MASLD Awareness Tracker

"How FDA Drug Approvals Shape Public Awareness of Liver Disease"

Evaluating the Impact of FDA Approvals on Public and Scientific Awareness of Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD)

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Research Question & Context: Tracking Awareness Milestones

Research Question: How do regulatory drug approvals shape public and scientific awareness of MASLD?

The Disease

MASLD (**Metabolic Dysfunction-Associated Steatotic Liver Disease**) is a serious, common liver condition affecting millions globally. Linked to obesity and diabetes.

Previously called **Nonalcoholic Fatty Liver Disease** (**NAFLD**), involves fat accumulation in the liver and can progress to cirrhosis and liver failure.
NAFLD → MASLD Terminology in June 2023.

No FDA-approved treatments until 2024.

The Events (The 'Milestones')

14 March 2024
Resmetirom (Rezdiffra®)
First-ever FDA-approved drug specifically for MASLD.

15 August 2025
GLP-1 Agonists (Semaglutide/Wegovy®)
Weight loss drugs showing significant MASLD benefits.

The Project

Multi-platform analysis of the impact of FDA approvals for MASLD treatments on **public awareness**, **community discourse**, and **scientific research**.

Aim: To **uncover patterns** in public discourse, scientific literature, and market response that reveal how regulatory events influence public awareness of MASLD.

Approach: Integrated and analyzed data from **Google Trends**, **Reddit**, **PubMed**, Stock Market, and Media.

A Multi-Platform Approach to Tracking Awareness

Data Source	Description	Type	Format	Processing Approach	Key Metric	Key Analysis	Purpose	Data Size Used
Google Trends	Public search interest for MASLD, NAFLD, Rezdiffra, Wegovy, Ozempic	API + G-Drive Fallback	CSV	Collected via pytrends API; weekly aggregation; ITS analysis; statistical validation (Welch's t-tests, Mann-Whitney U); seasonal decomposition for non-stationary time series	Search Volume Index for MASLD, NAFLD, Rezdiffra, Wegovy, Ozempic	Time Series Analysis, Statistical Impact Testing, Terminology Transition Monitoring	Measure public awareness and FDA approval impact	~5,000 data points
Reddit	Community discussions from 12 medical subreddits	API + G-Drive Fallback	JSON > DataFrame /CSV	Collected via Pushshift API; VADER sentiment analysis; NMF topic modeling for 5 themes; NetworkX for subreddit connectivity analysis; Temporal patterns	Post Volume, Sentiment Scores, Discussion Themes from r/MASLD, r/Ozempic, etc.	Topic Modeling, Temporal Patterns, Sentiment Tracking, Network Analysis	Analyze patient discourse and community engagement	9,146 posts 12 subreddits
PubMed	Scientific publications on MASLD and treatments	API + G-Drive Fallback	XML / JSON > DataFrame	Collected via Biopython/Entrez API; Fisher's exact tests for publication odds ratios; time-series tracking of disease-drug combination research	Publication Count for MASLD Research and Drug Treatments	Trend Analysis, Research Focus Tracking, Statistical Significance Testing	Assess scientific community response and research priorities	618 articles

Timeframe: January 2023 – October 2025 (148 weeks of data).

Statistical Methods: Interrupted Time Series (ITS) analysis, T-tests, Fisher's exact tests, Mann-Whitney U tests, Non-Negative Matrix Factorization (NMF), Cohen's d, Network Analysis, Sentiment Analysis (VADER).

Summary of the Results

FDA Approvals Drive Public Search Interest

🔍 METHODOLOGY
- Search terms: MASLD, NAFLD, Rezdiffra, Wegovy, Ozempic
- Data quality validation
- API + G-Drive Fallback
- Statistical Methods:
  - T-tests (30 days pre/post)
  - Interrupted Time Series (ITS)
  - Correlation Analysis
  - Validation: Non-parametric tests + assumption checks
  - Quality Control: Zero-analysis exclusion criteria

🎯 KEY FINDINGS

GLP-1 Approvals Drove Awareness
- MASLD: **+17.1 points** after GLP-1 approvals (p<0.001)*
- Wegovy: **+25.6 points** (p<0.01)*
- Ozempic: **+19.4 points** (p<0.01)*
- MASLD: **+14.4 points** (p<0.001)*, NAFLD: **+31.5 points** (p=0.001)*, Wegovy: **+21.8 points** (p<0.001)*

