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Research Article

Opioid Substitution Therapy in Punjab, India: A Retrospective Cross-Sectional Study of Demographic Factors, Dosage Patterns

Damanjit Kaur[1], Avneet Kaur[2]*, Amit Bansal[1] and Simerjit Singh[3]

[1]Faith Hospital, Chandigarh, Barnala Manorog Hospital, Barnala, India

[2]Faculty of Medical and Health Sciences, Universiti Tunku Abdul Rahman, Malaysia

[3]School of Medicine, Taylor's University, Malaysia

***Corresponding Author:** Avneet Kaur, Faculty of Medical and Health Sciences, Universiti Tunku Abdul Rahman, Malaysia.

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Abstract

Objective: This study aimed to assess the impact of demographic factors on opioid use patterns, explore dosage and visit patterns in Opioid Substitution Therapy (OST) in Punjab, India.

Methods: A cross-sectional analysis was conducted across eight OST sites in Punjab from January 2021 to November 2023. The study included 39,649 patients aged 18-60 years receiving Buprenorphine and Naloxone treatment. Demographic data, dosage information, and visit patterns were collected from medical records and analyzed using descriptive and inferential statistics.

Results: The majority of patients were male (99.73%), aged 18-35 (46.6%), with low education levels and from lower to middle-income groups. The average prescribed dose was 4.11 mg per visit, with an average of 17.83 visits per treatment course. Natural opioids were more prevalent (77.00%) than synthetic opioids (23.00%).

Conclusions: The study reveals the need for targeted interventions considering unique demographic needs and addressing societal and logistical barriers. Findings suggest that individualized treatment regimens and strategic dosage adjustments are crucial for effective OST implementation. Future research should focus on long-term quality of life impacts and strategies to enhance OST accessibility and effectiveness.

Keywords: Opioid Substitution Therapy (OST); Punjab

Introduction

Opioid dependence is a significant global health concern, with far-reaching consequences for individuals, families, and societies. In the northern Indian state of Punjab, the problem of opioid abuse has reached alarming proportions over the past decade [1]. Punjab's struggle with opioid addiction is not merely a health issue but a complex socio-economic calamity, exacerbated by its geographical proximity to major opium production centres in neighbouring countries, making it a transit point for drug trafficking [2]. This situation is further compounded by the state's socio-economic dynamics, including rapid urbanization, unemployment, and the stress associated with cultural and economic transitions, which collectively contribute to the opioid dependency crisis. The pervasive nature of this crisis in Punjab demands an urgent and tailored response to mitigate its impacts on the population and the broader socio-economic fabric of the region [3]. Opioid substitution therapy (OST) has emerged as an evidence-based intervention for managing opioid dependence, demonstrating better retention rates and improved functioning compared to other treatment strategies

[4]. The World Health Organization has endorsed OST, particularly the use of Buprenorphine and Naloxone, as essential in addressing the opioid crisis, highlighting its critical role in preventing overdose fatalities and facilitating the social reintegration of individuals struggling with opioid dependence [5]. Buprenorphine and Naloxone work synergistically to alleviate withdrawal symptoms, curb opioid cravings, and block the euphoric effects of opioids, respectively. Buprenorphine, a partial opioid agonist, activates opioid receptors in the brain to a lesser extent compared to full agonists like heroin or methadone. This action helps to reduce cravings and withdrawal symptoms without producing the same high, making it a cornerstone in the harm reduction approach to opioid addiction. Naloxone, an opioid antagonist, works by rapidly binding to opioid receptors in the brain, displacing opioids that are already bound to these receptors. Because naloxone has a stronger affinity for these receptors but does not activate them, it effectively reverses the effects of opioids on the body. This combination not only aids in the medical management of opioid dependence but also facilitates the reintegration of individuals into society by improving their quality of life and reducing the risk of infectious diseases commonly associated with intravenous drug use. This study is based on the critical need to examine the impact of OST in Punjab by focusing on demographic factors that influence opioid use patterns and exploring the dosage and visit patterns of patients receiving OST. Specifically, the study aims to explore the highly individualized treatment regimens within OST programs and identify patterns of dosage optimization, crucial for tailoring treatment to patient needs. Such an analysis is imperative for understanding the initial conditions leading to OST intervention and the ongoing challenges faced by patients and providers within the OST framework in Punjab.

