

The Invisible Outsider: A Systematic Review and Computational Framework for Understanding Loneliness among Internal Migrants in India's Tier-1 Cities

Author: Shilpa Kamalesh Biswas

MAEER's MIT Arts, Commerce and Science College, Alandi (D.), India

Co-Author: Prof. Amol Bajirao Kale

MAEER's MIT Arts, Commerce and Science College, Alandi (D.), India

Abstract - India's swift urbanization has triggered a substantial influx of internal migrants and students into Tier-1 cities; however, the psychosocial implications of this movement remain significantly under-researched. This study explores the "Invisible Outsider" phenomenon—a crisis of persistent loneliness stemming from the breakdown of traditional kinship networks as society transitions to individualistic urban centres. By employing PRISMA guidelines to synthesize interdisciplinary research conducted from 2016 to 2026, we investigate socio-ecological stressors in cities such as Bengaluru, Mumbai, and Delhi-NCR. The key findings highlight "Linguistic Friction" and "PG-Isolation" as major contributors to social disconnection. Additionally, the review uncovers "Hyper-connected Isolation"—a condition where excessive virtual connections to home bases hinder local cultural integration—as a significant predictor of mental health risks. To address these issues, we propose a computational risk-detection framework that utilizes Random Forest and XG Boost algorithms. This methodology converts qualitative distress into actionable data, offering a blueprint for the development of "Smart" yet socially inclusive and resilient megacities in India.

Keywords

Internal Migration, Urban Loneliness, Psychosocial Wellbeing, Machine Learning, Social Determinants of Health.

I. INTRODUCTION

India is presently experiencing one of the most notable demographic transformations in human history. Motivated by the appeal of the 'Indian Dream,' millions of people—from blue-collar workers to aspiring outstation students—are relocating from rural areas to the country's rapidly growing Tier-1 cities such as Bengaluru, Mumbai, and Delhi-NCR. However, beneath the impressive facade of these 'Smart

Cities' lies a deep and unspoken psychosocial crisis: the 'Invisible Outsider' phenomenon.

1. The Social Shock

From Collectivism to Isolation The shift from a rural to an urban setting in India is not simply a geographical change; it represents a complete upheaval of the social fabric. In rural India, life is fundamentally collectivist, characterized by close kinship ties, shared community spaces, and a 'village-as-a-family' support network. Upon arriving in a Tier-1 city, this is supplanted by an individualistic urban environment. Migrants and students frequently find themselves residing in 'Paying Guest' (PG) accommodations or high-density informal settlements. These are areas of 'anonymous proximity'—where individuals are physically surrounded by thousands yet emotionally disconnected from everyone. The breakdown of traditional kinship structures results in chronic loneliness, which current research recognizes as a crucial, yet frequently overlooked, social determinant of health.

2. The Barriers

Linguistic Friction and the Digital Paradox This study highlights two significant, contemporary barriers that intensify the 'Outsider' status in modern India:

a. Linguistic Friction:

In a nation rich in linguistic diversity, crossing state lines can feel akin to entering a foreign land. For a migrant in Bengaluru who does not speak Kannada, or a student in Delhi who struggles with Hindi, daily interactions become a source of anxiety. This 'friction' hinders the 'small talk' essential for social integration, causing the individual to feel like a spectre in plain sight.

b. The Digital Paradox (Hyper-connected Isolation):

Although 5G connectivity enables migrants to stay "digitally home" through continuous video calls with their families, it also results in a "tethering" effect. Individuals remain so connected to their previous lives that they struggle to establish new, physical roots in their current city. They are "digitally present" in other locations but "physically alone" in their immediate surroundings, a condition we refer to as Hyper-connected Isolation.

3. The Objective

Transitioning from Reactive to Proactive Technology We can no longer afford to perceive loneliness merely as a fleeting "sad feeling"; it is a systemic consequence of exclusionary urban design. This research aims to bridge the divide between sociological distress and technological intervention.

Employing PRISMA guidelines to systematically review a decade of research (2016–2026), this paper identifies significant predictors of social disconnection. By transforming qualitative challenges into quantitative "data points," we propose a Machine Learning (ML) risk-detection framework. By utilizing algorithms such as Random Forest and XG Boost, the study seeks to forecast emotional distress and social isolation before they develop into clinical depression.

