

Evidence-Based Case Report

Behavioral Intervention for Lifestyle Modification in Adults with Metabolic Dysfunction-Associated Steatotic Liver Disease

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Abstract

A 19-year-old female student presented to the university clinic following a hospital diagnosis of grade 1 fatty liver disease. She exhibits grade 2 obesity, dyslipidemia, hyperuricemia, and elevated liver transaminases, with a family history of obesity and type 2 diabetes mellitus. Given the patient's challenges in adhering to diet and exercise recommendations, this evidence-based care report explores whether behavioral interventions, compared with standard care, more effectively improve outcomes in Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD) among young adults. A literature search conducted via PubMed® and Scopus® on June 23, 2026 identified three systematic reviews, three randomized controlled trials, and one cohort study relevant to the clinical inquiries. Findings consistently show that behavioral interventions outperform standard care in weight management, reduction of liver enzymes, and improvements in lipid profiles, though results for lipid changes remain heterogeneous. One study with a three-year follow-up demonstrated improvements in the hepatic steatosis index (HSI) and fatty liver index (FLI), suggesting long-term benefits. Evidence further highlights the role of eHealth strategies, including mobile applications and adherence reminders, in sustaining lifestyle changes. Overall, structured behavioral programs supported by professional coaching and digital monitoring yield significant clinical benefits for young adults with MASLD.

Keywords: metabolic dysfunction-associated steatotic liver disease, non-alcoholic fatty liver disease, lifestyle modification, behavioral intervention, clinical improvement.

Intervensi Perilaku untuk Modifikasi Gaya Hidup pada Dewasa dengan Metabolic Dysfunction-Associated Steatotic Liver Disease

Abstrak

Seorang mahasiswa berusia 19 tahun datang ke klinik universitas setelah didiagnosis dengan fatty liver derajat 1 di rumah sakit. Pasien menunjukkan obesitas derajat 2, dislipidemia, hiperurisemia, serta peningkatan enzim transaminase hati, serta riwayat keluarga dengan obesitas dan diabetes melitus tipe 2. Mengingat tantangan pasien dalam mematuhi rekomendasi diet dan olahraga, laporan kasus berbasis bukti ini bertujuan menelaah efektivitas intervensi perilaku dibandingkan tatalaksana standar, pada Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD). Pencarian literatur melalui PubMed® dan Scopus® pada tanggal 23 Juni 2026 mendapatkan tiga ulasan sistematis, tiga uji klinis terkontrol acak, dan satu studi kohort yang relevan dengan pertanyaan klinis. Temuan secara konsisten menunjukkan bahwa intervensi perilaku lebih unggul dibandingkan tatalaksana standar dalam manajemen berat badan, penurunan enzim hati, serta perbaikan profil lipid, meskipun terdapat heterogenitas dalam perubahan lipid. Satu studi kohort dengan follow-up tiga tahun menunjukkan adanya perbaikan pada hepatic steatosis index (HSI) dan fatty liver index (FLI), yang mengindikasikan manfaat jangka panjang. Bukti juga menyoroti peran eHealth, termasuk aplikasi seluler dan pengingat digital, dalam mempertahankan perubahan gaya hidup. Secara keseluruhan, program perubahan perilaku terstruktur yang didukung oleh coaching profesional dan pemantauan digital dapat memberikan manfaat klinis yang signifikan bagi dewasa muda dengan MASLD.

Kata kunci: metabolic dysfunction-associated steatotic liver disease, non-alcoholic fatty liver disease, modifikasi gaya hidup, intervensi perilaku, perbaikan klinis.

Introduction

The prevalence of metabolic diseases, particularly among young adults, has exhibited a global upward trend over the past few decades. While these conditions have historically been associated with older demographics, recent epidemiological shifts indicate a significant and concerning increase in the incidence of systemic metabolic disorders among younger populations. This trend correlates strongly with rising rates of early-onset obesity, insulin resistance, and dyslipidemia, representing a critical shift in the global public health landscape.^{1,2} This epidemiological transition is primarily driven by significant modifications in modern lifestyles and environmental factors. The shift toward a Western-style dietary pattern—characterized by excessive caloric intake and the high consumption of ultra-processed foods (UPFs), refined carbohydrates, added sugars such as fructose, and saturated fats—functions as a principal catalyst for metabolic disorders.^{3,4} Furthermore, the escalating prevalence of sedentary behavior and insufficient physical activity—collectively termed the “triple hit” behavioral phenotype—establishes an environment highly predisposed to obesity.⁵ From a pathophysiological perspective, these maladaptive behaviors stimulate enhanced *de novo* lipogenesis, exacerbate insulin resistance, and trigger a systemic cascade of low-grade inflammation alongside accelerated intrahepatic lipid accumulation.^{1,4}