Resmetirom Created Spillover Effects
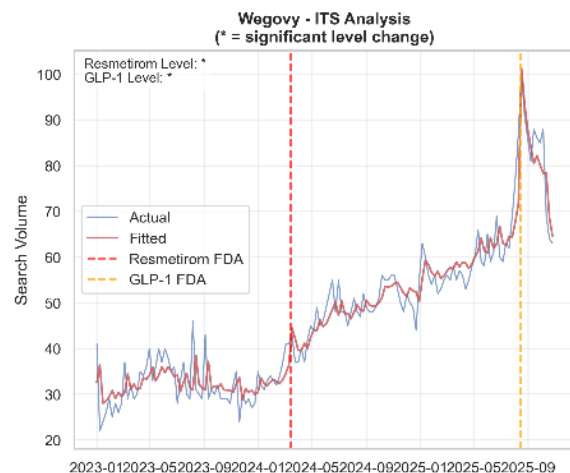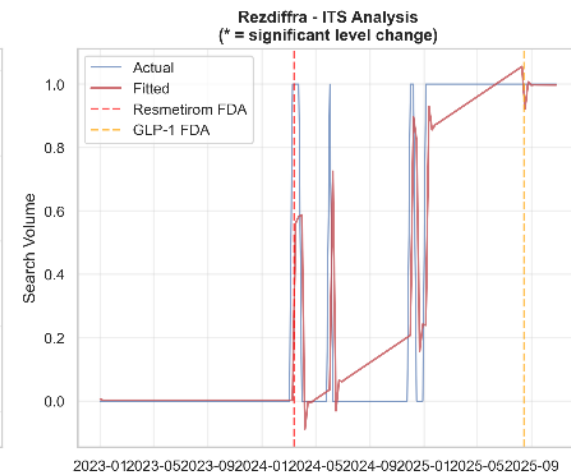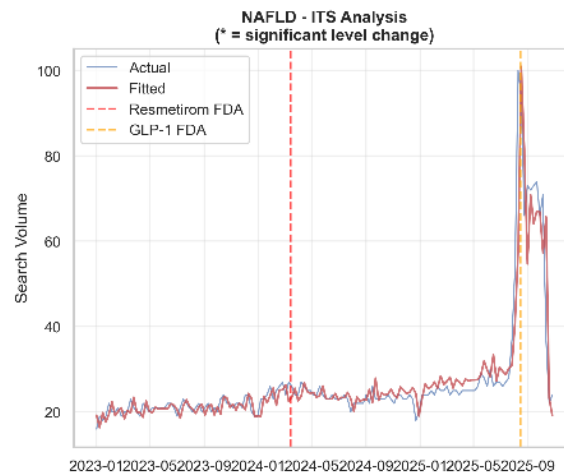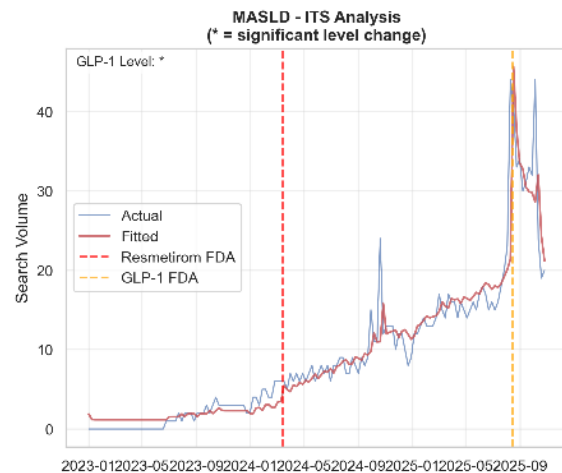- Wegovy: **+7.8 points** (p=0.0053)*
- Ozempic: **+19.6 points** (p<0.001)*
- MASLD: *No immediate level change but positive slope trend* (**+0.032**, p<0.001)*
- MASLD: **+4.4 points** (p<0.001)*, NAFLD: **+1.1 points** (p=0.030)*

Wegovy Strongly Correlates with Disease Awareness
- MASLD & Wegovy: **r=0.93**, NAFLD & Wegovy: **r=0.75**

💡 KEY INSIGHT
- **GLP-1 approvals** drove **MASLD awareness** more effectively than the dedicated MASLD drug.
- **MASLD terminology adoption** accelerated by **GLP-1 awareness**.

MASLD - ITS Analysis (* = significant level change)

NAFLD - ITS Analysis (* = significant level change)

Rezdiffra - ITS Analysis (* = significant level change)

Wegovy - ITS Analysis (* = significant level change)

Ozempic - ITS Analysis (* = significant level change)

