residents (15.1%), inpatient physicians (10.5%), academic staff (2.3%), and consultant physicians (2.3%).

Patient volume analysis

The annual patient volume exhibited substantial variability across the sample. Analysis of experience levels indicated that mean annual patient volume was highest among physicians with >20 years of experience (804 ұ 1364 patients/year) and lowest among those with 11–15 years of experience (190 ұ 194 patients/year).

Given the significant dispersion indicated by the standard deviations, we further analyzed the data using medians and interquartile ranges (IQR). The median annual patient volume was also highest in the >20 years of experience group [150 (IQR: 55–1000) patients/year], compared to the 15–20 years of experience group [60 (IQR: 35–200) patients/year].

The distribution across categories was as follows: "No category" [130 (IQR: 37.5–500)], "First category" [106 (IQR: 48.8–400)], "Second category" [70 (IQR: 30–120)] and "Highest category" [120 (IQR: 31.2–1000)]. Patient volume did not vary significantly across professional qualification categories (Kruskal-Wallis $\chi^2(3) = 2.74$, $p = 0.433$).

Prevalence of MASLD

The estimated prevalence of MASLD within the patient populations managed by the study participants varied significantly across the specified intervals ($\chi^2 = 82.70$, df = 3, $p < 0.001$) (Figure 1).

Table 1. Demographic and professional characteristics of participating endocrinologists (*n* = 172)

Characteristic	n	%
Age, years		
Median (Min – Max)	34.0 (25.0 – 54.0)	—
Gender		
Male	16	9.3
Female	156	90.7
Clinical Experience		
< 5 years	80	46.5
5–10 years	14	8.1
11–15 years	22	12.8
15–20 years	20	11.6
> 20 years	36	20.9
Academic/Scientific Degree		
MD	140	81.4
MSc	18	10.5
PhD	14	8.1
Professional Qualification Category		
Highest category	56	32.6
First category	24	14.0
Second category	12	7.0
No category / Other	80	46.5
Primary Current Position		
Outpatient physician	120	69.8
Medical resident	26	15.1
Inpatient physician	18	10.5
Academic staff	4	2.3

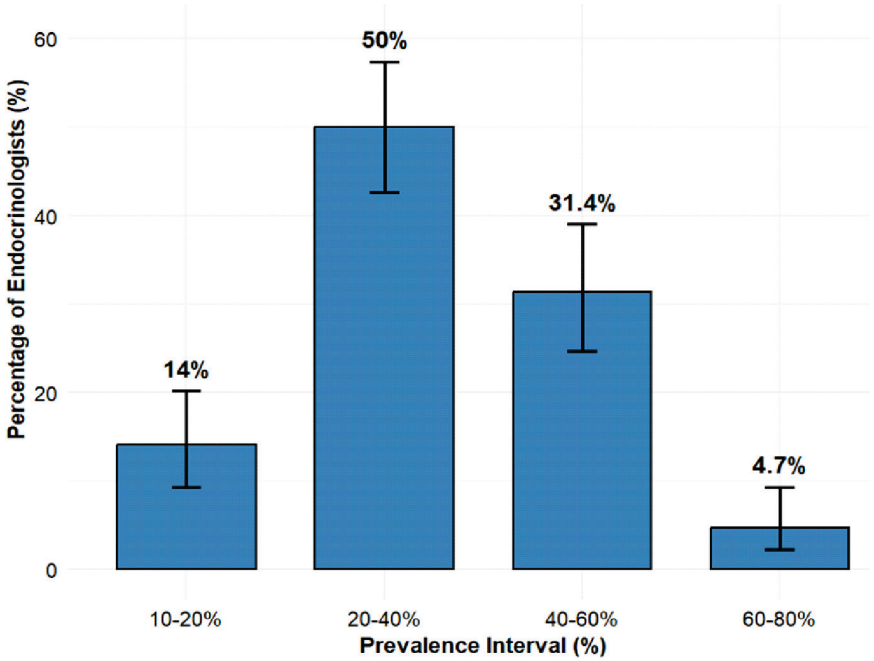


Figure 1. Distribution of endocrinologists according to the estimated prevalence of MASLD in their clinical practice.

