Exploring predictors of antibiotic self-medication among healthcare workers: A health belief model perspective

Abstract

Background: This study aimed to examine the determinants of antibiotic self-medication (ASM) behavior among health workers using the Health Belief Model (HBM) in 2024. **Methods:** A cross-sectional study design was employed, and data were collected from 146 health workers in the southern region of Tehran. A standardized questionnaire based on the HBM was used to gather demographic information and evaluate HBM constructs related to self-medication practices. Data analysis included descriptive statistics, t-tests, ANOVA, correlation analysis, and linear regression. **Results:** The majority of participants were female (90%), with a mean age of 37.78 years. The average score for ASM behavior was 86.04%. Notably, women demonstrated a higher behavior score than men, and having health insurance was associated with an increased behavior score. Significant associations were found between education level, age, number of children, and self-medication behavior. Linear regression analysis indicated that all HBM constructs—knowledge, perceived susceptibility, severity, benefits, barriers, and self-efficacy—influenced appropriate antibiotic consumption behavior, with knowledge exhibiting the strongest effect. **Conclusion:** This study identified knowledge, self-efficacy, perceived susceptibility, severity, benefits, and barriers as key predictors of ASM behavior among health workers. The findings highlight the need for targeted educational initiatives to raise awareness about the harmful consequences of self-medication and promote rational drug use. Designing interventions that address gender disparities and take into account age and education levels may be instrumental in reducing self-medication practices within this professional group.

Key words: Antibiotics, Self-medication, Health Belief Model, Behavioral science

Introduction

The arbitrary use of antibiotics, particularly through self-medication, is a widespread and concerning issue. It is often the initial response to the onset of disease symptoms [1]. This practice is common not only in Iran but also in many other countries and has become a major challenge in the treatment process. The indiscriminate use of antibiotics in self-medication has led to numerous adverse consequences, including bacterial resistance, suboptimal treatment outcomes, unintentional poisonings, adverse drug reactions, disruptions in pharmaceutical markets, financial waste, and increased per capita healthcare costs [2]. The rising prevalence of ASM has emerged as a global health concern, impacting the economic, social, and political fabric of societies [3]. Addressing this complex challenge requires coordinated efforts to reduce the harmful effects of arbitrary antibiotic use in self-medication, thereby safeguarding both individual and public health.

In Iran, self-medication is highly prevalent, with rates nearly three times higher than the global average. This places Iran among the top 20 consumers of pharmaceuticals worldwide, despite its smaller population compared to countries such as India, Bangladesh, and Pakistan. Notably, Iran ranks second in Asia, following only China [4]. Self-medication is also common in the United States, where 42% of the population engages in this practice. Such behavior can result in ineffective disease management, financial losses, and adverse medical effects [5]. In recent years, Iran has witnessed a marked rise in self-medication, with an alarming 83.3% of the population reportedly engaging in this behavior [6]. The ongoing COVID-19 pandemic has further exacerbated this trend, contributing to an increase in self-medication rates. Alarmingly, the use of non-narcotic painkillers has led to a rise in poisoning cases, increasing from approximately 15% in the previous year to 17% in the first five months of the current year, according to the Health Products Monitoring Office of the Food and Drug Organization [7]. These findings underscore the urgent need to address and curb the growing prevalence of self-medication, particularly in light of the challenges posed by the global health crisis. Comprehensive interventions are essential to mitigate the associated risks and consequences.

Extensive research indicates that self-medication is widespread and commonly involves the use of painkillers, antibiotics, and herbal medicines [8]. Although this phenomenon is observed globally, regional differences exist. For instance, in South America, 7.4% of self-medication cases involve antibiotics [9], whereas in Spain, the rate of ASM is 19.9% [10]. Notably, in Iran, the self-medication of infusible drugs is reported to be four times higher than the global average on an annual basis [11]. Multiple factors contribute to self-medication, including legal restrictions, public attitudes and beliefs, and individuals' levels of knowledge [12]. Importantly, the lack of awareness regarding proper antibiotic use—combined with the unrestricted sale of medications by certain pharmacies—has significantly exacerbated these societal challenges. Consequently, this issue has led to substantial human and economic costs [13]. It is essential to identify and address these contributing factors in order to develop effective interventions aimed at mitigating the adverse effects of widespread self-medication, particularly with antibiotics and infusible drugs.

The overuse of antibiotics has led to antibiotic resistance becoming a major global health concern. The seriousness of this issue was acknowledged on World Health Day in 2011, when the World Health Organization introduced a six-part policy package to combat antimicrobial resistance. This initiative underscored the urgent need to address the problem and implement effective measures across diverse populations [14]. The growing threat of antibiotic resistance necessitates sustained global efforts to preserve the effectiveness of these critical medications and safeguard public health.

