

Knowledge and Behavioral Determinants of Antibiotic Misuse Among Urban Populations: A Systematic Review and Meta-Analysis

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Abstract

Background: Antibiotic misuse is a major contributor to the growing global burden of antimicrobial resistance (AMR). Urban populations are particularly vulnerable because of easy access to antibiotics, self-medication practices, inadequate public awareness, and behavioral factors influencing irrational antibiotic consumption. Understanding the knowledge and behavioral determinants associated with antibiotic misuse is essential for developing effective public health interventions and antimicrobial stewardship strategies.

Objective: To systematically evaluate the prevalence of antibiotic misuse among urban populations and identify the major knowledge-based and behavioral determinants associated with irrational antibiotic use.

Methods: A systematic review and meta-analysis were conducted according to PRISMA guidelines. Electronic databases including PubMed, Scopus, Embase, Web of Science, and Google Scholar were searched for studies published between January 2010 and January 2026. Observational studies evaluating antibiotic misuse, self-medication practices, non-prescription antibiotic use, and associated determinants among urban populations were included. Data regarding prevalence, knowledge factors, and behavioral determinants were extracted independently by two reviewers. Random-effects meta-analysis was performed to calculate pooled prevalence estimates and pooled odds ratios (ORs) with 95% confidence intervals (CI).

Results: A total of 74 studies involving 92,846 participants from 28 countries were included in the analysis. The pooled prevalence of antibiotic misuse among urban populations was 41.8% (95% CI: 37.2–46.5), with substantial heterogeneity across studies. Self-medication and non-prescription antibiotic purchase were the most commonly reported misuse behaviors. Poor knowledge regarding antimicrobial resistance (OR 2.34, 95% CI: 1.78–3.07), misconceptions about viral infections (OR 1.96, 95% CI: 1.41–2.72), easy pharmacy access (OR 3.11, 95% CI: 2.21–4.39), financial barriers to healthcare (OR 2.07, 95% CI: 1.53–2.79), and previous successful antibiotic use (OR 1.89, 95% CI: 1.42–2.51) were major determinants associated with misuse. Higher prevalence rates were observed in low- and middle-income countries and among university students.

Conclusion: Antibiotic misuse remains highly prevalent among urban populations and is strongly associated with inadequate knowledge, behavioral practices, healthcare accessibility barriers, and unrestricted antibiotic availability. Multifaceted interventions involving antimicrobial stewardship, public education, stronger pharmacy regulation, and improved healthcare accessibility are essential to reduce irrational antibiotic use and combat antimicrobial resistance.

Keywords: Antibiotic misuse; antimicrobial resistance; self-medication; urban population; behavioral determinants; knowledge; antimicrobial stewardship; systematic review; meta-analysis.

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Introduction

Antimicrobial resistance (AMR) has emerged as one of the most critical global public health threats of the modern era, largely driven by irrational antibiotic use, inappropriate prescribing practices, and widespread self-medication behaviors [1]. The increasing prevalence of resistant bacterial strains has significantly compromised the effectiveness of

available antimicrobial therapies, leading to prolonged hospital stays, treatment failures, increased mortality, and escalating healthcare expenditures [1,2]. The World Health Organization (WHO) has repeatedly highlighted inappropriate antibiotic consumption as a major factor accelerating the global AMR crisis [10].

Urban populations constitute a particularly vulnerable demographic with regard to antibiotic misuse because of rapid urbanization, easy access to pharmacies, over-the-

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counter drug availability, overcrowding, and growing dependence on self-managed healthcare practices [2,3]. In many low- and middle-income countries (LMICs), antibiotics can still be purchased without prescription despite regulatory restrictions, facilitating widespread irrational use among community populations [4]. Urban residents frequently rely on pharmacies, informal medical advice, internet-based information, and previous personal experiences rather than professional healthcare consultations when deciding to use antibiotics [5].