The majority of physicians reported managing patient groups with an MASLD prevalence between 20% and 40% (n = 86, 50.0%; 95% CI: 42.6–57.4%). This was followed by the 40–60% prevalence interval (n = 54, 31.4%; 95% CI: 24.7–39.0%). Prevalence rates of 10–20% were observed by 14.0% of the group (n = 24; 95% CI: 9.3–20.2%), while the 60–80% interval was the least frequently reported (n = 8, 4.7%; 95% CI: 2.2–9.3%).

Screening protocols and clinical profile of patients

Screening practices among participating endocrinologists indicated that T2DM and obesity were the most frequently prioritized clinical conditions, reported by 91.9% (n = 158, 95% CI: 86.5–95.3%) and 88.4% (n = 152, 95% CI: 82.4–92.6%) of respondents, respectively. Alanine Aminotransferase (AST)/ Aspartate Aminotransferase (ALT) screening was reported by 69.8% (n = 120, 95% CI: 62.2–76.4%), dyslipidemia by 65.1% (n = 112, 95% CI: 57.4–72.1%), and arterial hypertension by 43.0% (n = 74, 95% CI: 35.6–50.8%). Less frequently reported conditions included hypothyroidism (31.4%, n = 54, 95% CI: 24.7–39.0%), polycystic ovary syndrome (PCOS) (27.9%, n = 48, 95% CI: 21.5–35.3%), and sleep apnea (20.9%, n = 36, 95% CI: 15.3–27.9%).

A total of 75.6% (n = 130, 95% CI: 68.3–81.7%) of endocrinologists routinely conducted targeted screening for obesity and T2DM. Additionally, 79.1% (n = 136, 95% CI: 73.0–85.1%) incorporated family history assessments into their diagnostic workflow.

Analysis of factors associated with targeted screening for obesity and T2DM demonstrated statistically significant variation based on physicians' clinical experience (x2(4) = 12.17, p = 0.016). Adherence was highest among endocrinologists with less than five years of experience (87.5%, 95% CI: 77.8–93.5%) compared to other experience groups. Significant differences were also identified across primary current positions (p = 0.012), with medical residents and academic staff reporting screening rates of 100% (95% CI: 84.0–100% and 39.6–100%, respectively), outpatient physicians at 71.7% (95% CI: 62.6–79.3%), and inpatient staff at 66.7% (95% CI: 41.2–85.6%). In contrast, physician qualification categories did not significantly influence screening practices ($\chi^2(3) = 4.15$, p = 0.246).

Screening and Diagnostic Practices

Participants reported employing a variety of diagnostic modalities for the assessment of metabolic liver disease. Liver ultrasonography (US) was the most frequently utilized tool, reported by 94.2% (n=162; 95% CI: 90.7–97.7%) of endocrinologists. Biochemical markers were also widely used, with ALT and AST assessment utilized by 73.3% (n=126) and 70.9% (n=122) of the group, respectively. Advanced imaging and invasive diagnostics were less frequent: elastography with CAP (27.9%; 95% CI: 21.2–34.6%), MRI (20.9%; 95% CI: 14.9–27.0%), and liver biopsy (19.8%; 95% CI: 13.8–25.7%). Computed tomography (17.4%) and thromboelastometry (8.1%) were the least reported methods.

Regarding the utilization of elastography with CAP across professional qualification categories, the highest adoption rates were observed among physicians in the "Highest category" (32.1%) and those with "No category" (30.0%), while "First" and "Second" categories reported lower utilization rates (16.7% each).