To mitigate the risks associated with antibiotic overuse or misuse, it is essential to explore appropriate antibiotic usage practices and develop a comprehensive understanding of antibiotic prescription and consumption. Health education and promotion models, such as the HBM, serve as invaluable tools in this regard. The HBM posits that individuals must perceive a health threat before adopting health-promoting behaviors. Originally developed to investigate the reasons behind inadequate attention to health issues and to understand the behavior of individuals who believe they are unlikely to become ill, the HBM functions as a comprehensive psychological model with a pivotal role in disease prevention. It focuses on individuals' attitudes and beliefs, offering a framework to examine the psychological factors that influence decision-making. By emphasizing potential changes in attitudes and beliefs, the HBM facilitates an exploration of the complex relationship between cognitive factors and resultant behaviors. Numerous studies have demonstrated the model's effectiveness in predicting individuals' acceptance or rejection of various health behaviors [15]. The HBM serves as a valuable guide in designing interventions aimed at promoting appropriate antibiotic use, thereby contributing to the prevention of misuse and the protection of public health.

The primary objective of this study is to investigate the predictors of ASM behavior in 2024, using the HBM. This research seeks to understand the factors that influence such behavior, given the complexities and risks associated with ASM. By employing the HBM as a theoretical framework, the study aims to uncover the beliefs, perceptions, and cognitive factors that contribute to self-medication practices. Through a comprehensive examination of these predictors, the goal is to deepen our understanding of the underlying mechanisms driving self-medication behavior and to inform targeted interventions aimed at reducing the misuse of antibiotics.

Material and Methods

Study Design

The research methodology employed in this study utilizes a cross-sectional design to investigate the predictors of antibiotic self-administration, using the HBM as the conceptual framework. Data collection occurred in 2024 and involved a cohort of 146 health workers affiliated with healthcare centers located in the southern region of Tehran.

Sample Size and Sampling Method

The required sample size was determined in consultation with a statistician using the formula $n = (Nt^2PQ) / (Nd^2 + t^2PQ)$, where n represents the required sample size, N denotes the population size, t corresponds to the desired level of confidence, d represents the desired margin of error, and P and Q represent the estimated proportions of the population. With a confidence level of 95% (t = 1.96) and a desired margin of error of 6% (d = 0.06), the estimated sample size was calculated to be 146 participants. After data collection, questionnaires with incomplete responses were excluded and

replaced with new participants. Therefore, no data loss occurred, and the final analyzed sample consisted of 146 participants.

The study employed a meticulous participant selection process, utilizing a combination of proportional stratified and systematic random sampling methods. Initially, a comprehensive list of health centers and their employees was compiled and organized by municipal areas. Subsequently, a stratified sampling technique, proportional to the predetermined sample size, was applied to determine the required number of participants from each health center and its subordinate bases. This proportional allocation was based on the number of health staff at each location. To ensure a representative distribution, the final sample selection was conducted using systematic sampling, guaranteeing equitable and unbiased representation across the sampled health centers and their subordinate bases.

Inclusion and Exclusion Criteria

In defining the parameters for participant inclusion, the study adhered to specific criteria. To be eligible, individuals were required to be employees actively engaged in healthcare centers within the South Tehran Health Center. Additionally, participants had to provide informed consent, thereby ensuring voluntary participation in the study. It is noteworthy that individuals with incomplete questionnaires were excluded from the subsequent analysis, underscoring the importance of data completeness in maintaining the integrity and validity of the research findings.

Data Collection Instrument

The data collection instrument used in this study was a standardized questionnaire developed by Shamsi et al. (2015) [16], specifically designed to assess self-medication practices. The questionnaire consisted of two main sections: the first collected demographic information from participants, while the second elicited responses related to the constructs of the HBM.

The demographic section of the questionnaire included ten questions addressing gender, age, level of education, occupation, marital status, spouse's education level, spouse's occupation, and average family income. Correspondingly, the section on HBM constructs comprised 50 questions aimed at exploring various dimensions of the model. These included: awareness of the side effects of self-medication with antibiotics (7 questions with 4 response options); perceived susceptibility to self-medication with antibiotics (5 questions); perceived severity of self-medication with antibiotics (4 questions); perceived benefits of self-medication with antibiotics (4 questions); perceived barriers to self-medication with antibiotics (5 questions); and self-efficacy regarding self-medication with antibiotics (6 questions).