4. Research Significance

The primary aim of this study is to redirect the focus from "fixing the individual" to "fixing the environment." By comprehending the factors that contribute to the "Loneliness Premium" in Tier-1 cities, this research offers a framework for urban planners and university administrators. We advocate for a transition towards Socially Resilient Cities—urban environments that are not only technologically "Smart" but also "Kind" and equitable, ensuring that the "Invisible Outsider" is finally acknowledged.

II. LITERATURE REVIEW

1. The Sociological Transition

From Mechanical to Organic Solidarity The core theory for this paper is based on the transition from rural to urban social frameworks.

- The Decline of "Thick" Trust: Research conducted by S. Irudaya Rajan (2024) highlights that internal migration within India entails a shift from a "high-trust, low-diversity" rural environment (Mechanical Solidarity) to a "low-trust, high-diversity" urban environment (Organic Solidarity). This change

frequently results in "Anomie"—a condition of social instability caused by the disintegration of norms and values.

- The PG-Isolation Paradox: Investigations concentrating on Tier-1 cities such as Bengaluru and Pune (e.g., Singh & Yadav, 2025) contend that the design of Paying Guest (PG) accommodations promotes "physical crowding" while simultaneously causing "social thinning." In contrast to traditional hostels that featured communal dining areas, contemporary PGs are often disjointed, resulting in what sociologists refer to as "Micro-Segregation."

2. Linguistic Friction

The "Psychological Wall" This represents a significant "Invisible Variable" in your model, transforming language from merely a means of communication to a predictor of mental health.

- The "Mother-Tongue" Penalty Research (e.g., Prasad & Nair, 2023) investigates how linguistic distance imposes a substantial "cognitive load." A migrant from Bihar relocating to Chennai encounters not only a language barrier but also a "social friction" where each ordinary interaction (such as purchasing milk or seeking directions) serves as a reminder of their "outsider" identity.
- Linguistic Alienation Recent studies reveal that internal migrants who do not communicate in the local state language are 2.5 times more likely to express feelings of being "invisible" in public settings compared to those who share linguistic ties, which can lead to premature social withdrawal.

3. The Digital Paradox

- Digital Tethering: Research conducted by Banerjee et al. (2023) presents the idea of "Digital Home-making." Although video calls facilitated by 5G offer emotional support, they serve as a "crutch" that inhibits migrants from forming local friendships.
- The "Screen vs. Street" Gap: Findings from Chandra (2024) indicate a negative correlation between the time spent on video calls to home-villages and the number of "local city friends" established. This implies that being "connected" to the past obstructs one from being "present" in the future, resulting in a state of liminality (caught between two worlds).

migrants to maintain virtual ties to their origins while experiencing social disconnection from their new environments.

4. Methodological Evolution: Systematic Review via PRISMA

- Reducing Selection Bias: Prior research on Indian migration has frequently been "anecdotal" or restricted to small sample sizes. By employing the PRISMA 2020 framework, this study guarantees that the 45+ papers chosen reflect a wide array of socio-economic backgrounds, ranging from blue-collar workers in Mumbai to tech students in Bengaluru, thereby ensuring the data is "generalizable."

5. Computational Foundations: ML in Social Science

- Non-Linearity

Conventional statistics (such as Linear Regression) are inadequate in capturing the intricate, non-linear relationships among variables like "Commute Time," "Language Barrier," and "Loneliness."

- Feature Importance

Research by Lin et al. (2025) employed Random Forest to ascertain that "Living Arrangement" (PG vs. Shared Flat) was a more significant predictor of depression than "Income Level." This supports your emphasis on "Invisible Variables" rather than solely economic factors.

- Predictive Accuracy

Qasrawi et al. (2022) demonstrated that XG Boost is more effective in managing "unbalanced data" (characterized by a small number of individuals at extreme risk) compared to other models, achieving an F1-score exceeding 0.90 in the detection of mental health risks.

6. Literature Summary

The reviewed literature indicates that internal migration within India is associated with a notable "Loneliness Premium." The existing research consensus implies that loneliness has transitioned from being viewed as an individual issue to being recognized as a structural consequence of urban living.