In clinical practice, healthcare providers focus on certain diagnostic criteria when deciding to perform a liver biopsy. Among the endocrinologists surveyed, 60.5% (n = 104, 95% CI: 53.2–67.8%) identified the risk of steatohepatitis or cirrhosis as the main reason. Metabolic syndrome was the next most common indication at 12.8% (n = 22, 95% CI: 7.8-17.8%), followed by other causes of steatohepatitis at 9.3% (n = 16, 95% CI: 5.0–13.6%). Other reasons included a high NAFLD fibrosis score (4.7%, n = 8, 95% CI: 1.5–7.8%), pediatric patients before starting medication (3.5%, n = 6, 95% CI: 0.7-6.2%), and cases where other causes of steatohepatitis could not be excluded (1.2%, n = 2, 95% CI: 0.0–2.8%).

In the context of multidisciplinary care integration, 98.8% of participating endocrinologists (n = 170; 95% CI: 97.2–100.0%) reported regularly referring patients to specialists, such as gastroenterologists or hepatologists, for advanced management. In contrast, only 1.2% (n = 2; 95% CI: 0.0–2.8%) reported not routinely making such referrals.

Therapeutic Management Strategies and Pharmacotherapy Approaches

Participating endocrinologists prioritized foundational lifestyle interventions as the primary management strategy for MASLD. Dietary recommendations were the most commonly implemented, reported by 89.5% (n = 154, 95% CI: 85.0–94.1%) of respondents, followed by physical exercise (65.1%, n = 112, 95% CI: 58.0–72.2%) and avoidance of hepatotoxic drugs (65.1%, n = 112, 95% CI: 58.0–72.2%). For weight loss targets, 58.1% (n = 100, 95% CI: 50.8–65.5%) recommended a 10% body weight reduction, while 27.9% (n = 48, 95% CI: 21.2–34.6%) and 9.3% (n = 16, 95% CI: 5.0–13.6%) recommended 3–5% and 2% reductions, respectively.

Statistically significant variation was observed in dietary prescription patterns among practitioners (p = 0.0046). Hypocaloric diets were most frequently preferred (45.3%, n = 78, 95% CI: 37.9–52.7%), followed by low-fat diets (30.2%, n = 52, 95% CI: 23.3–37.1%), low-carbohydrate diets (19.8%, n = 34, 95% CI: 13.8–25.8%), and high-protein diets (4.7%, n = 8, 95% CI: 1.5–7.9%).

Statins and UDCA were the most frequently utilized pharmacological agents, reported by 52.3% (n = 90, 95% CI: 44.8–59.8%) and 50.0% (n = 86, 95% CI: 42.5–57.5%) of endocrinologists, respectively. Additional therapies included metformin (37.2%, n = 64, 95% CI: 30.0–44.4%), vitamin E (37.2%, n = 64, 95% CI: 30.0–44.4%), pioglitazone (17.4%, n = 30, 95% CI: 11.8–23.1%), antioxidants (15.1%, n = 26, 95% CI: 9.8–20.5%), bariatric surgery for patients without cirrhosis (11.6%, n = 20, 95% CI: 6.8–16.4%), and obeticholic acid (7.0%, n = 12, 95% CI: 3.2–10.8%).

A majority of respondents (84.9%, n = 146, 95% CI: 79.5–90.3%) indicated that patients with elevated AST/ALT levels require pharmacotherapy, whereas 15.1% (n = 26, 95% CI: 9.7–20.5%) prioritized patients post-biopsy.

Clinical Perspectives, Practice Patterns, and Perceptions Regarding UDCA

In evaluating the clinical role of UDCA in MASLD, 80.2% (n = 138, 95% CI: 74.3–86.2%) of participating endocrinologists reported that its use is supported by clinical guidelines, while 19.8% (n = 34, 95% CI: 13.8–25.7%) disagreed.