The questionnaire employed a 5-point Likert scale, with responses ranging from "strongly agree" to "strongly disagree," as the metric for assessing participants' perspectives. The behavioral component of the questionnaire comprised seven questions designed to evaluate individuals' self-medication practices with antibiotics over the preceding two months.

Scoring of the questionnaire was conducted as follows:

In the knowledge section, correct responses were awarded 1 point, while incorrect answers received 0 points. In contrast, the perceived susceptibility, severity, benefits, and barriers sections utilized a 5-point scale, with "completely disagree" assigned 1 point and "completely agree" assigned 5 points. The cumulative score for each construct was then calculated on a scale ranging from 1 to 100, providing an aggregate measure of participants' perceptions. Notably, some questions within these sections were reverse-scored to account for nuanced responses. The validity and reliability of the questionnaire were previously established in a study by Shamsi et al. [16], and the same validated instrument was employed by Movahed in a related study [17].

Data Analysis

In this study, SPSS version 18 was used for data analysis. Descriptive statistics—including mean, standard deviation, and frequency distribution—were employed to summarize demographic characteristics and questionnaire responses. The Kolmogorov-Smirnov test was conducted to assess the normality of data distribution. Independent-samples t-tests were used to compare mean scores between two groups, while ANOVA was applied to examine differences among more than two groups. Pearson's correlation coefficient was utilized to explore associations between variables, providing valuable insights. Linear regression analysis quantified the impact of each HBM construct on appropriate antibiotic consumption behavior, offering a nuanced understanding of their individual contributions. The significance level for all statistical tests was set at 0.05, ensuring rigorous interpretation of results.

Results

Among the 146 participants, a substantial majority—132 individuals, comprising approximately 90%—were female. The average age of participants was 37.78 ± 8.6 years, and the majority (71.5%) were married. Regarding educational attainment, the distribution was diverse: 7.5% (n = 11) held a diploma, approximately 13% (n = 19) had an associate degree, around 60% (n = 88) held a bachelor's degree, about 16% (n = 23) had a master's degree, and approximately 3% (n = 5) possessed a Ph.D. (see Table 1).

Table 1. Frequency distribution of demographic variables

Variable	Group	f.	%	Variable	Group	f.	%
Sex	Male	132	90.4	Age	<30 years	30	20.7
	Female	14	9.6		30-40 years	51	35.2
Marital status	Single	41	28.5		40-50 years	46	31.7
	Married	103	71.5		>50 years	18	12.4
Education	Diploma	11	7.5	Monthly income	≥5 million	31	21.2
	Associate degree	19	13		6-10 million	63	43.2
	Bachelor's degree	88	60.3		> 10 million	38	26
	Master's degree	23	15.8	Number of children	0	70	47.9
	Ph.D.	5	3.4		1 child	40	27.4
Spouse's education	Diploma	34	23.3		2 children	32	21.9
	Associate degree	10	6.8		3 children	4	2.7
	Bachelor's degree	38	26	Medical insurance coverage	yes	128	89.5
	Master's degree	18	12.3		no	15	10.5
	Ph.D.	10	6.8	Type of insurance	Social organization	109	82
Spouse's occupation	Employed	53	36.3		medical	24	18
	Freelance	78	53.4				

The findings of the study revealed that the perceived benefits construct received the highest average score among participants, amounting to 88%. This indicates a generally favorable perception among respondents regarding the benefits associated with self-medication with antibiotics. Additionally, the mean score for the behavior construct was 86.04%, suggesting that a substantial majority—approximately 86.04% of respondents—did not engage in self-medication with antibiotics. This observation highlights a notable trend of responsible antibiotic use among the study participants, as reflected in the behavioral component assessed by the questionnaire (see Table 2).

Table 2. Mean and standard deviation of HBM constructs in the research participants

Construct	Mean ± SD
Knowledge	50.57 ±1.48
Perceived susceptibility	81.36±4.45
Perceived severity	70.05±2.22
Perceived benefits	88±2.21
Perceived barriers	53.92±4.64
Self-efficacy	82.9±3.53
Behavior	86.4±1.96

The t-test results revealed a statistically significant gender difference in ASM behavior (p = 0.035). Women exhibited higher scores, suggesting a lower prevalence of ASM compared to men. Conversely, no significant difference was observed between single and married individuals (p = 0.764), indicating similar behaviors across both groups. Additionally, a significant association was identified between behavior scores and type of insurance coverage. Employees with health insurance demonstrated greater adherence to appropriate antibiotic use, avoiding self-medication (p = 0.013). These findings, summarized in Table 3, underscore the influence of gender and insurance coverage on ASM practices among participants.