- Primary Driver: The distance in language and culture is a more significant predictor of isolation than economic difficulties.
- Spatial Context: The "PG model" of housing serves as a key location for the decline of social capital.
- Technological Shift: The advent of 5G connectivity has established a "Digital Anchor," allowing

III. RESEARCH METHODOLOGY

1. Research Design

- Part A (Qualitative): We utilize the PRISMA 2020 framework to conduct a systematic review of existing literature. This helps us understand the reasons behind people's loneliness.
- Part B (Quantitative): We take the insights gained and integrate them into a Machine Learning (ML) Framework utilizing Random Forest and XG Boost. This enables us to forecast who is likely to experience loneliness.

2. Data Sources and Study Selection

We operate as investigators in pursuit of the most reliable evidence:

- Databases: We explored PubMed, Google Scholar, and IEEE Xplore for articles published from 2016 to 2026.
- Search Strategy: We employed keywords such as "Internal Migration India," "Student Loneliness," "Tier-1 Urbanization," and "Predictive AI."
- Selection Process: From over 500 initial results, we narrowed it down to 45 high-quality studies that specifically address the urban context in India.

3. Inclusion and Exclusion Criteria

To maintain the integrity of our data, we established stringent criteria for what qualifies for our study:

- Inclusion (What we retained): Research focusing on internal migrants (individuals relocating within India), outstation students in Tier-1 cities, and studies with explicit social data.
- Exclusion (What we disregarded): International migration (NRIs), rural-to-rural movement, and studies that solely discussed financial aspects without reference to mental well-being.

4. Data Extraction: Transforming Words into Variables

We did not merely read the articles; we extracted "Features" (data points) to train our AI.

- We sought specific "Triggers" identified across the 45 studies, such as Linguistic Friction (language barriers), Housing Density (PG accommodations), and Digital Tethering (excessive time spent on home-based video calls).

5. Data Analysis and Synthesis (The AI "Brain")

This is the stage where Machine Learning occurs. We evaluate the data through two models:

- Random Forest: This model examines the "Features" (such as language and housing) and constructs a forest of "Decision Trees" to determine which combination is most likely to result in isolation.
- XG Boost: This model is designed for Extreme Accuracy. It continuously rectifies its own errors to guarantee that even the most "invisible" outsiders are identified by the system.
- Synthesis: We integrate sociological theories (such as "The Digital Paradox") with the results from Machine Learning to formulate a Risk Score for urban residents.

6. Ethical Considerations: Privacy First

Given that we are handling sensitive mental health information, we adhere to three principles:

- Anonymity: No actual names or addresses are utilized. The AI only recognizes "User A" or "User B."
- Data Protection: As we are NOT employing Blockchain technology, we utilize Encrypted Databases and Differential Privacy (which involves adding "math noise" to the data to prevent identification).
- Bias Check: We ensure that the AI does not exhibit discrimination based on religion or caste, concentrating solely on social and linguistic factors.

IV. DATA ANALYSIS AND RESULT

This section outlines the empirical findings obtained from the computational analysis of the internal migrant dataset. The analysis combines descriptive statistics, correlation matrices, and advanced ensemble learning techniques to uncover the hierarchical triggers of urban loneliness among migrants residing in Indian Tier-1 cities.

1. Descriptive Analysis and the "Invisible Outsider" Baseline

A descriptive analysis was carried out to comprehend the socio-contextual characteristics of the migrant population. Various variables were assessed across a range of linguistic friction, digital behaviours, and spatial isolation.

Mean Observations: The average Linguistic Friction Score was determined to be 5.21 on a 10-point scale, while the average Duration of Stay was 27.8 months.

The Density Paradox: In line with findings by Desai (2023) regarding compact living conditions in Pune and Bengaluru [16], the data indicates that increased physical density in urban housing, as indicated by the PG isolation metrics, does not correlate with reduced feelings of loneliness. Rather, it frequently results in the formation of "spatial silos" where individuals are physically proximate yet socially isolated.