The frequency of UDCA prescription varied significantly among practitioners (p = 0.0004): 44.2% (n = 76, 95% CI: 36.8–51.6%) prescribed it often, 30.2% (n = 52, 95% CI: 23.4–37.1%) sometimes, 15.1% (n = 26, 95% CI: 9.8–20.5%) rarely, and 10.5% (n = 18, 95% CI: 5.9–15.0%) never (Figure 2). Prescription frequency also differed significantly across physician qualification categories (Fisher's exact test p = 0.0142).

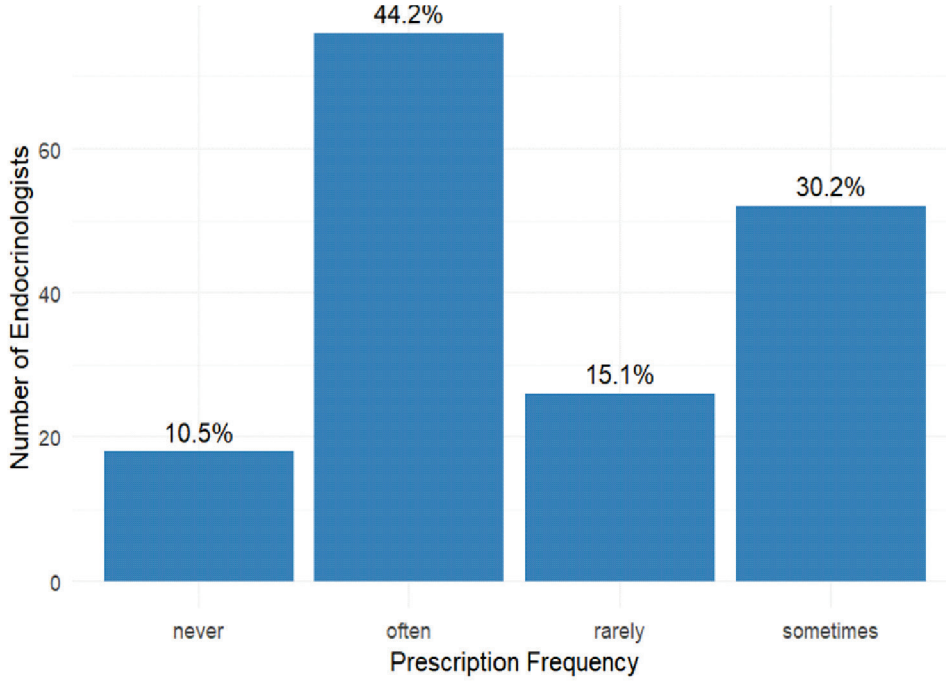


Figure 2. Reported frequency of ursodeoxycholic acid (UDCA) prescription in clinical practice.

Respondents most frequently cited improvement in liver enzyme profiles (46.6%, n = 124, 95% CI: 40.6–52.6%) and amelioration of liver fibrosis (20.3%, n = 54, 95% CI: 15.5–25.1%) as the primary therapeutic effects of UDCA. Additional perceived benefits included enhanced insulin sensitivity (16.5%, n = 44, 95% CI: 12.0–21.0%), uncertainty regarding the mechanism (9.0%, n = 24, 95% CI: 5.6–12.4%), and a belief in no proven efficacy (6.0%, n = 16, 95% CI: 3.1–8.9%). Perceptions of mechanisms did not differ significantly across qualification categories (Fisher's exact test p = 0.1206).

Regarding risks associated with non-evidence-based or inappropriate use of UDCA, 32.6% (n = 56, 95% CI: 25.6–39.6%)

of respondents perceived no risks. Other concerns included delayed initiation of evidence-based therapy (27.9%, n = 48, 95% CI: 21.2–34.6%), side effects (19.8%, n = 34, 95% CI: 13.8–25.8%), a false sense of improvement (12.8%, n = 22, 95% CI: 7.8–17.8%), and unnecessary expenses (4.7%, n = 8, 95% CI: 1.5–7.9%). The distribution of these perceived risks varied significantly across physician qualification categories (Fisher's exact test p = 0.0222).