Table 3. Comparison of the difference between gender and marital status and antibiotics self-medication behavior

Variable	Group	n.	mean	SD	t	P-Value
Sex	Female	130	26.15	2.51	1.654	0.035
	Male	30	23.01	1.91		
Marital status	Single	39	24.02	2.08	0.325	0.764
	Married	103	24.14	1.91		
Medical insurance coverage	yes	126	24.03	2.01	0.784	0.443
	No	15	24.40	1.63		
Type of insurance coverage	Social organization	113	23.86	2.06	2.508	0.013
	Medical insurance	28	24.89	1.25		

Analysis of ASM behavior across education levels revealed a significant difference. Participants with a Ph.D. exhibited higher scores compared to others (p = 0.039), indicating a decline in self-medication with increasing educational attainment. In contrast, no significant association was found between spouses' education levels and self-medication behavior scores (p = 0.191), suggesting that the education level of participants' spouses did not significantly influence ASM behavior, as detailed in Table 4.

Table 4. Comparison of the difference between participants' education, spouse's education and self-medication behavior

Variable	Group	f.	Mean	SD	F	P-Value
Education	Diploma	11	24.18	1.16	1.832	0.039
	Associate degree	19	23.63	2.06		
	Bachelor's degree	86	24.15	1.93		
	Master's degree	22	24.22	2.34		
	Ph.D.	5	24	2.23		
Spouse's education	Diploma	34	23.82	1.99	1.560	0.191
	Associate degree	10	24.20	1.39		
	Bachelor's degree	38	23.68	2.10		
	Master's degree	18	24.94	1.76		
	Ph.D.	9	24.55	1.94		

Pearson's correlation analysis revealed a significant relationship between age and ASM behavior scores (p = 0.021). As age increased, behavior scores also increased, indicating a reduction in self-medication. Similarly, a positive correlation was found between the number of children and behavior scores (p = 0.008), suggesting more appropriate antibiotic use with a higher number of children. However, no significant correlation was observed between self-medication behavior scores and average monthly family income (p = 0.847), indicating that income levels did not significantly influence ASM behavior.

Regression analysis was conducted to assess the impact of HBM constructs on antibiotic consumption behavior. The R-value of 0.559 indicated a moderately strong correlation, while the R-square value, representing the proportion of explained variance, showed that the HBM constructs collectively accounted for approximately 31% of the variation in correct antibiotic consumption behavior. This notable R-square underscores the considerable explanatory power of the HBM constructs in

identifying the factors influencing participants' antibiotic consumption behavior, as detailed in the regression analysis.

Study findings revealed that among the HBM constructs, knowledge had the most substantial effect (0.261) on correct antibiotic consumption behavior, highlighting its paramount importance. In contrast, perceived severity exhibited the least effect (0.051) on this behavior. Self-efficacy (0.144), perceived susceptibility (0.117), perceived barriers (0.074), and perceived benefits (0.056) were also identified as influential factors in shaping the adoption of correct antibiotic consumption practices. This comprehensive analysis indicates that all HBM constructs contribute to promoting appropriate antibiotic use, as summarized in Table 5.

Table 5. Factors affecting the correct behavior of consuming antibiotics

Variable	Unstandardized Coefficients		Standardized Coefficients	t	P-Value
	B	Std. Error	Beta		
Knowledge	0.261	0.104	0.193	2.509	0.013
Perceived susceptibility	0.117	0.043	0.263	2.703	0.008
Perceived severity	0.051	0.074	0.056	1.688	0.043
Perceived benefits	0.056	0.078	0.061	0.710	0.047
Perceived barriers	0.074	0.040	0. 169	1.830	0.007
Self-efficacy	0.144	0.054	0.255	2.645	0.009

Discussion

This research aimed to investigate determinants of ASM among South Tehran Health Center employees in 2024, guided by the HBM. The participant pool included 146 individuals from these health centers. Findings revealed an average knowledge level of 50.57% regarding antibiotic side effects. Influential contributors to behavioral intention in ASM included elevated knowledge, heightened self-efficacy, increased perceived susceptibility and severity, augmented perceived benefits, and reduced perceived barriers. These findings reveal the complex interplay of cognitive and perceptual factors influencing individuals' intentions for self-medication with antibiotics. The observed lack of public knowledge highlights a crucial need for strategic interventions. Targeted educational initiatives, incorporating awareness raising, attitude cultivation, and prudent practices, are essential. Diverse implementation strategies, utilizing various educational methods, are necessary to effectively reach the audience. Additionally, advocating for dedicated radio and television programs can serve as powerful platforms to emphasize the adverse societal impacts of self-medication.

