



Research Article



Pattern of Self-medication and Associated Factors: A Study in Islamabad, Pakistan

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Abstract

The main objective was to identify the pattern of self-medication (use of medicinal products without prescription) and its associated socio-demographic factors (income, geographical area, gender, education level, e.t.c.) A cross-sectional study was carried out on a sample of 40 participants. Multi-stage sampling technique was used and sample was selected from 5 sectors and 5 sub-areas of the city. Univariate analysis was conducted for descriptive statistics. Two bivariate regression models were used. Self-medication and its relation to COVID-19 was also analysed. Most common symptoms for which self-medication was practised included headaches and migraines (27.27%) Results were analysed through SPSS version 26. Prevalence of self-medication behaviours in Islamabad was estimated to be 70%. Knowledge, perceptions and attitudes related to self-medication were also analysed. People who reported self-medication behaviours often receive information through internet and social media. Self medication rate is more prevalent in women, persons who are married, and in people with existing co-morbid conditions.

Key Words

Self-medication, COVID-19, Antibiotic Resistance, Adverse Drug Reactions, Over-the-counter medications

Introduction

Self-medication can be understood as a practice of using drugs or other medicinal products for the treatment of self-identified symptoms without consultation and prescription of a healthcare practitioner. According to WHO, it can be defined as, 'The use of medicinal products to treat self-diagnosed disorders or symptoms, or the intermittent or continued use of a medication prescribed for chronic or recurring diseases or symptoms' (Lukovic et al., 2014) The rise in self-medication practices around the world is provoked by socio-economic, demographic, political, cultural as well as legal factors which include laws and regulations related to drug usage and sales. (Behzafidar et al., 2020) Due to variations in these factors there is a difference in the trends of self-medication practices among low, middle, and higher income countries. In low income countries, self medication is very common and it leads to relevant concerns by authorities related to unreasonable and incorrect use of medicines. (Araia et al., 2019) Patterns of self-medication also vary depending on other factors such health literacy, access to drugs, availability of

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medicines, satisfaction level and perception of people regarding certain diseases. ([Zeid et al., 2020](#)) According to [Bennadi \(2014\)](#), the prevalence of self-medication in United Kingdom, United States of America, Italy, Germany, Sweden, and Australia was estimated to be 9%, 13%, 8%, 11%, 9% and 11%. respectively. According to a study conducted by Chautrakarn et al. (2021) self-medication rate in the metropolitan areas of Thailand were estimated to be 88.2%. Self-medication provides patients autonomy and independence in decision making process for the management of ailments as well as reduces the cost of healthcare. ([Hughes et al., 2001](#)) A study conducted by [Noone and Blanchette \(2018\)](#) evaluated that by self-medicating aptly and correctly, approximately 10% of doctor visits can be avoided and the avoidance of these visits proves to be economical as it saves around USD 5.2 billion yearly in the US.

Although the practice of self-medication has prevailed globally due to numerous benefits, it still has its own risks and challenges. The possible risks of self medication can not possibly be disregarded. In some cases, it can lead to inaccurate self-diagnosis which cause Adverse Drug Reactions and other consequential health concerns. There is also a potential risk of dependence and abuse. ([Ruiz, 2010](#)) The biggest public health concern is antibiotic resistance which is the most probable result of unregulated and inaccurate self-medication practices around the world as antibiotics are available readily without prescription. Discussing antibiotic use is crucial because it is one of the reasons behind antibiotic resistance. It is evaluated that antibiotic resistance complications will cause 10 million deaths by the year 2050. ([Banda et al., 2021](#)) Self-medication rate of antibiotics in Asia is estimated to be ranging from 4 - 75% which is increasing with the passage of time. ([Alam et al., 2015](#)) Unfortunately, Pakistan is also one of those lower middle income countries of Asia where medications especially over-the-counter antibiotics are available conveniently. A detailed study conducted by [Atif et al. \(2019\)](#) evaluated that inappropriate use of antibiotics in Pakistan were connected to low literacy rate, inadequate level of basic health information, insufficient provision of healthcare services specially in government hospitals, poor health infrastructure in underdeveloped areas, expensive consultancy fee and unregulated supply and availability of antibiotics. Similarly, a study conducted by [Zafar et al. \(2008\)](#) indicates self-medication rate of 76% in Karachi, Pakistan.