Clinical Utilization and Safety Awareness of Vitamin E

Vitamin E was used by 37.2% (n = 64; 95% CI: 30.0–44.4%) of endocrinologists to manage metabolic liver disease. Regarding safety awareness, 50.0% (n = 86, 95% CI: 42.5–57.5%) of surveyed endocrinologists reported a complete lack of awareness of potential risks. Among those who identified specific hazards, the most frequently cited concerns were bleeding and stroke (21.5%, n = 37, 95% CI: 15.4–27.6%), gastrointestinal disorders (10.5%, n = 18, 95% CI: 5.9–15.1%), overdose and toxicity (5.8%, n = 10, 95% CI: 2.3–9.3%), metabolic disturbances (2.3%, n = 4, 95% CI: 0.1–4.5%), and allergic reactions (1.2%, n = 2, 95% CI: 0.0–2.8%). Awareness and perception of these safety profiles varied significantly across professional subgroups (Fisher's exact test p = 0.0020).

Endocrinologists' Perceptions of Medications That Exacerbate MASLD

When evaluating endocrinologists' awareness of medications that may exacerbate MASLD, paracetamol and corticosteroids were most frequently identified, each reported by 53.5% (n = 92, 95% CI: 46.0–61.0%) of respondents. These were followed by nonsteroidal anti-inflammatory drugs (NSAIDs) at 48.8% (n = 84, 95% CI: 41.3–56.3) and methotrexate at 45.3% (n = 78, 95% CI: 37.9–52.7%).

Other potentially hepatotoxic agents recognized by participating endocrinologists included statins (31.4%, n = 54, 95% CI: 24.5–38.3%), amiodarone (25.6%, n = 44, 95% CI: 19.1–32.1%), tamoxifen (25.6%, n = 44, 95% CI: 19.1–32.1%), valproate (23.3%, n = 40, 95% CI: 17.0–29.6%), quinine (23.3%, n = 40, 95% CI: 17.0–29.6%), and azathioprine (22.1%, n = 38, 95% CI: 15.9–28.3%).

The distribution of responses regarding medications worsening MASLD did not show statistically significant variation across physician qualification categories (Fisher's exact test p = 0.6401).

Socio-economic Impact, Clinical Management Barriers, and Professional Information Sources

Within the broader public health context, 91.9% of participating endocrinologists (n = 158, 95% CI: 87.8–96.0%) identified MASLD as a significant socio-economic and medical issue. In contrast, 8.1% (n = 14, 95% CI: 4.0–12.2%) did not share this perspective.

Endocrinologists identified several primary barriers in clinical management, with statistically significant differences observed ($\chi 2 = 56.37$, df = 4, $p < 0.001$) (Figure 3). Low patient adherence was the most frequently reported barrier (41.9%, n = 72, 95% CI: 34.5–49.3%), followed by insufficient physician confidence (20.9%, n = 36, 95% CI: 14.8–27.0%), cost of diagnostic evaluation and treatment (14.0%, n = 24, 95% CI: 8.8–19.2%), lack of time (11.6%, n = 20, 95% CI: 6.8–16.4%), and challenges in discussing obesity with patients (11.6%, n = 20, 95% CI: 6.8–16.4%). The distribution of these barriers was significantly associated with physician qualification categories (Fisher's exact test p = 0.0002).