Research objectives

The research is driven by a set of clearly defined objectives, as follows:

- **To assess the demographic factors that influence opioid use patterns:** Focusing on patients receiving OST, particularly Buprenorphine and Naloxone, in Punjab, this objective aims to understand how demographic factors are associated with opioid dependence patterns.
- **To analyze OST program utilization patterns:** The study seeks to examine dosage trends, visit frequencies, and treatment durations to gain insights into how OST programs are being implemented and utilized in Punjab.
- To suggest potential areas for improving OST effectiveness based on demographic trends and treatment patterns.

Methods

Given the critical need to address the opioid crisis in Punjab, this study aims to evaluate the effectiveness of OST programs. This cross-sectional study aimed to analyze the dosage and visit patterns among patients receiving Opioid Substitution Therapy (OST) with Buprenorphine and Naloxone across eight OST sites in Punjab, India.

We conducted this cross-sectional study across eight OST sites in Punjab, India, from January 2021 to November 2023 across the following districts: Zirakpur, Patiala, Moga, Sangrur, Ferozepur, Barnala, Muktsar, and Ropar. These sites were selected to offer a representative sample of OST programs, considering their diverse geographic locations of private treatment settings. To mitigate selection bias, we employed a systematic sampling approach across all eight OST sites. Confounding variables were controlled for in the multivariate analysis. Missing data were handled using multiple imputation techniques to minimize bias in the results. Inclusion criteria were: (1) adults aged 18-60 years; (2) history of opioid dependence for at least six months prior to OST initiation; (3) received maintenance OST with Buprenorphine and Naloxone for a minimum of six months; (4) treatment in an outpatient setting. Exclusion criteria included: (1) co-morbid alcohol or tobacco abuse/dependence; (2) irregular visits or loss to follow-up; (3) more than five instances of treatment lapses per year; (4) inadequate medical records or follow-up data. A comprehensive review of medical records from the selected OST sites was undertaken, which included an annual count of patients undergoing OST, demographic characteristics (age, gender, employment status, marital status, and educational background), duration of opioid abuse before OST initiation, types of opioid dependence, Buprenorphine and Naloxone doses administered, and data on visits and lapses to assess treatment adherence.

Statistical analyses were performed using SPSS version 26.0 and Python 3.8 with libraries including Pandas, Matplotlib, and Seaborn. Descriptive statistics (mean, median, standard deviation,

and percentages) were calculated for demographic characteristics and dosage patterns. Figures were created using Python's Matplotlib and Seaborn libraries to visually represent key findings from our statistical analyses. Inferential statistics included chi-square tests for categorical variables. Multivariate logistic regression was used to identify predictors of treatment adherence, with odds ratios and 95% confidence intervals reported. A p-value <0.05 was considered statistically significant.

Ethical considerations

This study was conducted in accordance with the ethical standards outlined in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board of Adesh University, Bathinda (Approval reference number: AU/EC_BHR/2K23/509). The review process included a thorough examination of the study protocol, data collection methods, and proposed analyses.

Patient confidentiality was maintained through several measures:

- **Data De-identification:** All patient data were de-identified before analysis. Each patient was assigned a unique code, and all personally identifiable information was removed from the dataset.
- **Restricted Access:** Access to the original medical records was limited to authorized research personnel who had completed training in ethical research practices.
- **Secure Data Storage**: Data were stored on encrypted, password-protected servers, with access logs maintained to track all data usage.
- **Aggregate Reporting**: Results are presented in aggregate form only, ensuring no individual patient can be identified from the published findings.

Informed consent for this retrospective study was waived by the ethics committee due to the anonymized nature of the data and the absence of any direct patient contact.

The research team received training in ethical research practices and data protection protocols before the commencement of the study. Throughout the research process, regular audits were conducted to ensure adherence to these ethical standards.