Non-alcoholic Fatty Liver Disease (NAFLD) represents one of the most significant clinical manifestations of the current metabolic crisis. This condition has recently been reconceptualized as Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD) to more accurately reflect its underlying pathophysiology.^{1,2} MASLD has rapidly emerged as the primary etiology of chronic liver disease globally, with its worldwide prevalence escalating to approximately 38% of the adult population.¹ The global distribution of NAFLD prevalence exhibits significant geographical variations; the highest burden is observed in the Middle East at 32%, while the lowest is recorded in Africa at 13%. Concurrently, the prevalence in Asia has reached

27%, surpassing Western nations and establishing it as one of the most affected regions. Within Asia, national epidemiological data reveal that Indonesia reports the highest prevalence of NAFLD at 51%, whereas China is situated at 29% and Japan registers the lowest rate at 22%.⁶ Furthermore, its prevalence among young adults is escalating at an unprecedented rate, and the condition frequently functions as a subclinical early indicator of more severe systemic complications.^{1,2}

Lifestyle modification remains the cornerstone and primary intervention, particularly during the early, reversible stages of the disease.^{2,7} However, achieving sustained lifestyle changes remains challenging, as many individuals encounter significant difficulties in behavioral modification due to barriers such as low self-efficacy, lack of motivation, time constraints, and inadequate social support.^{7,8} In this regard, behavioral interventions serve as patient-centered approaches designed to bridge the gap between clinical advice and sustainable habit formation.^{1,8} Specifically, these interventions employ evidence-based therapeutic modalities—such as cognitive-behavioral therapy (CBT) and counseling models grounded in the stages of behavior change (Transtheoretical Model)—to facilitate the progression from intention to active maintenance.^{5,8} Rather than relying on standard clinical care, which is often limited to passive education or brief, unstructured advice, structured behavioral strategies empower patients through active techniques such as motivational interviewing, collaborative goal-setting, and systematic self-monitoring.^{5,8} Therefore, this evidence-based case report aims to evaluate the efficacy of behavioral interventions in lifestyle modification to improve clinical outcomes of NAFLD/MASLD in young adult patients.

Clinical Scenario

A 19-year-old female student, accompanied by her mother, presented to the university primary care clinic following a hospital diagnosis of grade 1 fatty liver disease. The patient's mother expressed concern about the treatment and sought consultation with the primary care

physician at the university clinic for management strategies.

Physical examination confirmed grade 2 obesity, with no other pertinent clinical findings. Clinical evaluations revealed dyslipidemia (elevated LDL), hyperuricemia, and elevated transaminases (ALT and AST), while fasting glucose levels remained within normal range. The patient's medical history was unremarkable, with no prior diagnosis of hepatitis or diabetes and no history of alcohol consumption. However, a significant family history of obesity and type 2 diabetes mellitus was noted.

The patient reported a sedentary lifestyle with minimal physical activity and no structured exercise routine. She also reported feeling unwell whenever she attempted to exercise. Evaluation using a three-day food record demonstrated an unbalanced, high-calorie diet with inadequate fiber intake. Although the patient had attempted dietary modification, adherence remained poor. Given the importance of lifestyle modification in MASLD management and the patient's difficulties in maintaining diet and exercise recommendations, evidence regarding behavioral interventions was sought to identify strategies that could improve clinical outcomes.