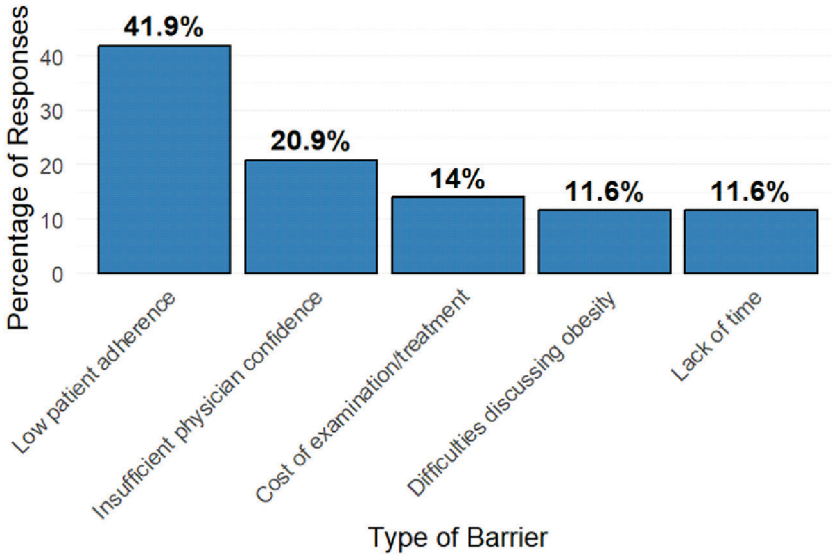


Figure 3. Distribution of clinical barriers encountered by endocrinologists during MASLD management.

Regarding educational resources used to maintain professional knowledge of MASLD, the distribution differed significantly across sources ($\chi 2 = 17.35$, df = 2, p = 0.0002). Reading clinical guidelines was the most common source, utilized by 43.0% (n = 74, 95% CI: 35.6–50.4%) of endocrinologists, while 18.6% (n = 32, 95% CI: 12.8–24.4%) reported attending educational lectures, and 38.4% (n = 66, 95% CI: 31.1–45.7%) indicated using neither. The choice of educational resources also varied significantly across professional qualification subgroups (Fisher's exact test p = 0.0316).

DISCUSSION

This study assessed current clinical practice patterns, screening preferences, diagnostic modalities, and therapeutic approaches for metabolic dysfunction-associated steatotic liver disease (MASLD) among endocrinologists. A comparison with existing international literature reveals key similarities and differences in the management of metabolic liver disease across various clinical settings.

While patient volume and referral patterns typically indicate specialty care utilization, they also reveal a broader clinical context in which individuals with major metabolic risk factors, including diabetes, hypertension, and visceral obesity, require proactive identification [7]. These findings further support conclusions from previous international studies that advocate for targeted education of healthcare providers to enhance early detection and facilitate timely referral of at-risk patients to specialized care [8].

The results indicate a substantial reliance on conventional diagnostic tools among endocrinologists, with liver ultrasonography being the most frequently utilized modality (94.2%), followed by biochemical marker assessments such as ALT (73.3%) and AST (70.9%). This distribution closely parallels prior literature, which suggests that hepatic ultrasound is widely favored in routine clinical practice due to its high availability, convenience, and cost-effectiveness.

Comparison with broader international surveys reveals notable nuances regarding advanced diagnostics. Although other studies have reported that specialists frequently utilize specialized methods when available, advanced imaging and invasive procedures in this endocrinology cohort, such as elastography with CAP (27.9%), MRI (20.9%), and liver biopsy (19.8%), remain considerably less frequent. These findings indicate an ongoing implementation gap in the adoption of advanced non-invasive fibrosis risk stratification tools within non-hepatology specialty settings [9].

With respect to invasive diagnostics, respondents primarily identified the risk of steatohepatitis or cirrhosis (60.5%) as the principal justification for performing a liver biopsy. This selective approach aligns with general clinical practice, where histological evaluation is typically reserved for high-risk profiles or delayed until non-invasive pathways or lifestyle interventions prove insufficient. Additionally, the exceptionally high rate of multidisciplinary integration observed in this study, with 98.8% of endocrinologists routinely referring complex cases to gastroenterologists or hepatologists, underscores a strong collaborative framework that mitigates the limitations of managing advanced metabolic liver disease within a single specialty [10,11].