The purpose of this study was to determine the pattern of self-medication practices in Islamabad, Pakistan and to investigate the factors that influence this practice. Existing studies ([Ullah et al., 2013](#), [Aqeel et al., 2014](#), [Afridi et al., 2015](#), [Haseeb and Bilal, 2016](#), [Aziz et al., 2018](#), [Atif et al., 2019](#)) shed a light on similar topic with detailed analyses in areas of Pakistan. But studies conducted by [Mendoza et al., 2022](#), [Santamaria et al., 2022](#), [Yasmin et al., 2022](#) report that during and in the wake of COVID-19, self medication behaviours have significantly increased. Similarly, [Mahadi \(2021\)](#) explains how by engaging in self-medication behaviours, the misuse of antibiotics would lead to a global disaster that is Post COVID-19 Antimicrobial resistance in lower and middle income countries. It has been found that due to this self-medicating behaviour, antibiotic resistance is expected to increase 4-7 times quicker. So another important objective of this study is to remain up-to-date with the rise in self-medication practices specially after the waves of COVID-19 pandemic in areas of Islamabad, Pakistan. The key findings provide deep understanding of self-medication phenomenon in local context. This study also aims to evaluate significant factors associated with self-medication during the COVID-19 pandemic in Islamabad.

Methodology

Study Area and Population

The study was carried out close to Islamabad. Pakistan's capital city, Islamabad, is situated at the

foot of the Margalla Hills. Islamabad has a total size of 906.50 square kilometres, according to information published by the Capital Development Authority, Government of Pakistan. It is Pakistan's ninth most populous city. It is home to people of various cultural backgrounds. Islamabad is Pakistan's most diverse metropolis with reference to population composition and arrangement. Islamabad was deliberately selected due to diversity in population from various parts of the country. Different areas and sectors from five zones of the city were selected for data collection to conduct a descriptive, cross sectional study. These areas represent diverse groups of the entire population.

Assessment Tools

A descriptive, cross sectional study was conducted on 50 participants, who were selected by multi-stage sampling technique. Since the population of the entire city is already divided into different zones, therefore this technique was applied to determine the representative sample of the population. In multi-stage sampling, population is divided into large groups which are further divided into smaller clusters for selection of target population. In the first stage, Islamabad city was divided into 5 zones, namely; zone 1, zone 2, zone 3, zone 4 and zone 5. In the second stage, 4 sectors and 4 areas including sector E, sector F, sector G, sector I and Pakistan Public Works Department PWD, Gulberg Greens, Soan Gardens, Shahzad Town were randomly selected from each zone. In the third stage, out of the randomly selected sectors and areas, 5 sub-sectors and 5 sub-areas were again randomly selected. 50 households were chosen at random from the sub-sectors and sub-areas chosen from which 50 participants were chosen in the final step to gather the required data. The total response rate of the survey conducted was 80% where as 20% people were either unapproachable or provided insufficient data because they were unwilling to share information. Therefore, the total sample size for analysis was reduced to 40 participants.

Data was collected through a validated, self-administered, structured and closed ended questionnaire. The questionnaire was validated by existing studies and later cross-culturally adapted and modified for use among the selected population sample. It was also reviewed by research and public health field experts and then pretested for further amendments. The questionnaire was divided into sections depending on the objectives of the study. It consisted of 3 parts: (1) Demographics, (2) Self-medication practice assessment and (3) Assessment of self-medication behaviours in COVID-19 pandemic. Part one consisted of questions relevant to demographic characteristics of participants such as gender, age, education level, and monthly income/allowance. Part 2 included questions which assessed behaviours of participants related to self-medication practice. The last part of the questionnaire included questions which determined self-medication behaviours of participants in the wake of COVID-19 pandemic. The questionnaire was designed in English language but it was also translated in Urdu for understandability and feasibility of local people.