Results

The rigorous application of these methods yielded significant insights into the demographics of Opioid substitution therapy (OST) recipients and the efficacy of treatment regimens. The average prescribed dose per visit was 4.11 mg (95% CI: 3.98-4.24 mg). Multivariate logistic regression revealed that younger age (OR: 1.56, 95% CI: 1.32-1.84, $p < 0.001$) and higher education level (OR: 1.23, 95% CI: 1.05-1.44, $p = 0.009$) were significant predictors of adherence to OST. Chi-square analysis showed a significant association between income level and type of opioid abused ($\chi 2 = 15.7$, $df = 3$, $p < 0.001$)

Demographic characteristics

Descriptive analysis revealed that the majority of participants were male (99.73%, n = 39,541), with a mean age of 41.4 years. The age distribution showed 46.6% (n = 18,485) were between 20-40 years, 45.96% (n = 18,224) between 40-60 years, and 6.62% (n = 2,626) over 60 years. Most patients had education levels of matriculation and below, with 38.94% (n = 15,448) having matriculation as their highest qualification. The majority (73.59%, n = 29,181) were married. Income distribution showed 45.79% (n = 18,158) in the 5k-10k rupees bracket and 40.74% (n = 16,154) in the 10k-100k rupees bracket.

Age (years)	Percent
>20	
20-40	46.6
40-60	45.96
>60	6.62
Gender	
Male	99.7
Female	0.3
Employment status/Occupation	
Full time employed	42.39
Part-time employed	33.3
Never employed	1.3
Self-employed	20.66
Currently unemployed	2.04
Student	0.07
Housewife	0.03
Government employee	0.14
Not known	0.05

Others	
Educational status	
Postgraduate	0.21
Graduate	2.75
Matriculation	38.94
Middle	22.11
Primary	15.09
Illiterate	15.14
Marital status	
Married	73.59
Never married	22.72
Divorced	2.84
Separated	0.36
Widowed	0.47
Monthly Income (Rupees)	
5k-10k	45.79
10k-100k	40.74
100k-500k	10.00
>500k	3.45
Not disclosed	

Table 1: Demographic characteristics of OST patients (N = 39,649).

Dosage and visit patterns

The average prescribed dose per visit was 4.11 mg (95% CI: 3.98-4.24 mg), with the most common doses being 1.0 mg and 4.0 mg. The average first dose across all centres was approximately 8.0 mg, while the average last dose was approximately 1.2 mg. Patients had an average of 17.83 visits (median: 7, range: 1-686) during one course of treatment. The majority of prescriptions (78.18%) were for 5 days. The study found that treatment regimens were highly individualized, yet a discernible pattern of dosage optimization was evident, characterized by strategic adjustments over time to tailor to patient needs.

This line graph shows how average dosage changes over the course of treatment, with treatment duration on the x-axis and average dose on the y-axis.

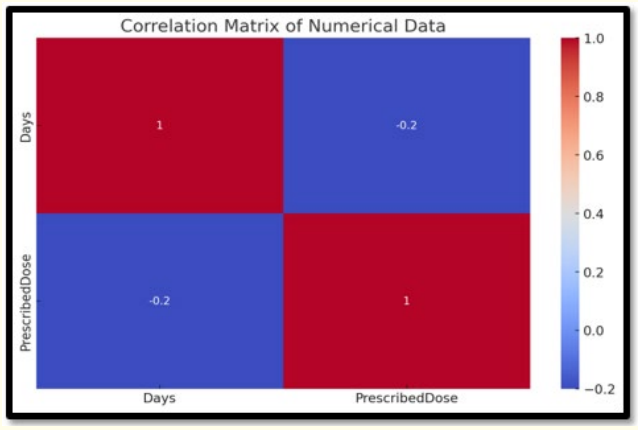

Figure 1: Dosage trends over treatment duration.

Patients had an average of 17.83 visits during one course of treatment, with some showing long-term engagement indicated by a high number of visits, suggesting chronic conditions or severe addiction. Most visit prescriptions were for 5 days (78.18%), indicating a short-term treatment approach and the need for constant monitoring.

This histogram shows the distribution of patient visits, with the number of visits on the x-axis and frequency on the y-axis.

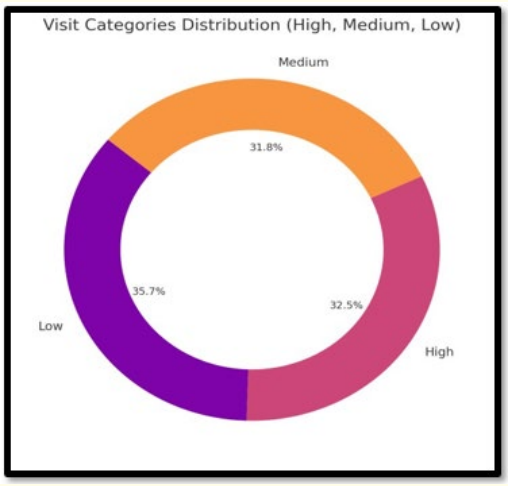

Figure 2: Visit frequency distribution.