In accordance with international guidelines that identify foundational lifestyle modifications as the primary therapy for metabolic liver disease, most participating endocrinologists prioritized non-pharmacological interventions [12]. Dietary recommendations were adopted by 89.5% of respondents, followed by physical exercise (65.1%) and avoidance of hepatotoxic drugs (65.1%). For weight loss targets, 58.1% of practitioners recommended a 10% reduction in body weight, while 27.9% and 9.3% recommended reductions of 3-5% and 2%, respectively.

Nevertheless, significant variation existed in specific dietary prescription patterns among practitioners ($p = 0.0046$). Hypocaloric diets were most frequently recommended (45.3%), followed by low-fat diets (30.2%), low-carbohydrate diets (19.8%), and high-protein diets (4.7%). These results are consistent with existing literature, which indicates that although dietary and lifestyle modifications are universally recognized as first-line interventions for MASLD, their implementation in clinical practice is often hindered by factors such as low patient adherence and varying dietary preferences among specialty subgroups [13].

The clinical use and perception of UDCA among endocrinologists reflect a strong reliance on its hepatoprotective properties, despite variability in prescribing frequency. Within this study, 80.2% of participating endocrinologists indicated that UDCA use in MASLD is supported by clinical guidelines, and nearly half prescribe it frequently (44.2% often and 30.2% sometimes). This prescribing pattern aligns with scientific evidence showing that UDCA significantly improves markers of hepatocellular injury and intrahepatic cholestasis. UDCA is also widely recognized for stabilizing hepatocyte membranes, reducing oxidative stress, and attenuating inflammation [14].

The most frequently cited rationale for prescribing UDCA was improvement in liver enzyme profiles (46.6%), followed by amelioration of liver fibrosis (20.3%), as primary therapeutic benefits. These perceptions are supported by comprehensive meta-analyses demonstrating that UDCA reduces levels of hepatocellular enzymes, such as ALT and AST, and contributes to long-term management strategies [15]. Furthermore, 16.5% of respondents identified enhanced insulin sensitivity as a therapeutic benefit, which is corroborated by recent evidence indicating that UDCA favorably modulates cardiometabolic parameters, fasting glucose, and lipid metabolism [16,17].

The findings also reveal notable gaps and divergent views regarding the safety profile and potential risks associated with UDCA. While 32.6% of endocrinologists perceived no risks related to non-evidence-based or inappropriate use, others expressed concerns including delayed initiation of evidence-based therapy (27.9%), potential side effects (19.8%), and a false sense of clinical improvement (12.8%). These varied perceptions, which differed significantly across physician qualification categories ($p = 0.0222$), underscore the need for ongoing education to harmonize clinical understanding, ensure adherence to evidence-based pathways, and optimize the targeted application of UDCA in comprehensive MASLD care.

Although there is strong consensus on the foundational importance of lifestyle interventions and targeted management strategies, real-world clinical practice faces significant practical barriers. In this cohort, endocrinologists identified several key impediments to optimal metabolic liver disease care, with low patient adherence reported as the most prevalent challenge (41.9%). This persistent issue highlights a widespread clinical reality: implementing evidence-based lifestyle recommendations and therapeutic regimens into sustained behavioral change remains exceptionally difficult for patients.

CONCLUSION

This study identifies prevailing clinical practices, diagnostic strategies, and therapeutic approaches for MASLD among

endocrinologists. Although metabolic screening and lifestyle modifications are prioritized, significant gaps persist in the adoption of advanced non-invasive diagnostics and the standardization of treatments such as ursodeoxycholic acid. In addition to challenges like low patient adherence, these findings underscore the necessity for unified guidelines, improved educational initiatives, and strengthened multidisciplinary collaboration to enhance real-world outcomes.

Transparency of the Study

The study had no financial support. The author bears full responsibility for submitting the final version of the manuscript for publication.

Declaration of Financial and Other Relationships

The author received no honorarium for the study.

Conflict of Interests

The author declares no conflict of interests.

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