Search Term Correlations

Search Interest Change After FDA Approvals (* = statistically significant)
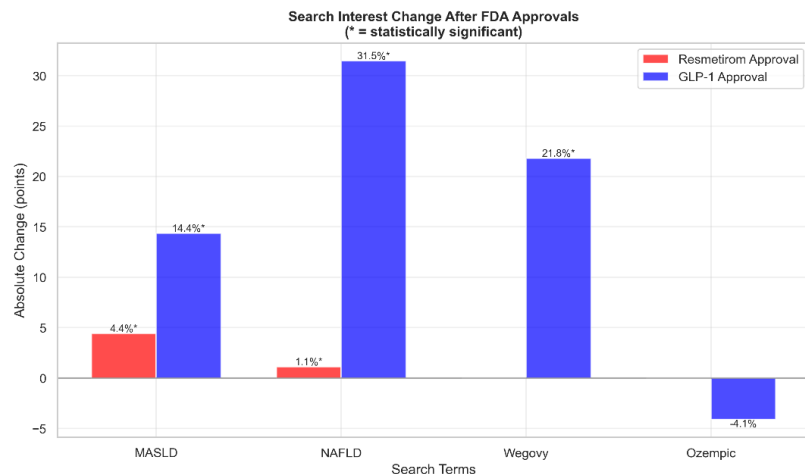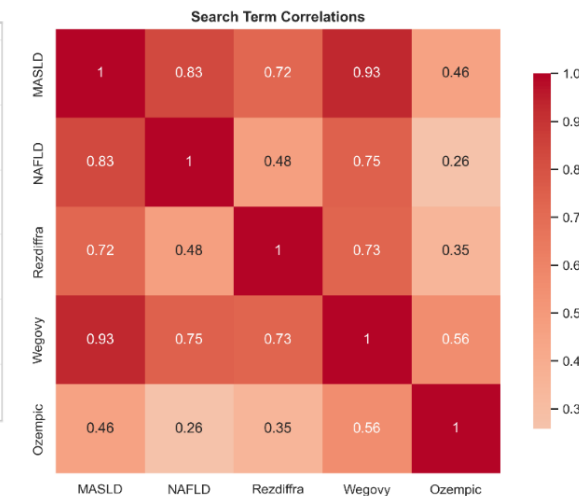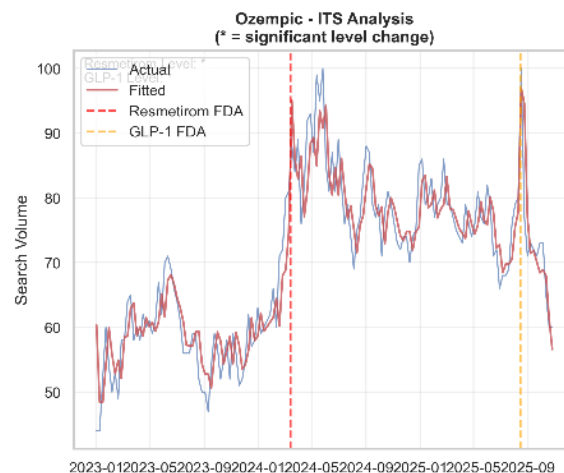
Community Discussion Focuses on Personal Experience and Treatment

🔍 METHODOLOGY
- 9,146 Reddit posts/comments (2023-2025)
- 12 subreddits across MASLD/NAFLD communities
- Data: Pushshift API + G-Drive fallback
- Statistical Methods:
  - VADER sentiment analysis with FDA event tracking
  - NMF topic modeling (5 topics)
  - Temporal pattern analysis (hourly/daily/monthly)
  - Statistical validation: Welch's t-tests, effect sizes, Bonferroni correction

🎯 KEY FINDINGS

GLP-1 Approval Drove Discussion Volume
- **+82.3%** increase in posts (96 → 175 posts)
- Community excitement around weight loss treatments

Resmetirom Showed Muted Response
- **-30.8%** decrease in discussion (39 → 27 posts)
- Limited engagement with MASLD-specific treatment

Personal Experiences Dominated Discussions
- Topic 0: Personal stories (**44%**) - "I'm, just, don't"
- Topic 4: Drug treatments (**33%**) - "Ozempic, weight, loss"
- Topic 3: Liver disease (**14%**) - clinical discussions

Sentiment Remained Stable
- **No significant shifts** after FDA approvals ($p>0.05$)
- Small negative effect for Resmetirom (Cohen's d = -0.305)
- Negligible effect for GLP-1 (Cohen's d = -0.012)