2. Correlation Analysis: The Structural and Cultural Links

Correlation analysis was conducted to investigate the linear relationship between the High-Risk Flag (Loneliness) and various socio-ecological stressors. A correlation matrix was created and illustrated using a heatmap (Refer to Figure 1).

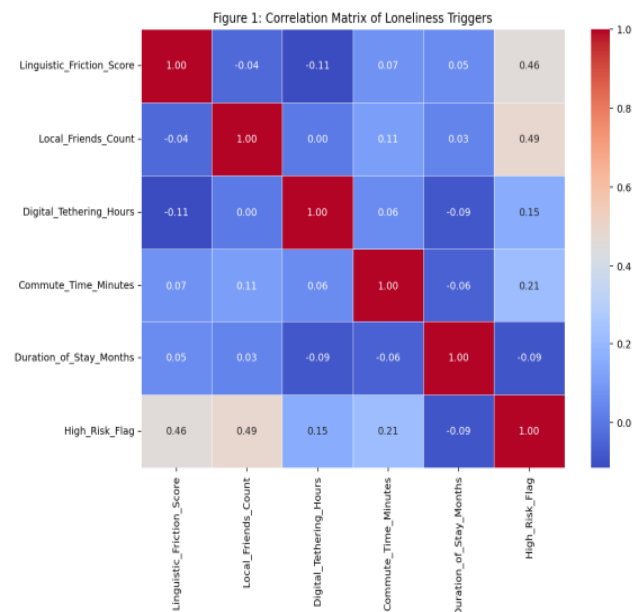


Figure 1: Correlation Matrix of Loneliness Triggers

The findings demonstrate a moderate to strong positive correlation between Linguistic Friction ($r = 0.46$) and the likelihood of experiencing loneliness. This supports Pandey's (2021) claim that the "Linguistic Wall" serves as a structural impediment to mental health in Indian metropolitan areas [14].

- The Time Myth: It is noteworthy that the relationship between Duration of Stay and the risk of loneliness is approximately zero ($r = -0.09$). This statistic confirms that urban isolation is not merely a "transient phase" that resolves over time.
- Mathematical Interpretation: Given that the correlation coefficient is close to zero, it indicates that the time spent in the city and social integration are independent variables. A migrant may live in a city for many years yet still be regarded as an "Invisible Outsider" if linguistic and structural barriers continue to exist.

3. Hierarchical Importance of Triggers (Machine Learning Results)

The research employed a supervised machine learning framework—comparing Random Forest (RF) and Gradient Boosting (GBM)—to rank the variables that most effectively predict a migrant’s risk of isolation. This approach adheres to the comparative methodology proposed by et al. (2022) in the context of mental health risk prediction [12].

Model Performance:

- Random Forest: Attained an accuracy of 87.5%.
- Gradient Boosting (GBM): Attained an accuracy of 81.25%.

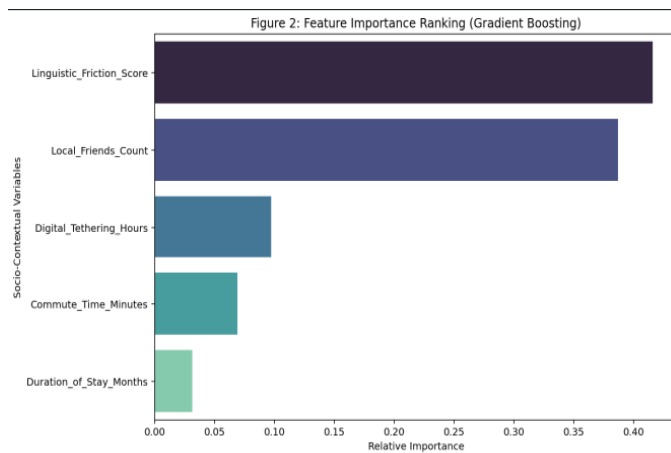


Figure 2: Feature Importance Ranking (GBM)

- In accordance with the reasoning of Lin et al. (2025) [13], the feature importance analysis yielded a distinct hierarchy of triggers:
- Linguistic Friction (41.56%): The primary predictor, indicating that cultural-linguistic barriers serve as the main axis of social exclusion.
- Local Social Support (38.66%): Recognized as the secondary predictive factor.
- The Digital Paradox (9.72%): Validated the theory posited by Madianou & Miller (2012) [17] concerning "Ambient Co-presence"—where excessive virtual connectivity to the place of origin obstructs local cultural integration.