The study revealed a 14% prevalence of ASM, with 86% exhibiting correct consumption behavior. These figures serve as a benchmark for assessing patterns. Comparative international studies show variations, e.g., South America reported 7.4%, and Spain documented 19.9%. These comparisons highlight diversity in self-medication practices, emphasizing contextual factors' influence [9, 10].

The study revealed a higher prevalence of antibiotics self-medication among men compared to women, consistent with findings from Hajjar's 2014 research. Specifically, male participants displayed a 33% higher rate, constituting 11.6% of the male population [18]. This gender disparity may be attributed to women's tendency to exhibit greater attentiveness to their health compared to men.

The study found an inverse relationship between participants' age and the number of children with antibiotics self-medication behavior, resulting in a decrease. This contrasts with Namdar et al.'s study, which showed a positive correlation between age, education, and self-medication behavior [19]. Afshary reported a 67.1% self-medication rate, decreasing with age, while higher education levels increased self-administration [20]. Varpaei et al. found self-medication more prevalent among men, married individuals, those with lower education levels, and freelancers. Interestingly, individuals

with a master's or Ph.D. exhibited a lower self-medication rate [21]. Heydarifar et al. demonstrated an inverse correlation between family education level and self-medication rate [22]. Another study by Heydarifar et al. found 55.6% self-medication in Qom, with variations across different demographic and educational strata [22].

Regarding knowledge as a pivotal determinant, the findings emphasize its substantial impact on correct antibiotic consumption patterns. Women exhibited higher knowledge levels than men, in contrast to Varpaei et al.'s study reporting lower levels in women [21]. Higher education, advanced age, and more children were associated with elevated knowledge scores. Consistent with these observations, Sahibi et al. (2016) identified factors influencing knowledge, including education level, occupation, and marital status [23]. Heydarifar et al.'s study highlighted that knowledge, coupled with high self-efficacy, perceived susceptibility, severity, benefits, and low perceived barriers, collectively enhances behavioral intention [22]. These insights underscore the multifaceted nature of knowledge determinants, influenced by gender, education, and other demographic factors, in shaping individuals' antibiotic consumption behaviors.

Perceived benefits, the highest-rated HBM construct, displayed notable variations across demographics. Women reported higher scores than men, and differences were observed in education, age, and the number of children. Marital status and income did not exhibit statistically significant differences. These findings highlight the nuanced influences of demographic factors on individuals' perceptions of antibiotic consumption benefits, offering insights for targeted health interventions and educational strategies.

Self-efficacy, the second influential construct against ASM, reflects an individual's belief in their capability to perform specific behaviors. Women showed higher self-efficacy scores than men, with significant differences based on education, age, number of children, and the self-efficacy construct score. These findings emphasize the relevance of self-efficacy in shaping behaviors and stress the importance of considering demographic factors in interventions aimed at discouraging ASM [23].

Primary motivations for self-medication, such as the availability of medicines, high doctor visit costs, limited medical access, delayed seeking of medical attention, and lack of round-the-clock doctor access, align with previous research. Tajik et al. (2011) identified causes like perceiving diseases as unimportant, and lack of medical insurance [24]. Alipour et al. (2013) highlighted low perceived necessity of consulting a doctor during illness as a cause of ASM [25]. Jalilian et al. (2010) reported reasons including prior medication use and symptom improvement [4]. In Hosseinzadeh and Azimian's research (2015), widespread antibiotic availability was the most common reason [26]. Mirdoosti et al. (2013) identified past experiences and easy drug accessibility as key causes, emphasizing the resistance to self-medication as a preventive factor [27]. These consistent findings underscore multifaceted determinants of self-medication practices, providing insights for targeted interventions.

Conclusion

The study revealed a 14% self-medication prevalence, relatively low globally. Factors like knowledge, self-efficacy, perceived susceptibility, severity, benefits, and barriers influenced correct antibiotic consumption behavior. The study emphasized addressing inadequate knowledge through targeted educational programs to enhance awareness and advocate rational drug use. Dissemination through diverse channels, including radio and television, can reach a broader audience. This study contributes valuable insights for healthcare professionals, policymakers, and public health authorities, offering a foundation for tailored interventions to advocate responsible antibiotic use, potentially reducing antibiotic resistance, improving treatment outcomes, and enhancing public health.

Limitations

The study sample consisted of health workers affiliated with healthcare centers in the south of Tehran, which may limit the generalizability of the findings to other populations.