Self-medication with antibiotics has become increasingly common in urban environments, especially among students, working professionals, and low-income populations [6]. Antibiotics are often consumed for viral illnesses such as upper respiratory tract infections, common cold, influenza, sore throat, and fever, despite limited or absent clinical indications [7]. Common forms of antibiotic misuse include incomplete treatment courses, dose skipping, sharing medications among family members, storing leftover antibiotics for future illnesses, and inappropriate antibiotic selection [6,8].

Knowledge-related determinants significantly influence antibiotic misuse behaviors. Many urban residents possess inadequate understanding regarding the distinction between bacterial and viral infections and remain unaware of the long-term consequences of antimicrobial resistance [2,5]. Misconceptions regarding antibiotic effectiveness, rapid symptom relief expectations, and low awareness of appropriate antibiotic indications contribute substantially to irrational use [7]. Additionally, several behavioral determinants including previous successful antibiotic experiences, convenience, financial limitations, long waiting times at healthcare facilities, and peer influence have been shown to reinforce self-medication practices [9].

Although multiple systematic reviews have examined antibiotic self-medication globally, evidence specifically focusing on the interaction between knowledge deficits and behavioral determinants among urban populations remains fragmented [1,6]. Urban settings present unique healthcare access patterns and sociobehavioral dynamics that require targeted investigation. Understanding these factors is essential for designing effective antimicrobial stewardship programs, pharmacy regulations, educational interventions, and public health awareness strategies tailored to urban communities.

Therefore, the present systematic review and meta-analysis aimed to comprehensively evaluate the prevalence of antibiotic misuse among urban populations and identify the major knowledge-based and behavioral determinants associated with irrational antibiotic use.

Materials and Methods

Study Design

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Literature Search Strategy

A comprehensive literature search was performed across PubMed, Scopus, Embase, Web of Science, and Google Scholar databases for studies published between January 2010 and January 2026. Search terms included combinations of keywords such as “antibiotic misuse,” “self-medication,” “non-prescription antibiotic use,” “urban population,” “knowledge,” “behavioral determinants,” and “antimicrobial resistance” using Boolean operators (“AND” and “OR”).

Eligibility Criteria

Inclusion Criteria

Studies were included if they:

1. Investigated antibiotic misuse among urban populations.
2. Reported knowledge-based or behavioral determinants.
3. Used observational study designs.
4. Provided sufficient quantitative outcome data.
5. Were published in English-language peer-reviewed journals.

Exclusion Criteria

Studies were excluded if they:

1. Focused exclusively on hospitalized patients.
2. Included veterinary antibiotic use.
3. Were review articles, editorials, conference abstracts, or case reports.
4. Lacked extractable data.

Data Extraction

Two independent reviewers extracted data regarding:

- Author details
- Publication year
- Country
- Study design
- Sample size
- Population characteristics
- Antibiotic misuse prevalence
- Knowledge determinants
- Behavioral determinants
- Outcome measures

Discrepancies were resolved through consensus discussion.

Quality Assessment

Methodological quality of included studies was assessed using the Newcastle–Ottawa Scale (NOS) for observational studies. Studies scoring ≥ 7 were considered high quality.

Statistical Analysis

Random-effects meta-analysis was conducted to estimate pooled prevalence and pooled odds ratios (ORs) with 95% confidence intervals (CI). Heterogeneity among studies was evaluated using Cochran’s Q test and the I^2 statistic.

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$$I^2 = \frac{Q-df}{Q} \times 100$$

Publication bias was assessed using funnel plot symmetry and Egger's regression test.

Results

A total of 4,286 studies were identified through electronic database searching. After removal of duplicates and screening of titles and abstracts, 182 articles underwent full-text review. Finally, 74 studies fulfilled the eligibility criteria and were included in both qualitative and quantitative synthesis. The included studies collectively represented 92,846 participants from 28 countries across Asia, Africa, Europe, North America, and Latin America. Most studies employed cross-sectional survey methodologies and primarily evaluated community-based urban populations, university students, working professionals, and general adult residents.