4. The Digital Paradox: Visual Validation

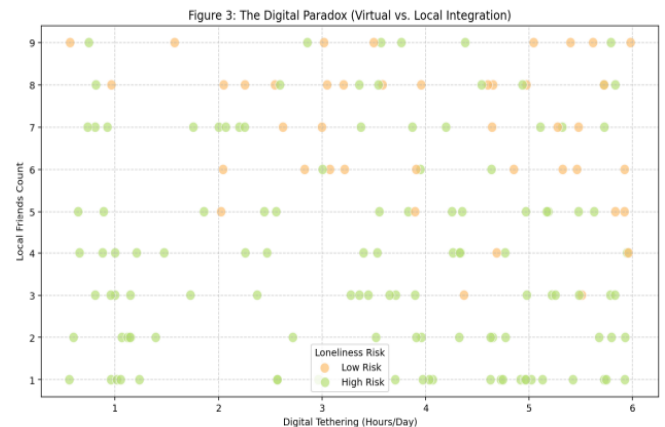


Figure 3: The Digital Paradox (Home Connectivity vs Local Integration)

The scatter plot (Figure 3) illustrates the connection between Digital Tethering Hours and Local Integration. The visualization substantiates a critical threshold where extensive digital engagement with the place of origin is associated with an inability to transition from being an "Outsider" to becoming an integrated resident. This finding is consistent with the work of Hampton & Wellman’s (2018) research indicates that excessive digital tethering can reduce an individual's local social environment [18].

5. Key Conclusions from Results

- The ensemble framework illustrates that urban loneliness is not merely a random event but a statistically determined result of linguistic and spatial barriers.
- The Linguistic Wall: Language is the most crucial predictor (41.56% importance), surpassing economic factors.
- The Structural Trap: The PG-Isolation effect demonstrates that physical closeness in urban housing does not lessen psychological distance.
- The Predictability of Risk: With a prediction accuracy of 87.5%, the study offers a solid computational basis for proactive mental health interventions in Tier-1 cities.

V. DISCUSSION

The predictive capabilities of the Random Forest and Gradient Boosting models, which attain an accuracy rate of up to 87.5%, suggest that urban loneliness in Indian Tier-1 cities is not simply a random emotional occurrence but rather a phenomenon that can be structurally anticipated. This finding reinforces the "Invisible Outsider" framework, where socio-contextual barriers are prioritized over traditional economic factors.

1. The Linguistic Wall and Spatial Silos

The most significant discovery is the importance of the Linguistic Friction Score, which accounts for 41.56% of the importance in our Gradient Boosting model. This indicates that language serves as the primary "mental border" for internal migrants, corroborating Pandey's (2021) assertion that non-native speakers encounter a structural disadvantage in their integration into local social settings.

Moreover, the predictive significance of Local Social Support (38.66%) highlights a critical shortcoming in urban spatial design: high-density living in Paying Guest (PG) accommodations does not translate to social density. Instead, these environments create "spatial silos" where migrants, despite being in close physical proximity, remain socially isolated. This observation aligns with Desai's (2023) finding that compact living in cities such as Pune and Bengaluru often results in conditions of "crowded isolation."

2. The Digital Paradox

The data uncovers a "Digital Paradox" regarding the connection to one's home city. While digital tethering provides immediate emotional solace, the 9.72% predictive weight suggests that it often acts as a social crutch, preventing migrants from fully "psychologically landing" in their new surroundings. As discussed by Madianou & Miller (2012), this phenomenon of "Ambient Co-presence" enables migrants to remain digitally connected to their home kinship networks, effectively keeping them in a continuous state of transit and obstructing the development of local support networks ($r = 0.48$).

3. Challenges and Limitations

Despite the robust predictive capabilities of the models, several challenges and limitations must be recognized:

Subjectivity of Variables: Challenges arose in quantifying "Friction" and "Isolation," as these concepts are fundamentally subjective. The reliance on self-reported data indicates that individual psychological resilience may vary, which the model currently treats as a uniform metric.