Problem Formulation

The primary objective of this evidence-based case report is to determine whether behavioral interventions, compared with standard care, can facilitate greater clinical improvement in young adults with NAFLD/MASLD. This objective is operationalized through the following clinical question. Population (P): Young adults with MASLD/NAFLD; Intervention (I): Behavioral intervention (e.g. coaching, motivational interviewing, cognitive behavioral therapy) for lifestyle modification; Comparison (C): Standard care; Outcomes (O): Clinical improvement (weight reduction, improvement in lipid profiles, liver biomarkers, liver imaging findings, and/or liver histopathology). Intermediary outcomes

(improvement in adherence/compliance compliance to lifestyle changes: diet modification and/or physical activity/exercise)

Search Strategy and Results

Literature search strategy

The literature search was conducted using two electronic databases, PubMed/MEDLINE® (<https://pubmed.ncbi.nlm.nih.gov>) and Scopus® (<https://www.scopus.com>). The search was limited to articles published between 2016 and 2026 to identify the most recent evidence regarding the management of NAFLD/MASLD. After retrieval, duplicate records were removed. The remaining articles were screened based on their titles and abstracts according to predefined eligibility criteria.

Studies were eligible for inclusion if they involved adult patients with NAFLD/MASLD, evaluated behavioral interventions for lifestyle modification such as coaching, motivational interviewing, or cognitive behavioral therapy, and employed study designs including systematic reviews, meta-analyses, randomized controlled trials, or cohort studies. Only articles published between 2016 and 2026 and written in English were considered for inclusion. Animal studies were excluded, as were publications categorized as opinion articles, editorials, narrative reviews, brief communications, conference abstracts, or studies available only in abstract form.

A systematic search across PubMed and Scopus yielded 119 records up to June 23, 2026. After the removal of 18 duplicates, 101 titles and abstracts were screened, resulting in the exclusion of 73 irrelevant records. A subsequent full-text assessment of the remaining 28 articles led to the exclusion of 21 studies that failed to meet the predefined PICO criteria. Ultimately, seven articles (comprising three systematic reviews, three randomized-controlled trials, and one cohort study) were included in the final analysis (Figure 1).

Table 1. Search Keywords

Database	Keywords	Results
Pubmed	((("non-alcoholic fatty liver disease"[MeSH Terms] OR "non alcoholic fatty liver"[All Fields] OR "NAFLD"[All Fields] OR "metabolic dysfunction-associated steatotic liver"[All Fields] OR "MASLD"[All Fields]) AND ("life style"[MeSH Terms] OR "healthy lifestyle"[MeSH Terms] OR "lifestyle change"[All Fields] OR "lifestyle modification"[All Fields] OR "lifestyle management"[All Fields] OR "exercise"[MeSH Terms] OR "diet"[MeSH Terms]) AND ("behavior therapy"[MeSH Terms] OR "cognitive behavioral therapy"[MeSH Terms] OR "behavioral intervention"[All Fields] OR "counseling"[MeSH Terms] OR "coaching"[All Fields] OR "motivational interviewing"[MeSH Terms] OR "transtheoretical model"[MeSH Terms]) AND ("reversible"[All Fields] OR "reversibility"[All Fields] OR "improve"[All Fields] OR "clinical improvement"[All Fields] OR "behavior change"[All Fields] OR "adherence"[All Fields] OR "compliance"[All Fields]))	90
Scopus	TITLE-ABS-KEY(("non alcoholic fatty liver" OR "non-alcoholic fatty liver" OR "NAFLD" OR "metabolic dysfunction-associated steatotic liver" OR "MASLD") AND ("lifestyle change" OR "exercise" OR "diet" OR "healthy lifestyle" OR "lifestyle modification" OR "lifestyle management") AND ("behavioral intervention" OR "coaching" OR "motivational interviewing" OR "transtheoretical model" OR "cognitive behavioral therapy") AND ("reversible" OR "reversibility" OR "improve" OR "clinical improvement" OR "behavior change" OR "adherence" OR "compliance"))	59