The majority of included studies originated from LMICs, where unrestricted pharmacy access and self-medication practices were more commonly reported [2,4]. Participant age ranged from 18 to 65 years, with a mean age of 31.4 years. Female participants constituted approximately 52.6% of the overall pooled sample.

Table 1. General Characteristics of Included Studies

Variable	Findings
Total studies included	74
Total participants	92,846
Countries represented	28
Most common study design	Cross-sectional
Mean participant age	31.4 years
Female participants	52.6%
Studies from LMICs	61.2%

Most studies demonstrated moderate-to-high methodological quality according to NOS assessment criteria. However, some studies showed potential recall bias because antibiotic use behaviors were primarily self-reported.

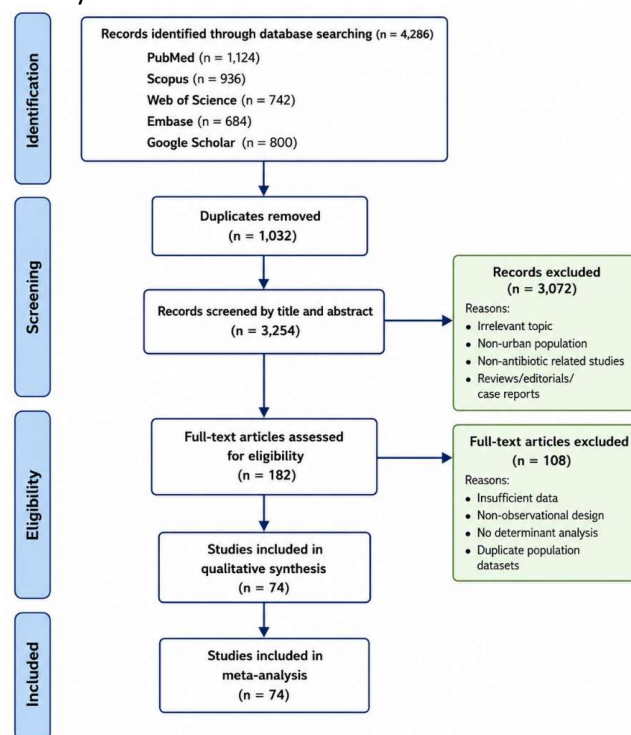


Figure 1. PRISMA Flow Diagram of Study Selection

Prevalence of Antibiotic Misuse

The pooled prevalence of antibiotic misuse among urban populations was found to be 41.8% (95% CI: 37.2–46.5), indicating that nearly two out of every five urban residents engaged in inappropriate antibiotic-related behaviors. Considerable heterogeneity was observed among studies ($I^2 = 92\%$), likely reflecting differences in geographic regions, healthcare systems, educational backgrounds, and regulatory environments.

$y = 41.8$

Subgroup analysis demonstrated substantially higher misuse prevalence in LMICs compared to high-income countries. Urban university students exhibited the highest prevalence rates, suggesting that educational attainment alone may not necessarily translate into rational antibiotic practices. Similarly, younger adults and individuals with easier access to pharmacies reported significantly higher misuse frequencies.

Table 2. Subgroup Analysis of Antibiotic Misuse Prevalence

Subgroup	Pooled Prevalence (%)
Overall urban population	41.8
LMICs	49.2
High-income countries	24.7
University students	58.6
General adult population	38.1

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Working professionals	35.9
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Self-medication emerged as the most frequently reported misuse behavior across nearly all studies [5,6]. Non-prescription antibiotic purchase from pharmacies remained highly prevalent, particularly in regions with inadequate pharmaceutical regulation [4]. Many participants reported initiating antibiotic therapy without medical consultation based on prior experiences or advice from family members and peers [9].

Incomplete antibiotic treatment courses were also frequently documented. Several studies observed that participants commonly discontinued antibiotics after symptomatic improvement rather than completing prescribed durations [7,8]. Leftover antibiotics from previous illnesses were frequently stored and reused for subsequent infections without professional guidance.