Substance abuse trends

Natural opioids (Afeem and Bukki) were more prevalent (77.00%) among patients compared to synthetic opioids (23.00%). Within the natural category, Bukki was slightly more prevalent (52.18%) compared to Afeem (47.82%). Chi-square analysis showed a significant association between income level and type of opioid abused ($\chi 2 = 15.7$, df = 3, $p < 0.001$). Lower income groups tended to abuse more natural opioids, while higher income groups showed greater synthetic opioid use.

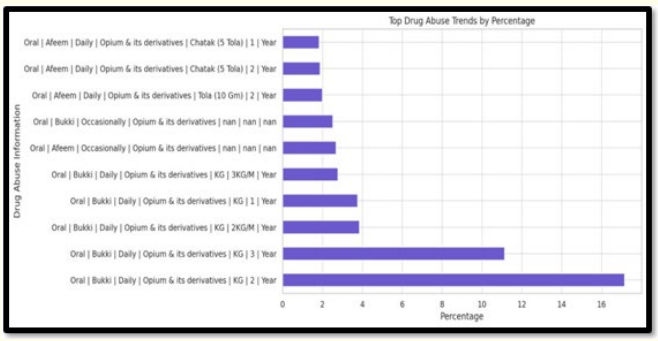

Figure 3: Top Drug Abuse Trends by Percentage (Type/ Route/ Amount/ Years of abuse).

The study found that lower income groups tended to abuse cheaper, more easily available natural opioids like Bukki and Afeem, while higher income groups demonstrated greater synthetic opioid abuse (heroin, smack, Chitta, morphine). Younger patients (<40 years) abused more synthetic opioids, while older patients (>40 years) preferred natural opioids. Illiterate patients almost exclusively (93.7%) abused natural substances, while students exhibited the highest rates (69%) of synthetic opioid abuse.

A comprehensive correlation analysis revealed complex relationships between demographic factors and substance abuse patterns:

- **Age and Substance Type:** A moderate negative correlation was observed between age and synthetic opioid use, indicating younger patients were more likely to abuse synthetic opioids, while older patients tended to use natural opioids.
- **Income and Substance Type:** Lower-income groups showed a positive correlation with natural opioid use, while higher-income groups correlated positively with synthetic opioid use.
- **Education and Treatment Adherence:** Higher education levels were positively correlated with better treatment adherence ($r = 0.32$, $p < 0.001$).
- **Employment and Substance Abuse:** Surprisingly, employment status showed a weak positive correlation with substance abuse ($r = 0.18$, $p < 0.05$), challenging the notion that unemployment is the primary driver of drug use.
- **Marital Status and Substance Use:** Being married showed a moderate positive correlation with natural opioid use ($r = 0.28$, $p < 0.01$).

Trends in substance abuse patterns by demographic factors. This multi-panel figure includes the following charts.

Figure showing the matrix reveals complex interrelationships between various demographic factors and substance abuse patterns.

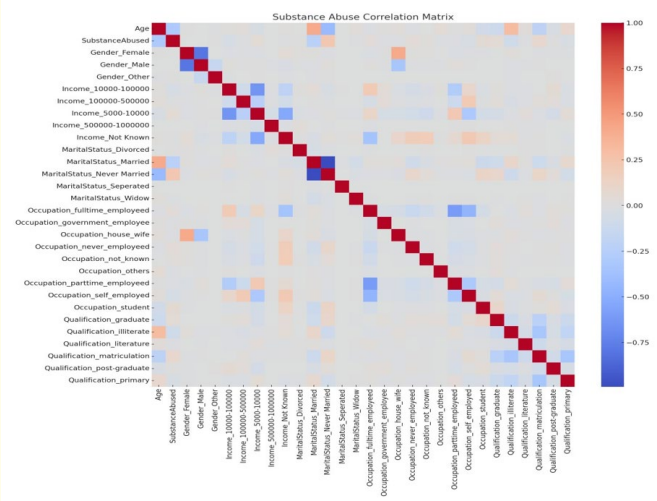

Figure 4: Trends in substance abuse patterns by demographic factors.