💡 KEY INSIGHT
- **GLP-1 drugs** generated **community excitement**, while MASLD-specific treatment saw reduced engagement - patients prioritize **weight loss discussions** over liver-specific treatments.
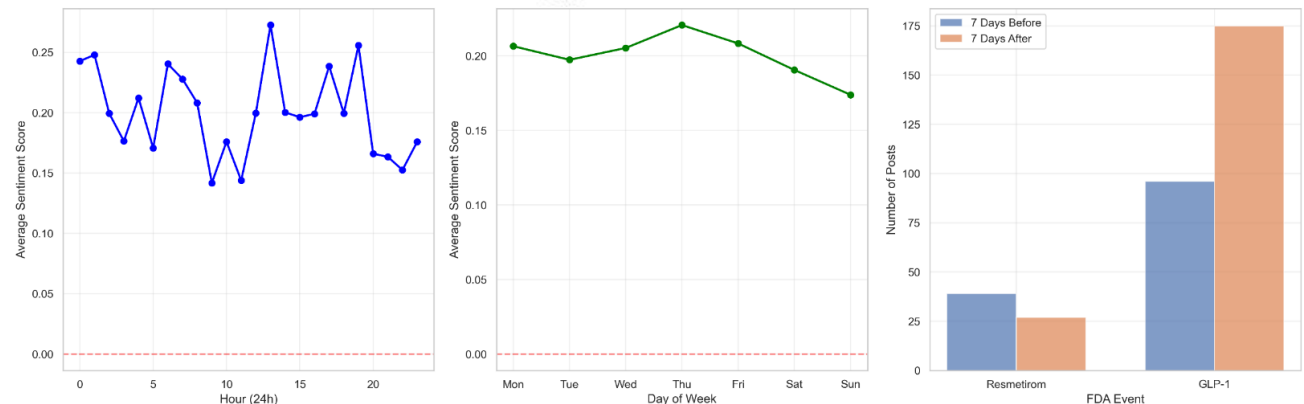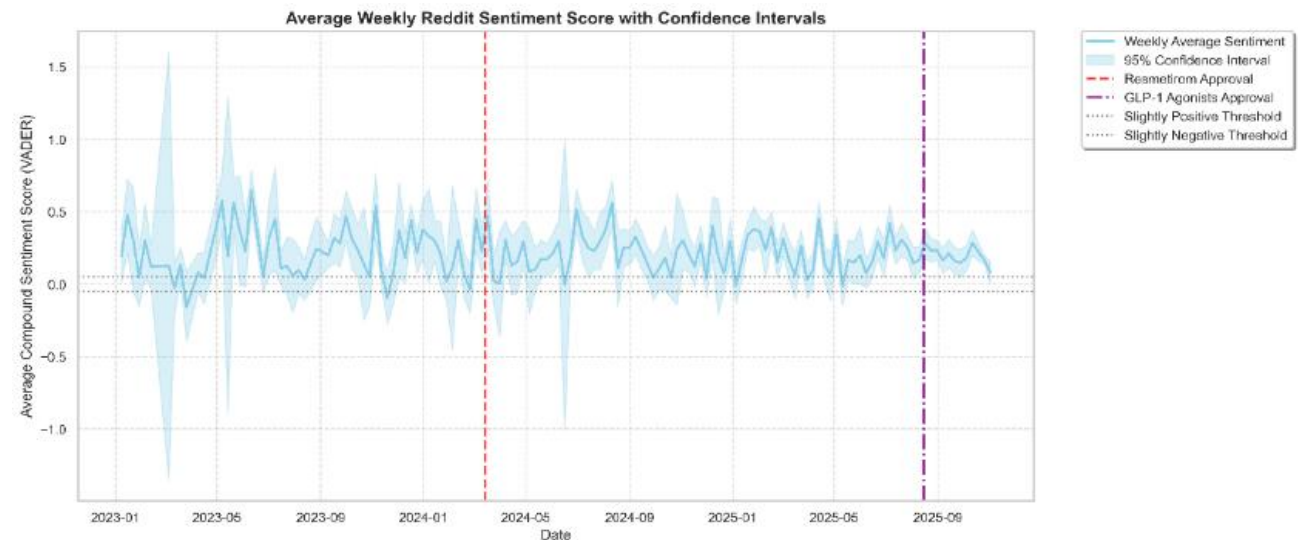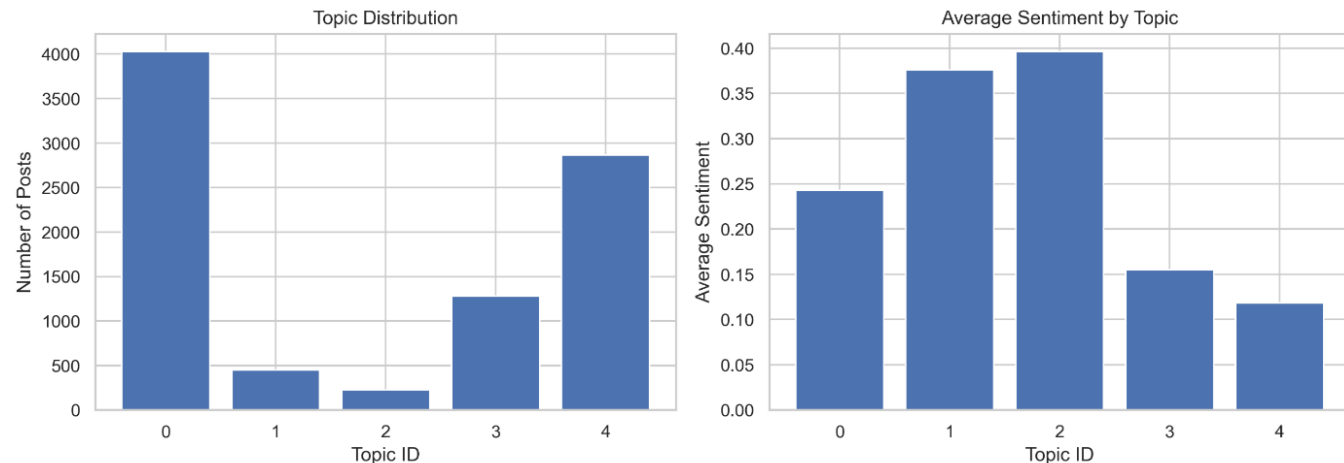
The Awareness Ecosystem: Do Google Trends-Reddit Correlate?