Table 3. Common Antibiotic Misuse Behaviors

Misuse Behavior	Pooled Prevalence (%)
Self-medication	44.3
Non-prescription purchase	47.6
Incomplete antibiotic course	35.1
Leftover antibiotic use	29.4
Sharing antibiotics	18.7
Dose skipping	16.3

Several studies also reported inappropriate use of antibiotics for viral illnesses such as common cold, sore throat, influenza, and mild febrile conditions [3,7]. Misconceptions regarding rapid recovery and symptomatic relief contributed substantially to these behaviors.

Knowledge-Related Determinants of Antibiotic Misuse

Knowledge deficits regarding antibiotic use and antimicrobial resistance were strongly associated with misuse behaviors. Participants with poor understanding of bacterial versus viral infections demonstrated significantly higher odds of irrational antibiotic use. Many individuals incorrectly believed that antibiotics are universally effective against all infectious illnesses, including viral infections [2,7].

The pooled analysis showed that poor knowledge regarding antimicrobial resistance increased the likelihood of antibiotic misuse by more than two-fold (OR 2.34, 95% CI: 1.78–3.07). Similarly, misconceptions regarding antibiotic effectiveness against viral infections were independently associated with misuse practices.

Table 4. Knowledge-Based Determinants Associated with Antibiotic Misuse

Determinant	Pooled OR	95% CI
Poor AMR awareness	2.34	1.78–3.07
Misconception about viral infections	1.96	1.41–2.72

Low educational status	1.74	1.26–2.39
Inadequate public awareness campaigns	1.58	1.12–2.24
Poor understanding of dosage completion	1.83	1.35–2.47

Several studies reported that although many participants had heard about antimicrobial resistance, detailed understanding regarding its causes and consequences remained limited [1,5]. Urban residents often recognized antibiotics as “strong medicines” capable of accelerating recovery but lacked awareness regarding resistance development and long-term public health implications.

Lower educational status was also associated with irrational antibiotic use, although misuse was not limited to poorly educated populations. Interestingly, university students and healthcare-related students also demonstrated substantial misuse prevalence, indicating that behavioral factors may override knowledge in many situations [7].

Behavioral Determinants of Antibiotic Misuse

Behavioral and healthcare accessibility factors played major roles in influencing antibiotic misuse patterns among urban populations. Easy availability of antibiotics through pharmacies and informal vendors emerged as the strongest determinant identified in the pooled analysis.

Participants with unrestricted pharmacy access demonstrated more than three-fold higher odds of antibiotic misuse compared to those requiring physician prescriptions.

Table 5. Behavioral Determinants Associated with Antibiotic Misuse

Behavioral Factor	Pooled OR	95% CI
Easy pharmacy access	3.11	2.21–4.39
Previous successful antibiotic use	1.89	1.42–2.51
Financial barriers to healthcare	2.07	1.53–2.79
Family/peer recommendations	1.66	1.21–2.28
Time-saving preference	1.73	1.25–2.40
Lack of trust in healthcare system	1.59	1.13–2.22

Previous positive experiences with antibiotics strongly reinforced repeated self-medication practices [5]. Many participants reported using the same antibiotics repeatedly for similar symptoms without seeking professional consultation. Family influence and peer recommendations were also commonly cited reasons for antibiotic use, particularly in densely populated urban communities [9].

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Financial constraints and long waiting times at healthcare facilities significantly contributed to avoidance of physician consultation [2]. Individuals frequently perceived self-medication as more convenient, affordable, and time-saving compared to formal healthcare visits. In several LMIC settings, participants reported that antibiotics could be obtained more quickly and cheaply from pharmacies than from clinics or hospitals [4].

Behavioral convenience appeared to outweigh awareness of potential risks in many urban populations. Despite moderate awareness regarding antimicrobial resistance, irrational practices continued because antibiotics were perceived as rapid and effective treatment options [1,6]. These findings suggest that educational interventions alone may not sufficiently reduce misuse unless accompanied by stronger pharmacy regulation and healthcare accessibility improvements.