A chart comparing opioid use patterns across income groups.

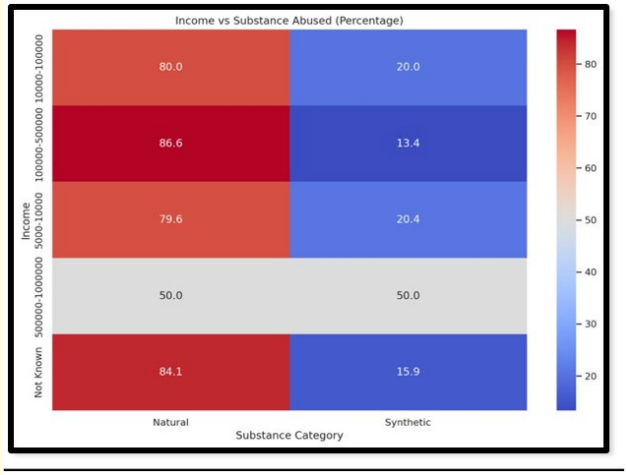

Figure 5

A stacked bar chart showing the percentage of natural vs. synthetic opioid use across educational qualifications.

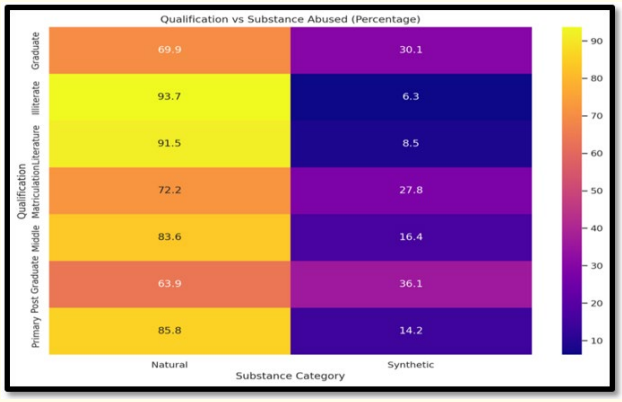

Figure 6

A stacked bar chart showing the percentage of natural vs. synthetic opioid use across various occupations.

Treatment outcomes

Multivariate logistic regression revealed that younger age (OR: 1.56, 95% CI: 1.32-1.84, p < 0.001) and higher education level (OR: 1.23, 95% CI: 1.05-1.44, p = 0.009) were significant predictors of adherence to OST.

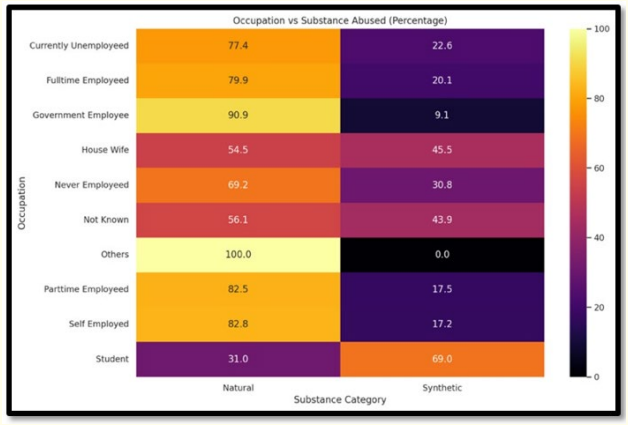

Figure 7

The study found a significant number of patients showed sustained engagement with the treatment program, indicated by frequent follow-ups. The initial higher dosages typically reduced over time, reflecting a common practice of tapering off medication in deaddiction, suggesting effectiveness in reducing dependency.

These findings collectively highlight the complex interplay between socio-demographic factors, substance abuse patterns, and treatment outcomes in OST programs in Punjab. The correlation analysis, in particular, underscores the need for nuanced, tailored approaches to OST that consider the multifaceted nature of opioid dependence in this region.