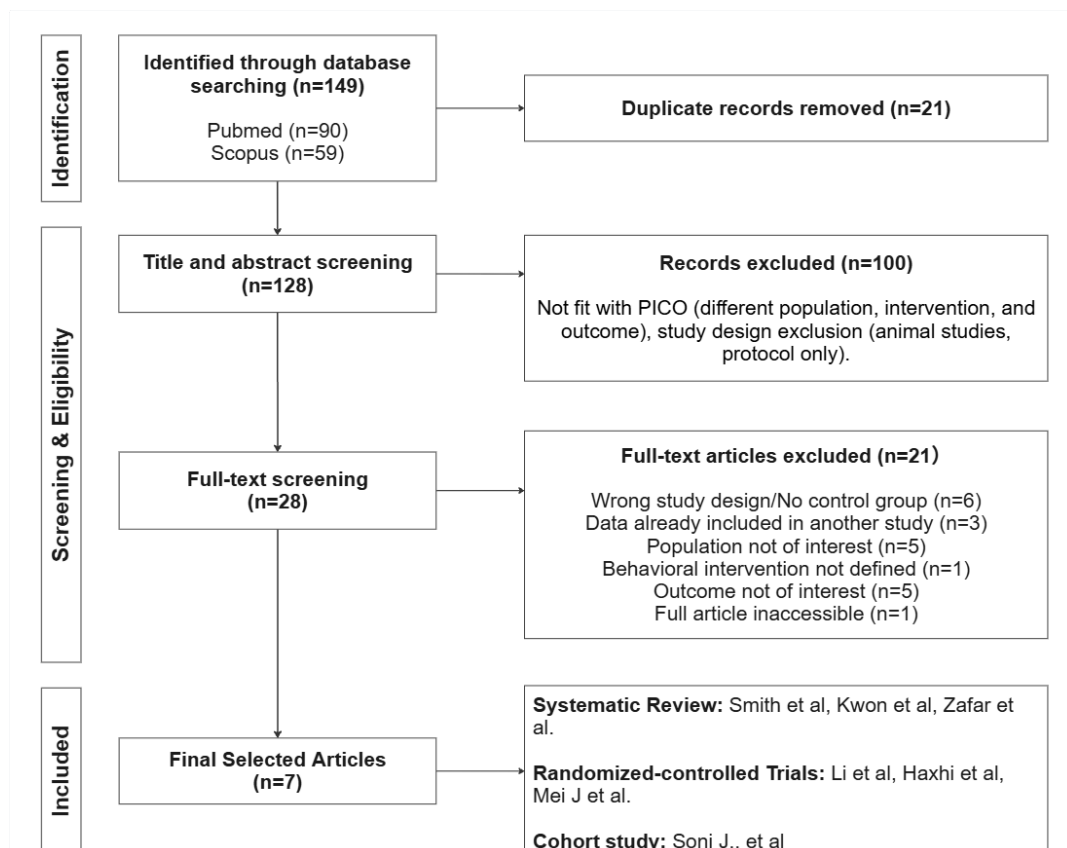


Figure 1. Search Strategy Flowchart

Results

The selected literature comprised systematic reviews and meta-analyses, randomized controlled trials, and a cohort study investigating structured lifestyle coaching, behavior change theory-based approaches, and digital health interventions specifically targeting behavioral, cognitive, and lifestyle modifications for MASLD/NAFLD. Methodological quality was assessed using the Oxford Centre for Evidence-Based Medicine (CEBM) critical appraisal tool for systematic reviews⁹ and clinical trials¹⁰, and the Critical Appraisal Skills Programme (CASP) checklist for the cohort study.¹¹ Level of evidence is determined according to the Oxford Centre for Evidence-Based Medicine.¹² The findings of the critical appraisal are summarized in Table 2, Table 3, and Table 4.

Overall, the selected systematic reviews fulfilled all validity criteria, with the exception of the outcomes' homogeneity among the included studies. Furthermore, the participants, interventions, comparison groups, and outcomes are entirely relevant to the present clinical scenario.

The three clinical trials were appropriately randomized, with intervention and control groups exhibiting comparable baseline characteristics. However, two of the three studies failed to implement blinding, which may have introduced bias in outcome assessment. Participants who

dropped out were excluded from the final analysis, and none of the three conducted an intention-to-treat analysis, thereby raising concerns regarding attrition bias. Although no research has specifically focused on young adults, the three studies included adult participants. Only the study by Haxhi et al. differs from the others in terms of type 2 diabetes mellitus diagnosis and a more advanced age (range from 40 to 80 years).¹⁶ Intervention and outcome measures from all studies remain applicable to our specific clinical setting.

The retrospective cohort study maintained complete follow-up data; however, the sample size was insufficiently small (n=22). Potential confounding factors were neither adequately identified nor addressed during the statistical analysis. Furthermore, high variability in exercise and dietary habits was observed among participants. Additionally, the 12-week follow-up duration may have been insufficient to detect significant changes, particularly as prior research suggests that such outcomes typically manifest after 6 to 12 months.^{19,20} Consequently, the study exhibits a high risk of bias and limited internal validity, thereby compromising its overall methodological quality.

