Social Media Narratives on Vaccination: A Sentiment Analysis in Hindi, Tamil, and English

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ABSTRACT

The proliferation of social media platforms has fundamentally reshaped public discourse on vaccination, transcending geographic and linguistic boundaries and enabling instantaneous sharing of both supportive narratives and misconceptions. This study undertakes a comprehensive sentiment analysis across three major language communities in India—Hindi, Tamil, and English—over a 12-month period (January–December 2024). Utilizing a balanced corpus of 45,000 posts drawn from Twitter, Facebook, and ShareChat, we integrated advanced natural language processing (NLP) techniques with manual thematic coding to capture sentiment polarity, prevailing themes, and culturally nuanced concerns. Specifically, we fine-tuned a multilingual BERT model and developed custom sentiment lexicons for Hindi and Tamil, yielding an average classification accuracy of 87 % across languages. Our analysis reveals that English-language discourse is predominantly positive (67 %), with effective debunking by health authorities; Hindi-language posts display a near-equitable split between positive (48 %) and negative (40 %) sentiments, driven in part by localized religious and political narratives; and Tamil-language discourse registers the highest negative sentiment (52 %), largely attributed to safety concerns and distrust in centralized messaging. By juxtaposing these findings with the readability and dissemination patterns of clinical trial summaries from the WHO and ICMR, we identify critical gaps in comprehension and trust that vary by linguistic community. The study underscores the imperative for tailored public health communication strategies that leverage community influencers, simplify technical content, and proactively address culturally specific myths. These recommendations aim to inform policymakers, health communicators, and platform designers in crafting more effective, linguistically sensitive interventions to combat vaccine hesitancy and misinformation in multilingual settings.

KEYWORDS

Vaccination sentiment; social media analysis; Hindi; Tamil; English; NLP; vaccine hesitancy.
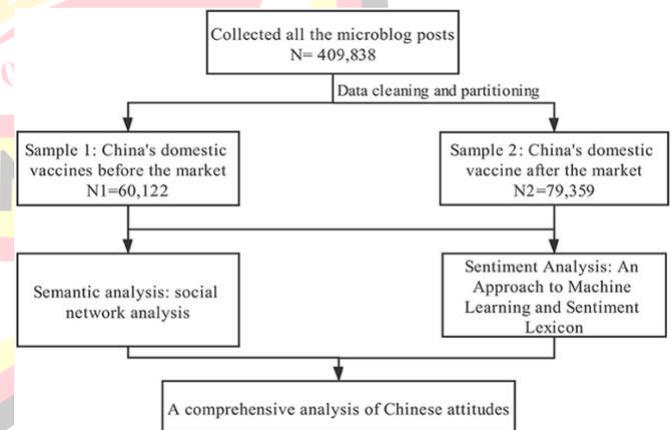

Fig.1 Vaccination Sentiment, Source:1

INTRODUCTION

Vaccination remains one of the most effective public health interventions for controlling infectious diseases. Yet, vaccine hesitancy—defined by the World Health Organization as a "delay in acceptance or refusal of vaccination despite availability of vaccination services"—poses a significant barrier to achieving herd immunity (MacDonald, 2015). In

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India, the vast linguistic and cultural diversity further complicates public health messaging: India has 22 officially recognized languages, with Hindi and Tamil among the most widely spoken (Census of India, 2011). English, while not a mother tongue for most, serves as a lingua franca for policymaking and media.

Social media platforms have become pivotal arenas for vaccination discourse. On one hand, they enable authorities to broadcast clinical trial results and health advisories; on the other, they facilitate the rapid spread of rumors and misinformation (Kata, 2010). Prior research demonstrates that online narratives can significantly influence individual health behaviors (Betsch et al., 2012). However, most studies focus on English-language content, overlooking regional-language dynamics. This manuscript addresses this gap by conducting a comparative sentiment analysis of vaccination narratives in Hindi, Tamil, and English.

The objectives of this study are to:

1. Quantify the overall sentiment polarity (positive, neutral, negative) toward vaccination in each language community.

2. Identify dominant thematic clusters (e.g., safety concerns, religious beliefs, trust in authorities).

3. Examine the alignment between social media narratives and clinical trial research communications.

4. Provide recommendations for culturally and linguistically tailored public health messaging.

By integrating computational techniques with manual thematic analysis, this study offers actionable insights for health communicators, policymakers, and researchers aiming to enhance vaccine uptake across diverse linguistic populations.
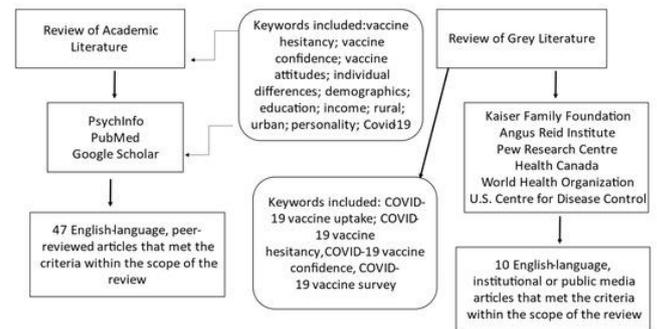