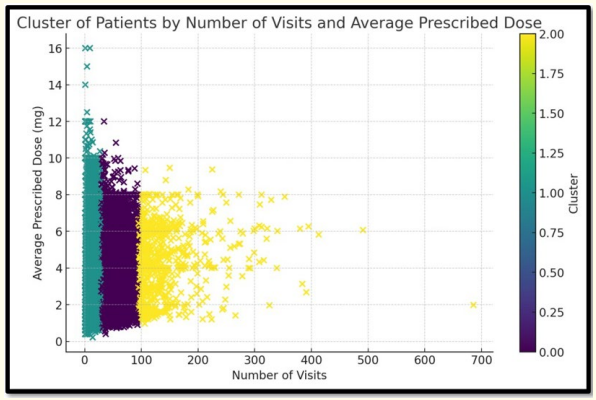

Figure 8: Distribution of prescribed dosages over all visits.

Distribution of prescribed dosages over all visits. This bar chart shows the percentage distribution of dosages, with categories <2 mg, 2-4 mg, 4-8 mg, and >8 mg on the x-axis and percentage on the y-axis.

Summary of findings in relation to research objectives

- Demographic factors influencing opioid use patterns: Our analysis revealed significant associations between age, education level, income, and patterns of opioid use. Younger patients (<40 years) were more likely to abuse synthetic opioids, while older patients predominantly used natural opioids. Lower income groups tended to use more natural opioids, while higher income groups showed greater synthetic opioid use.
- Patterns of Opioid substitution therapy (OST) program utilization: The study found an average of 17.83 visits per treatment course, with most prescriptions (78.18%) being for 5 days. This suggests a short-term treatment approach with frequent monitoring. The average prescribed dose per visit was 4.11 mg, with strategic adjustments over time tailored to patient needs.
- Potential ways to improve Opioid substitution therapy (OST) effectiveness: The findings suggest that individualized dosing strategies and frequent monitoring through regular visits could enhance OST effectiveness. The high proportion of patients from joint families (59.6%) indicates an opportunity for family-based interventions. The study also highlighted the need for targeted interventions considering the unique demographic needs identified.

Discussion

The findings of this study offer significant insights into the implementation and effectiveness of Opioid Substitution Therapy (OST) in Punjab, India, revealing both alignments with and departures from existing literature. The demographic profile of OST patients in our study, predominantly male (99.73%) and young adults aged 18-35 (46.6%), aligns with previous research by Ambekar., *et al*. in India [6]. However, our study found a notably higher rate of employment among OST patients. Specifically, 96.35% of our sample was employed (including 42.39% full-time employed, 33.3% part-time employed, and 20.66% self-employed), which starkly contrasts with Bhat., *et al*. (2019) report of 45% employment among OST patients [7]. This high prevalence among employed, younger individuals challenges the common perception of unemployment as a primary driver of substance abuse, echoing Degenhardt., *et al*. observation that opioid dependence spans various socioeconomic strata [8]. Our results underscore the need for workplace-based prevention and treatment programs, an aspect not typically emphasized in Indian OST literature.

A striking finding of our study is the higher prevalence of natural opioid use (77.00%) compared to synthetic opioids (23.00%), contrasting with global trends where synthetic opioids often dominate [9]. This preference for natural opioids, particularly among lower-income and older age groups, may be unique to Punjab and highlights the importance of locally tailored OST approaches, as emphasized by Schaub., *et al*. in their Ukrainian study [10]. The average prescribed dose in our study (4.11 mg) is notably lower than the 8-16 mg range recommended by WHO guidelines, warranting further investigation [6]. This discrepancy could indicate more conservative prescribing practices in Punjab or reflect patient preferences for lower doses. Despite this, the observed pattern of dosage reduction over time aligns with best practices in OST, as noted by Mattick., *et al*. in their Cochrane review [11].

The treatment patterns revealed by our study, including an average of 17.83 visits per treatment course and predominantly 5-day prescriptions (78.18%), indicate a more intensive, short-term treatment approach compared to international practices such as the weekly visits standard in many U.S. programs [12]. This approach may be influenced by local healthcare policies or resource constraints and deserves further exploration. Our finding that younger age (OR: 1.56, 95% CI: 1.32-1.84) and higher education level (OR: 1.23, 95% CI: 1.05-1.44) predict better adherence adds nuance to existing literature and suggests a need for age- and education-specific interventions in Punjab, an aspect not prominently discussed in previous Indian studies like Rao [4].