🔍 METHODOLOGY
- Network Analysis: 12 subreddits, 66 connections
- Cross-platform correlation: **Reddit vs. Google Trends**
- Community detection algorithms
- Temporal alignment: 2023-2025 period

🎯 KEY FINDINGS

Unified Network Structure
- Fully connected community (**density=1.000**)
- All subreddits equally **central** - no information bottlenecks
- Single detected **community** - coordinated response
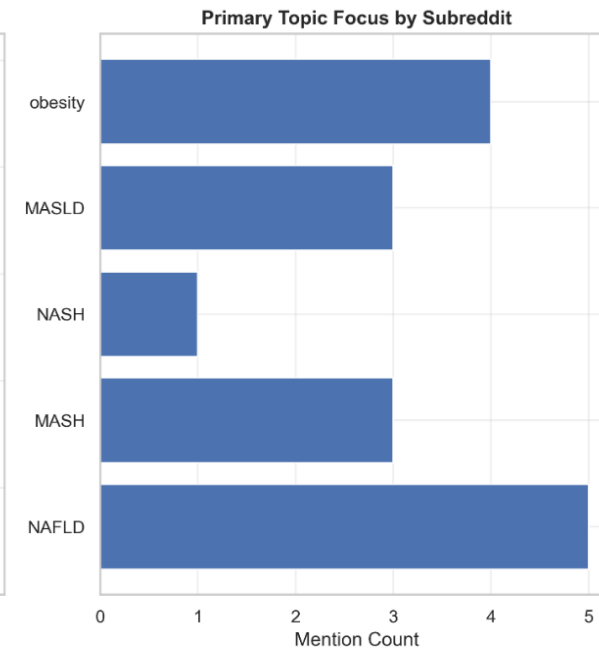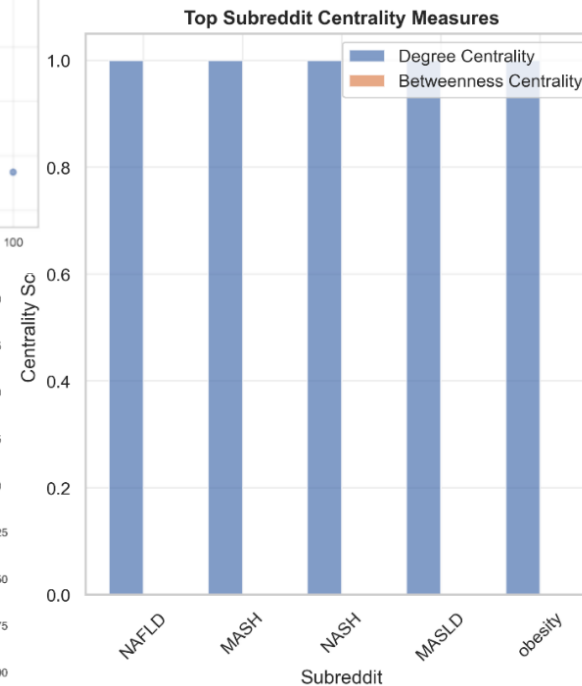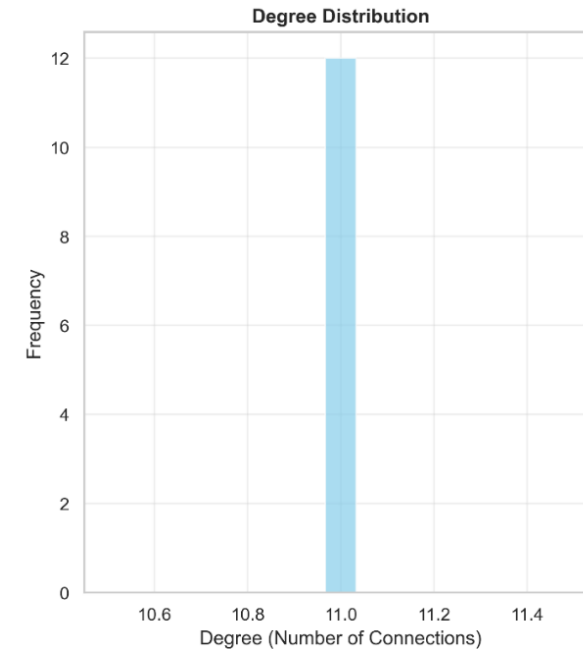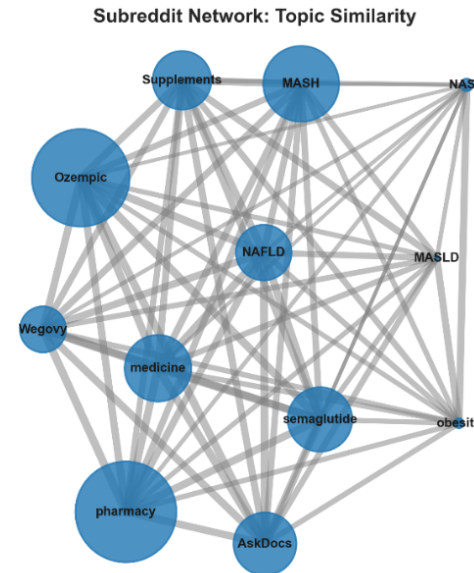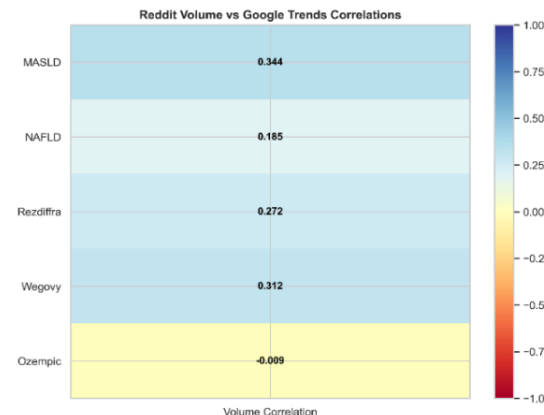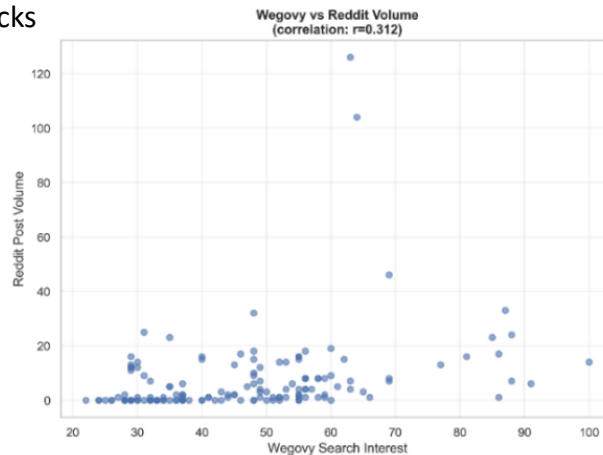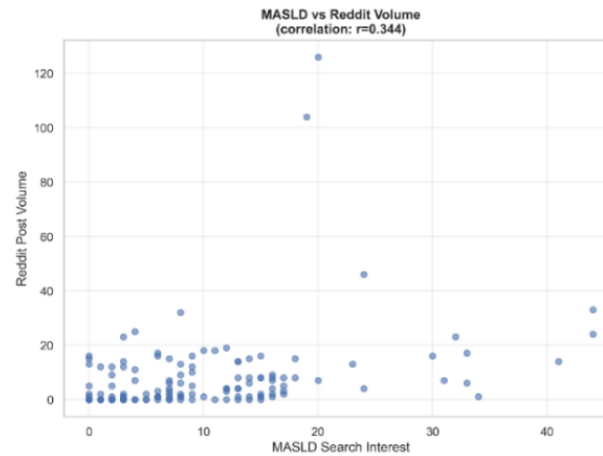
Efficient Information Propagation
- Explains +82.3% **GLP-1 discussion spike**
- FDA news **reaches entire network** instantly
- Simultaneous **engagement** across **all communities**

Limited Cross-Platform Integration
- Weak Reddit-Google correlations:
  - MASLD: r=0.344
  - Wegovy: r=0.312
  - Ozempic: r=-0.009
- Discussion volume ≠ public search interest

💡 KEY INSIGHT
- **Reddit** forms a **unified discussion ecosystem** that responds collectively to FDA events, but **operates independently** from general public search behavior - indicating **different user motivations across platforms**.