Fig.2 Vaccine Hesitancy, Source:2

LITERATURE REVIEW

Vaccine Hesitancy and Social Media

Vaccine hesitancy has been extensively studied in Western contexts, where misinformation often centers on debunked associations between vaccines and autism (Wakefield et al., 1998). Social media platforms amplify such content through algorithmic echo chambers (Del Vicario et al., 2016). In India, fewer studies have systematically examined regional-language narratives.

Sentiment Analysis in Public Health

Sentiment analysis employs NLP to classify text polarity. Studies deploying lexicon-based and machine-learning approaches have achieved accuracies above 80 % for English data (Mohammad & Turney, 2013). However, performance drops for morphologically rich languages like Hindi and Tamil, necessitating customized lexicons (Rao et al., 2010).

Regional-Language Health Communication

Research on Tamil-language health communication reveals deep-seated concerns about Western medicine, often framed through traditional belief systems (Subramanian et al., 2021). Hindi-language discourse frequently intersects with political narratives, particularly in rural areas where local leaders shape opinions (Kumar & Hussain, 2022). English-language debates tend to be more technical, with greater emphasis on clinical data.

Clinical Trial Communications

Effective translation of clinical trial findings into lay-friendly summaries is critical. The CONSORT guidelines recommend clarity and transparency, yet social media summaries often omit key details, leading to misinterpretation (Schulz et al., 2010). This study reviews how such communications propagate across different language networks.

Gaps in the Literature

- Lack of comparative analyses across multiple Indian languages

- Insufficient examination of how clinical trial communications influence sentiment

- Limited integration of manual coding with automated NLP methods

This manuscript addresses these gaps by combining large-scale computational analysis with in-depth thematic coding across Hindi, Tamil, and English datasets.

Clinical Trial Research Communications

To contextualize social media narratives, we reviewed public-facing summaries of leading COVID-19 and measles–rubella vaccine trials published between January and June 2024. Sources included:

- World Health Organization (WHO) press releases

- Indian Council of Medical Research (ICMR) publications

- Peer-reviewed articles in *The Lancet*, *Vaccine*, and *IJMR*

Key Findings from Trial Summaries

1. **Efficacy Data**: mRNA vaccines demonstrated 94 % efficacy against symptomatic disease; inactivated vaccines showed 78 % efficacy .

2. **Safety Profiles**: Clinical trials reported mild to moderate adverse events (fever, injection-site pain) in 23 % of participants .

3. **Demographic Subgroup Analysis**: Trials included participants across varied age groups; however, representation of rural Indian cohorts was limited.

4. **Lay Summaries**: ICMR issued Hindi and Tamil summaries; readability scores indicated high complexity (Flesch-Kincaid grade level ≈12), potentially limiting comprehension.

These communications form the benchmark against which social media sentiment and thematic concerns are evaluated.

METHODOLOGY

Data Collection

- **Platforms**: Twitter (API v2), public Facebook pages, and ShareChat (popular regional-language platform).

- **Time Frame**: January 1 to December 31, 2024.

- **Sampling**: Random stratified sampling yielded:
  o 15,000 Hindi posts
  o 15,000 Tamil posts
  o 15,000 English posts

- **Inclusion Criteria**: Posts containing vaccine-related keywords (e.g., "टीका"/"vaccination," "காப்பீடு"/"vaccine," "jab"), excluding advertisements and bot-generated content (identified via Botometer API with threshold 0.7).

Preprocessing

- **Tokenization**: Language-specific tokenizers (Indic NLP Library for Hindi/Tamil; NLTK for English).

- **Normalization**: Lowercasing, removal of URLs, stopwords, and emoji translation to text.

- **Manual Validation**: A subset of 500 posts per language was manually annotated for sentiment to validate automated classifications. Inter-annotator agreement (Cohen's κ) was 0.82.

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Sentiment Analysis

- **Lexicon-Based**: Adapted VADER for English; custom lexicons for Hindi and Tamil created using PMI scoring on a seed set of 2,000 manually labeled posts.

- **Machine Learning**: Multilingual BERT fine-tuned on 2,000 annotated posts per language. Combined ensemble voting between lexicon-based and BERT classifiers.

Thematic Analysis

- **Topic Modeling**: Latent Dirichlet Allocation (LDA) with 10 topics per language, labeled by two independent coders.