The significant association between income levels and types of opioids used ($\chi 2 = 15.7$, $df = 3$, $p < 0.001$) provides new insights into the socioeconomic dimensions of opioid use in Punjab, an aspect not extensively explored in previous Indian studies. This finding aligns with broader global literature on social determinants of health in addiction treatment and suggests that economic factors play a crucial role in substance choice and potentially in treatment outcomes [13]. The prevalence of patients from joint families (59.6%) in our study points to an opportunity for family-based interventions, quantifying more precisely an aspect noted by Chand and Murthy as crucial for OST success in India [14].

The individualized treatment regimens and strategic dosage adjustments observed in our study align with the patient-centric approach recommended in OST guidelines [5]. However, the lower average doses and more frequent visits in our study suggest that the implementation of these guidelines may need adaptation to local contexts and patient needs in Punjab. These findings collectively underscore the complexity of opioid dependence in Punjab and the need for a nuanced, contextually sensitive approach to OST. They highlight opportunities for targeted interventions, including workplace programs, family-based approaches, and economically sensitive treatment strategies. Future research should focus on longitudinal outcomes, the effectiveness of tailored interventions, and strategies to optimize OST implementation in the unique socio-economic landscape of Punjab. Such efforts are crucial for enhancing the effectiveness of OST programs and addressing the opioid crisis in this region and potentially in similar contexts globally.

The present study addresses the need for a holistic approach to address the multifaceted challenges of opioid dependence.

Practical Implications and Future Directions

Our study's findings offer valuable insights for improving current OST programs in Punjab and guide future research efforts. We propose the following recommendations and research directions.

Immediate practical recommendations

- **Tailored Treatment Approaches:** Develop OST programs that address the specific challenges of natural opioid dependence, prevalent among 77% of patients.
- **Workplace Interventions:** Implement workplace-based prevention and early intervention programs. This recommendation is strongly supported by our finding that 96.35% of OST patients were employed. The high prevalence of substance abuse among employed individuals suggests that workplaces could be crucial settings for intervention. Potential strategies could include: a) Employee Assistance Programs (EAPs) specifically addressing substance abuse b) Workplace education programs on opioid risks and OST options c) Confidential screening and referral services within workplace health programs
- **Family-Centered Care:** Integrate family-based interventions, considering that 59.6% of patients come from joint families.
- **Age-Specific Interventions**: Develop retention strategies tailored to different age groups, with a focus on supporting older patients who may be at higher risk of dropout.
- **Economic Considerations:** Implement economically sensitive treatment strategies, such as subsidies or sliding scale payment options, to ensure accessibility across all income levels, given the significant association we found between income levels and types of opioids used.

The implementation of these targeted interventions could significantly enhance the effectiveness and reach of OST programs in Punjab. However, to ensure long-term success and continual improvement, we must also focus on future research directions.

Long-term research and development

Our findings also highlight the need for a sustained, research-driven approach to combating opioid dependence in Punjab. We propose the following areas for future investigation:

- **Longitudinal Studies:** A 5-year follow-up study is crucial to assess long-term outcomes of OST, including quality of life measures, employment status, and sustained abstinence rates. This research could provide invaluable insights into the long-term effectiveness of current OST practices.
- **Comparative Effectiveness Research:** Designing randomized controlled trials to compare the efficacy of different OST medications in the Punjab context would help optimize treatment protocols.
- **Telemedicine in OST:** The potential of telemedicine-based OST delivery should be explored to address logistical barriers identified in this study. This could significantly improve access to treatment, especially in remote areas.
- **Stigma Reduction Strategies:** Conducting mixed-methods studies to develop and test culturally appropriate interventions for reducing stigma associated with OST in Punjab is essential for improving treatment acceptance and adherence.
- **Economic Analysis:** A comprehensive cost-effectiveness analysis of OST implementation in Punjab would inform policy decisions and resource allocation, ensuring the sustainability of these programs.

Additionally, healthcare providers should regularly assess the efficacy of current dosing practices, given our finding of lower average doses (4.11 mg) than WHO recommendations. The frequent visit pattern (average 17.83 visits) suggests a need for resources to support this intensive monitoring approach. Public education campaigns about opioid dependence and OST should be developed, targeting both the general public and potential patients, given the link between higher education and better adherence.