MASLD vs Reddit Volume (correlation: r=0.344)

Wegovy vs Reddit Volume (correlation: r=0.312)

Reddit Volume vs Google Trends Correlations

Subreddit Network: Topic Similarity

Top Subreddit Centrality Measures

Degree Distribution

Primary Topic Focus by Subreddit

FDA Approvals Reshape Scientific Research Priorities

🔍 METHODOLOGY

- 618 MASLD research articles (2023-2025)
- Disease-drug combination analysis
- Statistical Methods:
  - Publication trend analysis with FDA event tracking
  - Fisher's exact tests with odds ratios
  - Research focus distribution mapping
  - Journal impact analysis

🎯 KEY FINDINGS

Resmetirom Created New Research Field

- **0 → 132** publications after approval
- Entirely **new research area** established
- Scientific community rapidly **adopted MASLD terminology**

**GLP-1 Research Accelerated Significantly**

- Odds ratio: **3.557** (p<0.001)*
- **3.5x** higher publication probability post-approval
- Established research base continued growth

Research Focus Distribution

- **MASLD + Resmetirom**: 132 publications (emerging field)
- GLP-1 maintains larger research footprint

💡 KEY INSIGHT

- **Resmetirom approval** created a **new research** domain, while **GLP-1 approvals** accelerated **established research** - demonstrating different innovation patterns: **breakthrough discovery vs. incremental advancement**.

FDA Approval Impact on Publication Volume

PubMed Publication Trends: MASLD Research Evolution
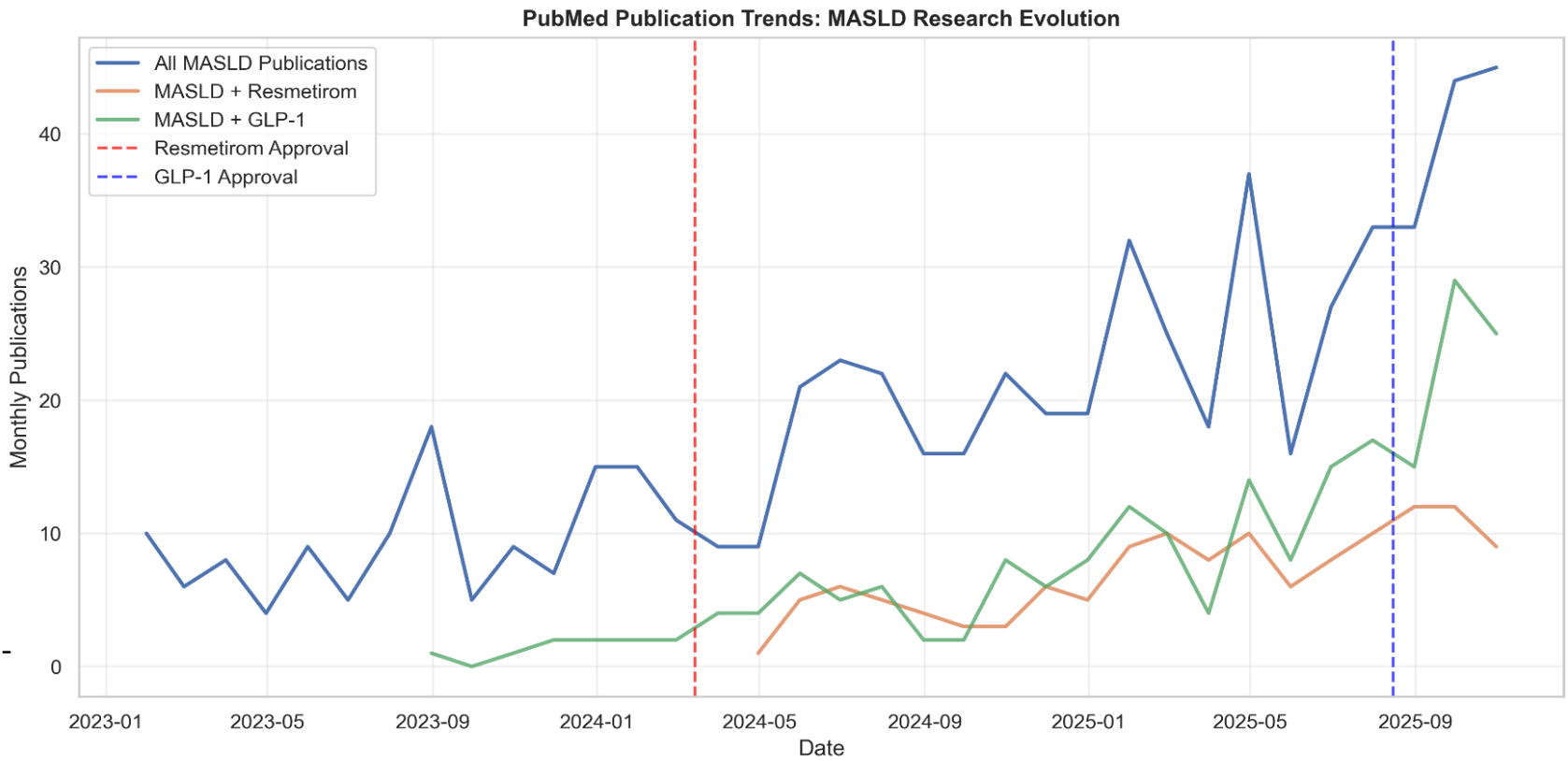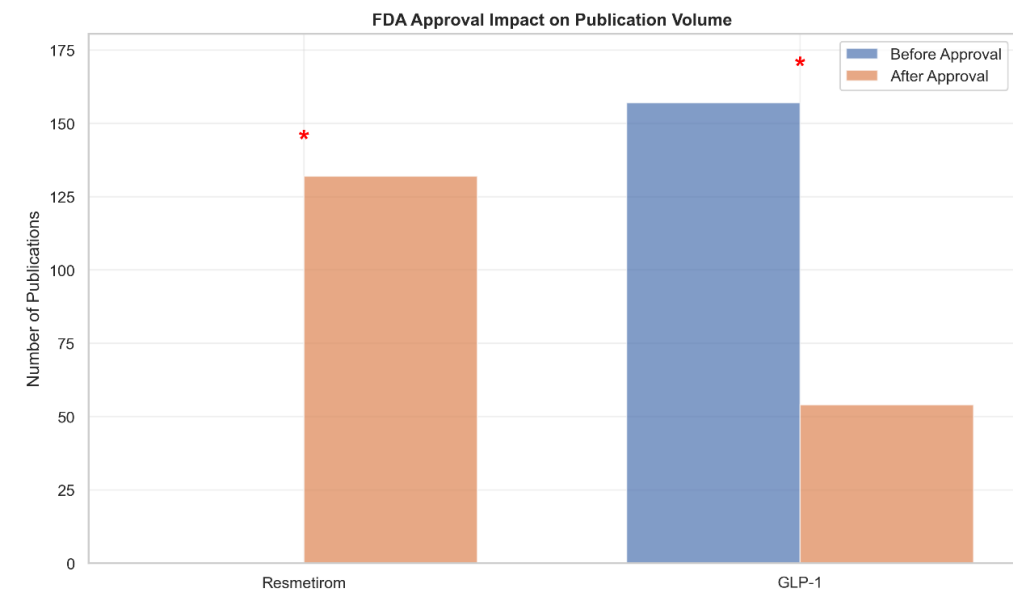
Project Challenges