Data Entry and Analysis

Microsoft Excel was used to collect the data and gathered into Statistical Package for Social Science SPSS version 26 for analysis. Univariate analysis was performed to summarise and describe the data. Descriptive statistics provided a wide range of data in a compiled form. For Clearly defined demographic explanatory variables i.e, Age, gender, monthly income, marital status, education level, area of residence and presence of co-morbidity/medical conditions were used for analysis. The dependent variable in question was binary. It equals to one for engaging in self-medication behaviour and zero for others. Bivariate regression analysis was carried out with

the study's goals in mind. Two logit regression models were used for analysis. In the first model, factors associated with self-medication practices were analysed and causal relationship between dependent variable and explanatory variables was predicted by using bivariate regression analysis. The equation becomes $Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 \dots b_nX_n$. Where Y is the dependent variable, b_0 is the intercept or slope of the regression line and $X_{(1-n)}$ are the independent variables. In the second model, another binary dependent variable was used. It equals to one for engaging in self-medication practice in the COVID-19 pandemic and equals to zero for others. The equation in this scenario is the same. For difference we use $Y' = b'_0 + b'_1X'_1 + b'_2X'_2 + b'_3X'_3 + b'_4X'_4 \dots b'_nX'_n$. Demographic explanatory variables as explained above were used for analysis. Furthermore, correlation analysis was also done to determine the extent or degree of relationship between dependent and independent variables. All variables were included in the model regardless of their significance. Coefficient value of 0.05 was considered statistically significant.

Results

Descriptive statistics were used to summarise the associated factors related to self-medication practice. Correlation and regression analysis helped to show significant relationship between dependent and independent variables.

Table 1. Descriptive Statistics

Variable	N	Mean	Std.Deviation
Age (years)	40	.7000	.46410
Gender	40	33.6750	13.33472
Income (USD)	40	.6500	.48305
Education	40	387.1250	115.41946
Living Conditions	40	2.3250	.61550
Marital Status	40	.8500	.42667
Co-morbidity/Medical Condition	40	.5500	.50383
Total Observations List-wise N	40	.5000	.50637

Education shows the highest level of standard deviation. Which means that education level data set deviates much from the mean value.

Prevalence of Self-medication with Relation to Socio-demographic Factors

A total of 40 respondents were included in the study (n= 40). Slightly more males were included in the study. (n= 26) Majority of the respondents were between 21 to 30 years of age. (n= 42.5%), married (n=55%) and belonged to urban area of residence (n=82.5) Females engaged more in self-medication practices as compared to males. (n=65%) Similarly, married respondents were more inclined towards self-medication behaviour as compared to unmarried respondents. (n=55%) It is shown in table 2 as follows:

Table 2. Socio-demographic Characteristics of Respondents

Characteristics	Range/groups	Self Medication (n=28)	No Self Medication (n=12)	Total (%)
Age (Years)	20 or below	2	2	4 (40%)
	21-30	8	9	17 (42.5)
	31-40	5	4	9 (22.5)
	41-50	5	0	5 (12.5)

Characteristics	Range/groups	Self Medication (n=28)	No Self Medication (n=12)	Total (%)
Gender	51 or above	4	1	5 (12.5)
	Female	21	5	26 (65)
	Male	7	7	14 (35)
Monthly Income (USD)	200 or below	0	3	3 (7.5)
	201-350	9	5	14 (35)
	351-500	14	6	20 (50)
Residence	501 or above	3	0	3 (7.5)
	Rural	3	4	7 (17.5)
	Urban	25	8	33 (82.5)
Education level	Primary	1	2	3 (7.5)
	High school/intermediate	13	8	21 (52.5)
	Undergraduate/Postgraduate	14	2	16 (40)
	Phd or Higher	0	0	0
Marital Status	Married	18	4	22 (55)
	Unmarried	10	8	18 (45)
Co-morbidity/ medical condition	Yes	17	3	20 (50)
	No	11	9	20 (50)