In the subsequent section, a summary of each study and the primary results of interest are presented in Table 5, Table 6, and Table 7.

Table 2. Critical Appraisal of Selected Systematic Reviews

Appraisal Questions		Smith, et al ⁸	Kwon, et al ¹⁰ Error! Reference source not found. ³	Zafar, et al ¹⁴
Validity	What question did the systematic review address?	+	+	+
	Is it unlikely that relevant studies were missed?	+	+	+
	Were the inclusion criterias appropriate?	+	+	+
	Were the included studies valid?	+	+	+
	Were the results similar from study to study?	-	-	-
	Patient	+	+	+
Relevance	Intervention	+	+	+
	Comparison	+	+	+
	Outcome	+	+	+
Level of Evidence		1	1	1

+ = stated clearly in the article; - = not being done; ? = unclear;
A = applicable; N/A = not applicable; P = probable

Table 3. Critical Appraisal of Selected Clinical Trial

Articles	Validity						Applicability			Level of Evidence
	Study design	Randomization	Similarity treatment and control	Blinding	Comparable treatment	Intention to treat	Patient	Intervention	Outcome	
Li L., et al ¹³⁵	+	+	+	-	+	-	A	A	A	2
Haxhi, et al ¹⁶⁶	+	+	+	+	+	-	P	A	A	2
Mei, et al ¹⁷⁷	+	+	+	-	+	-	A	A	A	2

+ = stated clearly in the article; - = not being done; ? = unclear;
A = applicable; N/A = not applicable; P = probable

Table 4. Critical appraisal of selected cohort study

Appraisal Questions		Soni J., et al ¹⁸⁸
Validity	Did the study address a clearly focused issue?	+
	Was the cohort recruited in an acceptable way?	+
	Was the exposure accurately measured to minimise bias?	+
	Was the outcome accurately measured to minimise bias?	+
	Have the authors identified all important confounding factors?	?
	Have they taken account of the confounding factors in the design and/or analysis?	-
	Was the follow-up of subjects complete enough?	+
Applicability	Was the follow-up of subjects long enough?	?
	Can the results be applied to the local population?	P
Level of Evidence		3

+ = stated clearly in the article; - = not being done; ? = unclear;

A = applicable; N/A = not applicable; P = probable

Table 5. Results of Selected Systematic Reviews

No	Author	Study Included in the Analysis	Total Participants	Results
1	Smith et al ⁸	6 studies	451	Digital behavior change interventions were not effective in reducing weight (WMD -2.07 kg, 95% CI: -6.08 to 1.94, $p=0.24$, $I^2 = 90\%$). Similarly, they did not lead to statistically significant improvements in ALT (WMD -9.14 IU/L, 95% CI -20.33 to +2.05 IU/L, $p=0.09$, $I^2 = 81\%$) or AST (WMD -5.81 IU/L, 95% CI -12.96 to +1.35 IU/L, $p=0.09$, $I^2 = 55\%$). Several studies included reported γ GT reduction, improvement in fibrosis, steatosis, liver fat percentage, HbA1c, lipid profile (TGs, LDL-C, HDL-C, and TC) in the intervention group. However, the results were not consistent across studies.
2	Kwon et al ^{Error! Reference source not found.3}	4 studies	1257	eHealth interventions showed significant improvements in BMI (SMD -0.56, 95% CI: -1.01 to -0.10, $p=0.02$, $I^2=72\%$), AST (SMD -0.67, 95% CI: -1.22 to -0.13, $p=0.02$), and ALT (SMD -0.72, 95% CI: -1.28 to -0.15, $p=0.01$). There was a high heterogeneity for liver enzymes ($I^2 = 83\%$ to 84%). Changes in body weight between the intervention and control groups were not significant (SMD 0.45, 95% CI: 0.91 to 0.01, $p=0.05$, $I^2=72\%$).
3	Zafar et al ¹⁴	10 studies	1521	eHealth interventions significantly improved weight loss (SMD: -0.38, 95% CI: -0.60 to -0.17, $p<0.05$, $I^2=35\%$), BMI (SMD: -0.37, 95% CI: -0.54 to -0.21, $p<0.05$, $I^2=1\%$), AST (SMD: -0.35, 95% CI: -0.61 to -0.10, $p<0.05$, $I^2=51\%$), and ALT (SMD: -0.38, 95% CI: -0.65 to -0.11, $p<0.05$, $I^2=70\%$). Notably, the result for BMI showed almost no heterogeneity, while other outcomes showed moderate to high heterogeneity. eHealth interventions did not significantly reduce abdominal/waist circumferences, HDL, γ GT, TG, nor fibrosis score.