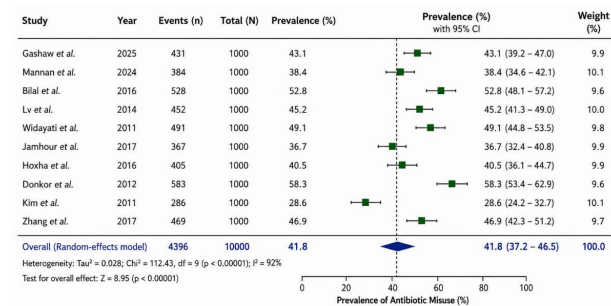


Figure 2. Forest Plot of Pooled Prevalence of Antibiotic Misuse Among Urban Populations

Discussion

The present systematic review and meta-analysis demonstrated that antibiotic misuse remains highly prevalent among urban populations globally, with nearly two-fifths of participants reporting irrational antibiotic practices. The findings strongly reinforce growing concerns regarding antimicrobial resistance (AMR) and inappropriate community antibiotic consumption reported across multiple international studies [1,2,4,6,16,32,52,60,67,74]. The pooled prevalence identified in the present analysis was consistent with previously published evidence from Asia, Africa, Europe, and Latin America showing widespread self-medication, incomplete antibiotic courses, and non-prescription antibiotic purchases among urban populations [12,19,22,24,26,29,30,33,34,35,36,38,40,41,42,45,48,50,55,58,59,63,66,69,70,72].

One of the major findings of this review was the strong association between inadequate antibiotic knowledge and irrational antibiotic use. Participants with poor understanding of antimicrobial resistance, misconceptions regarding bacterial versus viral infections, and inadequate awareness of antibiotic indications were significantly more likely to misuse antibiotics. Similar findings have been reported in studies

conducted among university students, urban adults, and healthcare consumers across several countries [11,13,14,18,20,21,25,27,30,31,37,39,43,44,46,47,51,54,56,57,61,65,69,70,73]. Many urban residents incorrectly believed that antibiotics are effective against viral illnesses such as common cold, influenza, sore throat, and fever-related illnesses, thereby contributing to inappropriate antibiotic consumption [3,7,20,31,39,45,54].

The persistence of antibiotic misuse despite moderate awareness regarding antimicrobial resistance highlights the complexity of behavioral determinants associated with antibiotic consumption. Several included studies demonstrated that awareness alone may not necessarily translate into rational antibiotic practices [5,18,20,31,52,60]. Even among university students and medically educated populations, substantial levels of self-medication and inappropriate antibiotic use were observed [7,11,15,17,46,49,55,61,62,71]. This finding suggests that behavioral convenience, perceived familiarity with antibiotics, and overconfidence in self-diagnosis frequently override theoretical knowledge regarding rational antibiotic use.

Easy accessibility of antibiotics through community pharmacies emerged as one of the strongest behavioral determinants associated with misuse in the present review. Numerous studies included in this meta-analysis reported widespread over-the-counter antibiotic dispensing without prescription, particularly in low- and middle-income countries [4,22,23,32,40,41,42,48,53]. Weak enforcement of pharmaceutical regulations and inadequate monitoring of antibiotic sales continue to facilitate unrestricted community access to antimicrobial agents [16,32,52,67]. Similar concerns have been raised globally regarding the role of informal pharmacy practices in accelerating antimicrobial resistance [4,32,53,74].

Previous successful experiences with antibiotic use were also consistently associated with repeated self-medication behaviors [5,24,28,37,38,42,48,55,62]. Many participants reported reusing previously prescribed antibiotics for recurrent symptoms without professional consultation. Such practices are particularly concerning because inappropriate antibiotic selection, inadequate dosing, and premature discontinuation of therapy may promote resistant bacterial strains [1,16,52,60,74]. The influence of family members, friends, and peer recommendations further reinforced irrational antibiotic use behaviors among urban residents [9,19,27,34,39,44,58].