API Rate Limits & Data Consistency

➢ Managing **API rate limits** and **data formats across different platforms**.

➢ PubMed **XML parsing errors**.

➢ **Building a robust pipeline** with Google Drive fallbacks.

Statistical Complexity & Rigor

➢ Advancing from t-tests to **ITS** (SARIMAX).

➢ Ensuring validity required **advanced statistical validation** (Non-parametric tests, Bonferroni correction) to account for **time-series non-stationarity** and **multiple comparisons**.

Scale Disparity in Multi-Platform Data

➢ Handling vastly **different data scales**.

➢ **Millions** of searches → **thousands** of posts → **hundreds** of papers.

➢ Maintaining meaningful **cross-platform comparisons**.

Key Conclusions

Weight Loss Drugs Dominate, Disease-Specific Treatments Lag

Regulatory approvals trigger selective engagement patterns: **GLP-1** drugs **stimulated public discussion** while **MASLD-specific treatments** saw **reduced engagement**, revealing **differential community priorities**.

GLP-1 Dominates Public Awareness

The **GLP-1 approval had the largest impact** on public search interest and patient community engagement.

Resmetirom Reshapes Research

The **Resmetirom approval** had the **largest impact** on **scientific research** focus, creating an entirely new field.

Public Health Implications

✓ **Terminology Transition**: MASLD adoption tied to GLP-1 awareness.
✓ **Disease awareness follows drug approvals**.
✓ Patient communities prioritize weight loss discussions over liver-specific treatments, suggesting **public health messaging should integrate MASLD awareness with GLP-1 education**.
✓ Online discussions operate independently from public searches, requiring **multi-platform strategies to reach both** patient communities and general public effectively.
✓ Rapid research response to Resmetirom demonstrates **efficient translation from regulatory approval to scientific validation**, supporting evidence-based adoption.

https://github.com/DrSAMA2025/dsci510_fall2025_final_project/blob/main/src/results.ipynb

THANK YOU

MASLD
Awareness Tracker