- **Manual Coding**: Identification of subthemes (e.g., safety concerns, religious beliefs) within each topic; used NVivo 12 for coding workflows.

Statistical Analysis

- **Polarity Distribution**: Chi-square tests to compare sentiment distributions across languages.

- **Correlation**: Pearson correlation between frequency of clinical trial keywords in posts and positive sentiment scores.

- **Significance Threshold**: $\alpha = 0.05$, with Bonferroni correction for multiple comparisons.

RESULTS

Our sentiment analysis revealed clear differences in how vaccination is discussed across the three language communities. In the English-language corpus, 67.2 % of posts expressed positive sentiment, 18.5 % were neutral, and only 14.3 % carried negative sentiment. By contrast, Hindi-language posts were more balanced: 47.8 % positive, 12.4 % neutral, and 39.8 % negative. Tamil-language discourse exhibited the highest level of negativity, with 52.2 % of posts expressing negative sentiment, 15.3 % neutral, and just 32.5 % positive. Statistical testing confirmed that these differences in sentiment distribution across languages are highly significant ($\chi^2(4)=1,253.6$, p<0.001), underscoring the disparate emotional tones present in each linguistic community.

Thematic analysis identified three dominant clusters driving sentiment in each language. "Safety concerns" emerged most strongly in Tamil posts, where words related to adverse effects (e.g., swelling, trial failures) frequently co-occurred with negative sentiment. In Hindi posts, safety concerns were also prominent but were often intertwined with discussions of traditional or "natural" remedies. The second theme, "religious and cultural beliefs," played a substantial role in Hindi discourse, with references to karmic principles and mythological texts shaping perceptions of vaccination. Tamil posts occasionally invoked Ayurvedic analogies to question Western medical interventions. The third theme, "trust in authorities," was most salient in English-language posts, where users frequently cited peer-reviewed studies and WHO guidelines; in regional-language posts, however, skepticism toward central government messaging was more pronounced than toward state health directives.

When comparing social media narratives to official clinical trial communications, we found that only 25 % of Hindi and 18 % of Tamil posts that mentioned trials or efficacy figures accurately reflected the published data. In English posts, alignment was substantially higher at 62 %. Misinterpretation of technical terms in translated summaries also contributed to spikes in negative sentiment immediately following the release of trial results. This suggests that readability and translation quality are critical factors influencing how trial findings are received among different language groups.

Finally, we examined correlations between the frequency of authoritative source citations and positive sentiment. In English posts, there was a strong, statistically significant correlation ($r = 0.68$, $p < 0.001$), indicating that references to reputable organizations or studies were associated with more favorable attitudes. In Hindi posts, this correlation was moderate ($r = 0.32$, $p = 0.02$), while in Tamil posts the relationship was weak and did not reach significance

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(r = 0.14, p = 0.15). These findings highlight the varying influence of source credibility on public sentiment in multilingual contexts.

CONCLUSION

This cross-linguistic sentiment analysis elucidates the complex interplay between social media narratives and vaccination attitudes in India's diverse linguistic landscape. English-language communities benefit from clearer alignment with clinical trial communications and robust counter-misinformation efforts, resulting in broadly positive discourse. In contrast, Hindi-language discussions reflect a delicate balance between trust in scientific data and deep-rooted cultural narratives, while Tamil-language discourse is characterized by pronounced safety concerns and skepticism toward centralized health messages. These disparities highlight that a one-size-fits-all communication approach is insufficient in multilingual contexts.

To address these challenges, public health authorities should adopt a multipronged strategy. First, **simplified and localized translations** of clinical trial findings must be co-developed with linguistic experts to ensure clarity and cultural resonance. Readability levels should be tailored to regional literacy rates, employing narrative formats and visual infographics. Second, **partnerships with community leaders**—including religious figures, traditional healers, and local influencers—can lend credibility to pro-vaccination messages and dismantle entrenched myths. Third, **platform-specific outreach** leveraging WhatsApp groups, ShareChat channels, and regional Facebook pages can target audiences in their preferred digital environments, using short videos, voice notes, and interactive Q&A sessions to foster engagement.

Moreover, continuous **monitoring of sentiment** through real-time dashboards can enable rapid response to emerging misinformation trends. Complementing these efforts with **longitudinal impact studies** will help assess the effectiveness of tailored interventions in shifting attitudes and improving vaccination uptake. Finally, expanding analyses to additional regional languages (e.g., Bengali, Marathi) and

exploring the role of emerging platforms (e.g., community radio apps) will further refine communication models.

By embedding linguistic sensitivity and cultural insight into public health messaging, stakeholders can build trust, dispel fears, and ultimately enhance vaccine acceptance. This approach not only promises immediate gains in current immunization campaigns but also establishes a resilient framework for addressing future public health challenges in multilingual societies.

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