By integrating these practical recommendations with future research directions, we can create a comprehensive, evolving approach to the Opioid substitution therapy (OST) in Punjab. This strategy not only addresses immediate needs but also ensures continuous improvement and adaptation of OST programs. The insights derived from this ongoing research could revolutionize OST programs, ensuring they are not only effective in the short term but also transformative in enhancing the long-term well-being of individuals and communities affected by opioid dependence in Punjab.

Limitations

This study has several limitations that should be considered when interpreting the results:

- **Retrospective Design:** The reliance on medical records may have introduced information bias due to inconsistencies in record-keeping across different OST sites. This could have led to underreporting of certain variables or missing data, potentially affecting the accuracy of our findings, particularly regarding treatment adherence and outcomes.
- **Single-Region Focus:** The study's concentration on Punjab limits the generalizability of findings to other regions of India or globally. The unique socio-cultural and economic factors in Punjab may influence opioid use patterns and treatment responses in ways that are not applicable to other contexts.
- **Cross-sectional Nature:** This design prevents the establishment of causal relationships between demographic factors and treatment outcomes.
- **Potential Selection Bias:** Patients with incomplete records were excluded, which may have skewed the sample towards those with better treatment adherence. This could potentially overestimate the effectiveness of the OST programs and underrepresent challenges faced by less adherent patients.
- **Lack of Control Group:** The absence of a comparison group limits our ability to assess the relative effectiveness of OST compared to other treatment modalities or no treatment. This restricts our capacity to make strong claims about the overall efficacy of OST in the Punjab context.
- **Limited Scope of Data:** Our study focused primarily on demographic and dosage data, potentially missing other important factors influencing OST outcomes, such as comorbid mental health conditions or social support structures.
- **Limited Outcome Measures:** While we assessed treatment adherence, our study lacks data on broader patient outcomes such as quality of life improvements, long-term abstinence rates, or social reintegration success. This limitation restricts our ability to comprehensively evaluate OST effectiveness and identify all potential areas for improvement.

These limitations may affect the interpretation of results by potentially overestimating treatment effectiveness and underrepresenting certain patient subgroups or outcome measures. Future studies should address these limitations by employing prospective designs, including multiple regions, incorporating control groups, using mixed-methods approaches to capture qualitative insights, and assessing a broader range of patient outcomes.

Conclusion

This study provides crucial insights into the landscape of Opioid Substitution Therapy (OST) implementation in Punjab, India, directly addressing our research objectives and offering a comprehensive analysis of demographic factors, treatment patterns, and outcomes in a region severely affected by the opioid crisis.

Addressing our first objective, we identified significant demographic factors influencing opioid use patterns. Our findings highlight the complex interplay between socioeconomic factors, opioid use patterns, and treatment outcomes, underscoring the need for a multifaceted, context- specific approach to OST. Key takeaways include the predominance of natural opioid use, especially among lower-income and older age groups, and the unexpectedly high proportion of employed individuals among patients.

In line with our second objective, we analyzed OST program utilization patterns, revealing unique dosage and treatment frequency trends that diverge from global norms. The average prescribed dose of 4.11 mg and the prevalence of 5-day prescriptions suggest a more intensive, short-term treatment approach compared to international practices, indicating the need for locally tailored approaches.

Addressing our third objective, we identified potential ways to improve OST effectiveness. Our findings call for age- and gender-specific interventions, economically sensitive treatment strategies, and a reevaluation of dosing practices. The high prevalence of patients from joint families opens avenues for innovative family-centered care approaches, while the high employment rate among patients suggests a need for workplace-based interventions.

Our study uniquely contributes to the field by offering a detailed picture of OST in Punjab, identifying specific demographic and socioeconomic factors influencing treatment outcomes, and highlighting the prevalence of natural opioid use. These insights provide a foundation for enhancing OST programs in Punjab and potentially in similar contexts globally.

Looking forward, this research underscores the necessity of a sustained, research-driven approach to combating opioid dependence. Future studies should focus on longitudinal outcomes, family-based interventions, and strategies to overcome identified barriers, as well as addressing the limitations of the current study.

In conclusion, this study represents a significant step towards understanding and effectively addressing the opioid crisis in Punjab. By providing evidence-based insights into the unique characteristics of opioid dependence and OST in this region, our research lays the groundwork for more effective, targeted interventions. Ultimately, the application of these findings has the potential to transform OST programs, improve patient outcomes, and significantly mitigate the impact of the opioid crisis on individuals, families, and communities in Punjab.

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