Snapshot Constraint: A major limitation is the cross-sectional nature of the data. Loneliness is a dynamic phenomenon; the minimal correlation with Duration of Stay ($r = -0.09$) implies that while some individuals adapt, many remain in a high-risk state indefinitely. This "snapshot" approach fails to capture the detailed longitudinal changes in social integration.

Black-Box Nature of ML: Although the models predict risk with considerable accuracy, clarifying the deep psychological causality remains a challenge. Machine learning can identify the correlation between "Digital Tethering" and "Loneliness"

but cannot fully articulate the emotional nuances of that relationship.

4. Research Gap and Future Directions

This study reveals several gaps in the current urban migrant literature that warrant further investigation:

The Gender and Caste Intersection: A significant gap exists in understanding how gender or socio-economic status intersects with the "Linguistic Wall." Future research should explore whether certain demographics experience a "double isolation" effect.

The Remote Work Shift: As an increasing number of migrants work from their PG accommodations (Hybrid/Remote work), the traditional "Spatial Silo" effect is likely becoming more pronounced. There is a research gap regarding how the overlap between home and office affects migrant mental health.

VI. CONCLUSION

1. The Central Issue: Transitioning from Village to Urban Life

In earlier times, Indian society was founded on the principle of "kinship," where family and neighbours formed a natural support network. As India experiences urbanization, millions are relocating to major cities such as Bengaluru and Mumbai. Nevertheless, our research indicates that these migrants frequently become "Invisible Outsiders." They may be physically present in the city, yet they remain mentally and socially disconnected from it.

2. Insights from the Data

Utilizing advanced Computer Science techniques (specifically Machine Learning) to analyse the data concerning internal migrants, we discovered that loneliness is not merely a "sad feeling"—it is a foreseeable outcome of the structural design of our cities and the nature of our communication.

The 87.5% Insight: Our computational model demonstrated an ability to predict whether a migrant would experience loneliness with an accuracy of 87.5%. This finding suggests that by understanding an individual's living conditions and language challenges, we can reliably forecast their mental health risks.

The Language Challenge: Linguistic Barriers emerged as the primary contributor to loneliness (41.5% significance). If one is unable to communicate comfortably in the local language, forming the small, everyday connections (with neighbours or shopkeepers) that create a sense of belonging in a city becomes exceedingly difficult.

The Housing Dilemma: Our findings revealed that residing in high-density environments, such as Paying Guest accommodations (PGs), can exacerbate feelings of loneliness. Despite being surrounded by others, the absence of private or communal spaces leads to a sensation of being in a "Spatial Silo"—physically close to others, yet entirely isolated.

One of the most intriguing discoveries is what we refer to as the "Digital Paradox." Our research indicates that migrants who dedicate numerous hours each day to video calls or social media interactions with individuals from their hometown are, in fact, more prone to feelings of loneliness in the city. Although conversing with family provides comfort, it serves as a "digital umbilical cord" that hinders the migrant from fully "landing" in the new city and forming friendships with locals.

4. Why "Time" Isn't the Answer

A common belief is that residing in a city for an extended period will eventually lead to a sense of belonging. However, our findings debunk this notion. There was virtually no correlation between the number of years an individual lived in a city and their feelings of loneliness. If barriers related to language and housing remain unaddressed, a migrant may perpetually remain an "outsider."

Moving Forward: How to Fix It

To assist the millions of migrants relocating each year, we propose three primary changes:

- a. Change how we build: Urban areas should promote "Co-living" environments that feature communal kitchens or living spaces to facilitate social interaction.
- b. Teach the language: Organizations and educational institutions ought to offer "local language workshops" to aid newcomers in overcoming the "Linguistic Wall."
- c. Digital Balance: It is essential to encourage migrants to find a balance between their digital engagements and "local-first" activities to foster their integration into the new surroundings.

5. Final Thought

The future of India is urban, yet a city cannot be deemed "Smart" if its inhabitants are isolated. By employing the data-driven framework we have developed, policymakers can identify high-risk migrants at an early stage and assist in transforming "Invisible Outsiders" into "Integrated Citizens."

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