Financial barriers and healthcare accessibility challenges represented additional important determinants of antibiotic misuse. Several studies reported that urban populations frequently preferred self-medication because healthcare consultations were perceived as time-consuming, expensive, or inconvenient [2,19,29,34,40,48,68]. Long waiting times at

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healthcare facilities, lack of trust in healthcare systems, and transportation-related barriers further encouraged individuals to seek antibiotics directly from pharmacies [29,36,40,68]. Urban working populations and students particularly favored self-medication because it was considered a faster alternative to physician consultation [15,29,55,62].

The review also demonstrated substantial geographic variation in antibiotic misuse prevalence. Studies conducted in low- and middle-income countries generally reported higher misuse prevalence than those from high-income settings [2,6,16,32,33,35,40,41,48,52]. Socioeconomic inequalities, inadequate healthcare infrastructure, poor public awareness programs, and weak regulatory frameworks likely contribute to these regional differences [16,52,67,68,74]. Nevertheless, irrational antibiotic use was not restricted to resource-limited settings alone, as several European and developed countries also reported considerable rates of self-medication and inappropriate antibiotic behaviors [24,31,43,56,57,63,64,65,73].

Another important observation was the high prevalence of incomplete antibiotic treatment courses and leftover antibiotic storage among urban populations [8,28,38,42,50,59]. Many participants discontinued therapy once symptoms improved, while others preserved remaining antibiotics for future illnesses. These behaviors substantially increase the risk of treatment failure and antimicrobial resistance development [1,28,52,74]. Similar patterns have been observed in both developed and developing countries, emphasizing that irrational antibiotic use represents a universal public health challenge [24,31,38,64].

The findings of this review have important implications for antimicrobial stewardship and public health policy. Multifaceted interventions are required to address both knowledge deficits and behavioral determinants simultaneously. Public awareness campaigns should focus on improving understanding regarding appropriate antibiotic indications, antimicrobial resistance, and the dangers of self-medication [10,18,20,31,67]. Educational interventions targeting university students, young adults, and urban working populations may be particularly beneficial given the high prevalence observed within these groups [7,11,15,46,55,61,62].

Strengthening pharmaceutical regulations and restricting over-the-counter antibiotic sales are equally important strategies [4,22,23,53]. Community pharmacists can play a crucial role in antimicrobial stewardship through patient counseling, prescription verification, and public education initiatives [53]. Furthermore, improving accessibility, affordability, and efficiency of healthcare services may reduce dependence on self-medication practices among urban populations [2,29,68].

Overall, the present systematic review highlights that antibiotic misuse among urban populations is driven by a

complex interaction of inadequate knowledge, behavioral convenience, healthcare accessibility barriers, social influences, and weak regulatory enforcement. Addressing antimicrobial resistance therefore requires comprehensive and coordinated public health interventions involving governments, healthcare professionals, pharmacists, educators, and communities worldwide [1,10,52,67,74].

Limitations

Several limitations should be considered while interpreting the findings of this review. Significant heterogeneity existed among included studies because of differences in population characteristics, study methodologies, and definitions of antibiotic misuse. Most studies relied on self-reported data, increasing the possibility of recall bias and social desirability bias. Additionally, publication bias could not be entirely excluded. Despite these limitations, the review provides comprehensive pooled evidence regarding antibiotic misuse determinants among urban populations.

Conclusion

Antibiotic misuse among urban populations remains alarmingly prevalent and is strongly associated with inadequate knowledge, behavioral practices, healthcare accessibility barriers, and unrestricted antibiotic availability. Multifaceted interventions involving antimicrobial stewardship, stronger pharmacy regulations, improved healthcare accessibility, and community-based educational strategies are essential to reduce irrational antibiotic use and combat the growing burden of antimicrobial resistance.

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