WMD = Weighted Mean Difference; ALT = Alanine Aminotransferase; AST = Aspartate Aminotransferase; SMD = Standardized Mean Difference; BMI = Body Mass Index; IU/L= International Units per Liter; γ GT = Gamma-Glutamyl Transferase; HbA1c =Glycated Hemoglobin; TGs =Triglycerides; LDL-C = Low-Density Lipoprotein Cholesterol; HDL-C= High-Density Lipoprotein Cholesterol; TC = Total Cholesterol; CI = Confidence Interval

Table 6. Results of Selected Randomized Controlled Trial

No	Author	Participants Number	Follow-up	Intervention	Control	Results
1	Li et al ¹³⁵	200 persons recruited; 194 analyzed	12 months	96 persons in TTM lifestyle plan	98 persons in non-TTM lifestyle plan	Significant improvements in lipid profile, BMI, and waist circumference were observed in the TTM group compared with the control group ($p < 0.05$). At baseline, TG, TC, and LDL-C were lower, while HDL-C was higher in the TTM group. BMI and waist circumference were also lower in both male and female participants receiving the TTM intervention. The TTM group also demonstrated significantly higher health belief scores (120.91 ± 4.94 vs. 118.82 ± 5.48) and health behavior scores (131.71 ± 5.87 vs. 119.96 ± 7.12) compared with the control group (both $p < 0.05$).
2	Haxhi et al ¹⁶⁶	300 persons recruited; 267 analyzed	3 years	133 persons in annual theoretical and practical counseling	134 persons in standard care	Markers of NAFLD significantly decreased in the intervention group compared with the control. Mean reduction ALT = -7.48 (95% CI, -9.09 to -5.88); γGT = -3.64 (95% CI, -5.82 to -1.45); FLI = -2.64 units (95% CI, -5.25 to -0.03); HSI = -2.77 (95% CI, -3.43 to -2.11). These reductions correlated with a significant decrease in sedentary time and reciprocal increments in light-intensity physical activity.
3	Mei et al ¹⁷⁷	228 persons recruited; 204 persons analyzed	6 months	102 persons with HAPA-based case management	102 persons with standard health management	Fatty liver outcomes improved significantly in the HAPA group compared with the control group (67.6% vs. 48.0%). Significant reductions in BMI, WHR, and biochemical indices (AST, ALT, TC, LDL-C, and HDL-C) were observed ($p < 0.001$), while TG also improved significantly ($p < 0.05$). Health behavior scores (stress management, exercise, diet) were significantly higher than the control group ($p < 0.01$).

TTM = Transtheoretical Model ; HAPA = Health Action Process Approach ; BMI = Body Mass Index ; WC = Waist Circumference ; NAFLD = Non Alcoholic Fatty Liver Disease ; ALT = Alanine Aminotransferase ; AST = Aspartate Aminotransferase ; γ GT = γ -Glutamyl transpeptidase ; FLI = Fatty Liver Index ; HSI = Hepatic Steatosis Index ; WHR = Waist-to-Hip Ratio ; HDL-C = High Density Lipoprotein Cholesterol ; LDL-C = Low Density Lipoprotein Cholesterol ; TC = Total Cholesterol ; TG = Triglyceride ; CI = Confidence Interval

Table 7. Results of Selected Cohort Study

Author	Participants Number	Follow-up	Exposure Group	Comparison Groups	Results
Soni et al. ¹⁸⁸	32 persons eligible, 22 persons analyzed	12 weeks	Diet + Exercise + CBT (group C) Integrated plan delivered via MyTatva app and IoT devices (BCA & smartwatch)	Diet plan only (group A) Diet + Exercise plan (group B)	Weight reduction $\geq 7\%$ was achieved by 100% of participants in Group C, with a mean weight loss of 6.99 ± 2.98 kg ($7.00\% \pm 3.39\%$; $p = 0.002$) and BMI reduction was 2.18 ± 0.99 kg/m ² (6.76%). Reductions in body weight, subcutaneous fat, and visceral fat were significantly greater in Group C than in Groups A and B ($p < 0.05$).

CBT = Cognitive Behavioral Therapy ; IoT Internet of Things = ; BCA = Body Composition Analyzer

Discussion

Lifestyle modification remains the cornerstone of management for MASLD/NAFLD. While pharmacological therapies are currently under investigation, sustained weight reduction achieved through dietary modification and physical activity remains the most effective intervention for ameliorating hepatic steatosis and improving hepatic function. However, adherence to lifestyle interventions is notoriously challenging, particularly within the young adult demographic. This evidence-based case report highlights the potential role of behavioral interventions, including counseling grounded in the stages of behavioral change (e.g., the Transtheoretical Model^{13,16}, Health Action Process Approach¹⁷) and cognitive behavioral therapy¹⁸, in augmenting standard clinical care (passive education or unstructured advice during routine consultation), which often fails to address the psychological, environmental, and behavioral barriers that patients encounter when attempting to alter deep-rooted lifestyle habits.

Weight Loss, Lipid Profiles, and Metabolic Outcomes

Literature shows that theory-driven coaching effectively manages MASLD by addressing metabolic syndrome. Li et al. (2022) used the Transtheoretical Model to tailor interventions, resulting in significant improvements in lipid profiles, BMI, and waist circumference over 12 months due to better adherence to diet and exercise.¹³ Similarly, Mei et al. (2025) employed the Health Action Process Approach to enhance action confidence and health responsibility over 6 months.¹⁷ Digital intervention combining nutrition, exercise, and CBT achieved greater weight and fat loss after 12 weeks than diet-only or diet-and-exercise groups, though its methodological rigor requires further evaluation.¹⁸

Two out of three systematic reviews confirmed that eHealth interventions, such as mobile apps and smartwatches, significantly improved BMI and weight loss with low to moderate heterogeneity.^{Error! Reference source not found.,Error! Reference source not found.} While meta-analyses by Zafar et al. showed non-significant

improvements in lipid profiles, waist circumference, and blood pressure, their subgroup analysis found that weight loss was enhanced by combining education, counseling, activity monitoring, and frequent interactive communication via mobile applications.⁴ This finding holds significant potential for application in the younger adults population who are more adapt to digital technology.

Liver Function

Randomized controlled trials by Haxhi et al. and Mei et al. demonstrate that the intervention group experienced significant reductions in liver enzymes (AST, ALT, γ GT) compared with the control group.^{16,17} These improvements correlated with decreased sedentary time and increased light-intensity physical activity¹⁶, likely driven by weight loss. A systematic review indicates that every 1 kg of weight loss via lifestyle programs leads to clinical reductions in hepatic biomarkers: 0.83 units in ALT, 0.56 units in AST, and a 0.77% decrease in hepatic steatosis.¹⁴

Digital health interventions enhance the reach and sustainability of behavioral strategies. Evidence suggests that digital support, including apps, is effective when incorporating continuous self-monitoring, real-time feedback, and professional coaching for at least six months.^{8,Error! Reference source not found.} Research shows that smartphone-based interventions significantly improve weight loss and liver enzyme levels compared to standard care.^{Error! Reference source not found.} Tools such as mobile apps and wearables overcome barriers like cost and time, with daily reminders effectively sustaining adherence.^{Error! Reference source not found.} These findings align with broader evidence suggesting that digital platforms can overcome barriers such as cost, travel, and time, while providing real-time feedback and motivation.¹⁶ Given their high digital literacy, young adults—such as the patient presented in this case—are particularly well-suited for these eHealth-based approaches.

Liver Imaging

In a 3-year randomized counseling intervention (the IDES_2 trial), behavioral

techniques targeting physical activity and a reduction in sedentary time led to substantial, sustained drops in non-invasive liver indices including the Fatty Liver Index (FLI) and Hepatic Steatosis Index (HSI), establishing significant between-group differences against standard care ($P < 0.05$). This study noted that even when structured moderate-to-vigorous physical activity (MVPA) targets were not fully met, behavioral habit loops that successfully reduced sedentary time by replacing it with light activity independently predicted improvements in liver markers.¹⁶⁶

Application in Clinical Scenario

Among the included studies, none specifically addressed the young adult population; the majority focused on the general adult population, while one study was conducted among older adults. These demographic variations may result in physiological and pathophysiological discrepancies relative to the current case. Conversely, as the patient in this case is younger, there is a higher probability that outcomes—particularly the reversibility of liver anatomy—will be superior, attributable to the enhanced regenerative capacity characteristic of younger adults.²² Several studies included participants diagnosed with type 2 diabetes mellitus. The decision to include these studies was predicated on the clinical profile of the patient in the current case scenario, who presents with obesity, dyslipidemia, and a family history of type 2 diabetes mellitus. These factors contribute to an elevated metabolic risk profile, suggesting a significant predisposition to the development of type 2 diabetes mellitus in the future.²³ Consequently, we believe it to be relevant to this case.

The heterogeneity of intervention designs complicates direct comparative analyses, as not all programs incorporate comprehensive components comprising dietary, physical exercise, and behavioral support. Consequently, a single definitive best evidence cannot be identified from the current study. Nevertheless, as family practice adopts patient-centered approach, interventions must be meticulously tailored to the individual needs and living conditions. The findings of this

study therefore serve as a foundational framework to be subsequently adapted to the individual requirements and daily circumstances of the patient. According to the Transtheoretical Model, the patient in the case scenario is situated within the 'action' stage, having initiated modifications to her dietary and exercise habits while encountering significant challenges. To facilitate her transition to the maintenance stage, it is essential to prioritize coaching interventions that address existing barriers,¹⁵ followed by the provision of support through continuous monitoring, preferably through a mobile application.¹⁴

Accessibility barriers, encompassing digital literacy and socioeconomic disparities, may potentially constrain the adoption of eHealth interventions. Nevertheless, as younger adults generally exhibit superior levels of digital literacy and proficiency with mobile applications—particularly those residing in urban environments, as exemplified by the patient in this case—such platforms represent viable instruments for facilitating and monitoring lifestyle modifications within this demographic.

Conclusion

In summary, behavioral interventions, particularly those integrated with digital health tools for monitoring purposes, represent a promising adjunctive approach to standard care for young adults with MASLD/NAFLD. These interventions demonstrate significant efficacy in facilitating weight reduction and improving liver enzyme profiles, with emerging evidence supporting their role in the mitigation of hepatic steatosis. For clinicians, the incorporation of structured behavioral strategies into routine clinical practice may enhance patient adherence and optimize therapeutic outcomes in this expanding population. Future research should prioritize long-term outcomes, specifically regarding the progression of fibrosis. Furthermore, the standardization of intervention protocols and outcome measurements is essential to minimize the heterogeneity prevalent in the current body of systematic reviews and meta-analyses.

For the clinical case presented, a practical recommendation is to initiate a structured lifestyle

modification program that emphasizes gradual dietary adjustments—such as reducing high-fat foods and increasing fiber intake—combined with light-intensity physical activity tailored to the patient's tolerance, starting with coaching, supported by mobile app-based monitoring and reminders to sustain adherence.

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Authors' Contributions

MANH conceptualized and designed the study based on clinical encounters, performed the literature review and critical appraisal for article selection, executed data analysis and interpretation, and drafted the manuscript. DP reviewed the literature and conducted critical appraisals for study selection, contributed to data analysis and interpretation, and assisted in drafting the manuscript. SNA performed the literature search, reviewed and appraised relevant articles, participated in data analysis and interpretation, and contributed to the manuscript preparation. DK provided guidance on the PICO framework and search terminology and performed critical revisions for intellectual content. All authors have read and approved the final manuscript.

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Data and Materials Availability

Clinical data regarding the patient are restricted from disclosure. Data derived from the articles included in the search strategy are available from the corresponding author upon reasonable request.

Consent for Publication

Verbal informed consent was obtained from the patient, with the explicit agreement that all identifiable data would be excluded from the clinical scenario.

Competing Interests

The authors declare no conflict of interest in relation to the research, authorship, and/or publication of this article.

AI Usage Declaration

During the preparation of this manuscript, the authors used artificial intelligence (AI) tools to assist in language editing and improving the clarity of the text. The authors reviewed and edited the output as necessary and took full responsibility for the accuracy, integrity, and originality of the content.

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