Table 3. Correlation Analysis

Variable	Coefficient	Age	Gender	Income	Education	Co-morbidity
Self-medication	Pearson's Correlation	.348*	.320*	.390*	.350*	.327*
	N	40	40	40	40	40

Correlation is significant at the 0.05 level (2-tailed)

Correlation analysis showed significant results. Age, gender, income, education and presence of co-morbidity were significant at 0.05 level. Which showed that there exists a strong relationship between dependent (self-medication) variable and independent variables. (age, gender, income, education and co-morbidity)

Table 4. Regression Analysis

Variables	B	S.E	Sig.
Age	-.020	.084	.808
Gender	1.253	1.078	.245
Income	.009	.006	.131
Education	1.888	.958	.049
Co-morbidity	1.820	1.293	.159
Area of residence	.463	1.416	.744
Marital Status	1.109	1.367	.417
Constant	-8.266	2.968	.005

Regression analysis also yielded important results. According to the statistics, 1% increase in age would lead to 0.8% increase in self-medication behaviour. Similarly, 1% increase in male population would increase self-medication behaviour by 0.245%. 1% increase in income would lead to 0.131% increase in self-medication practices. Similarly, 1% increase in co-morbid conditions would lead to increase in self-medication behaviour by 0.159%

Perceptions, Knowledge and Attitudes of Participants towards Self-medication

Table 5 shows a wide range of responses of participants regarding their perceptions, knowledge and attitudes regarding self-medication. Cost effectiveness was the major reason behind self medication behaviours (n=57.57%) followed by lack of trust in health-care professionals. (n=12.12%) Majority of the people who engaged in self-medication practices complained of headaches (n=27.27%) followed by cough/cold/flu. (n=17.5%) Most of the respondents received information regarding self-medication practice via Internet, print, electronic and social media. (n=30%) Majority of the people thought of self-medication as an unacceptable practice. (n=54.5%)

Table 5. Perceptions, Knowledge and Attitudes of Participants towards Self-medication

Variable	N (%)
Reasons for Self-medication	
Cost effective	19 (57.57)
Saves time	3 (9.09)
Cost of consultation	2 (6.06)
Lack of trust in doctor	4 (12.12)
Have old prescription	2 (6.06)
Pharmaceutical advertising	1 (3.03)
Emergency use	2 (6.06)
Symptoms/conditions associated with Self-medication	
Headaches/migraines	9 (27.27)
Gastrointestinal (stomach) problems	2 (6.06)
Cough/cold/flu	6 (17.5)
Anxiety/depression	3 (7.5)
Infections	1 (3.03)
Insomnia	3 (9.09)
Pain	3 (9.09)
Skin problems	1 (3.03)
Eye problems	1 (3.03)
Menstrual pain/disorders	4 (12.12)
Source of Information	
Academic knowledge	2 (5)
Family/peers	7 (17.5)
Advertising	3 (7.5)
Internet/print, electronic, social media	12 (30)
Pharmacist/Health-care professional	6 (15)
Previous prescription of similar disease	6 (15)
No Knowledge about drug	4 (10)

Variable	N (%)
Respondent opinion about self-medication practices	
Effective practice	10 (30.3)
Unacceptable practice	18 (54.5)
Neither effective nor unacceptable practice	5 (15.1)
Reading instruction/guidelines	10 (30.31)
Not reading instructions/guidelines	23 (69.69)
Switching medications in between treatment	7 (21.21)
Not switching medications in between treatment	26 (78.78)
Awareness about anti-biotic resistance	18 (54.54)
No awareness regarding anti-biotic resistance	15 (45.45)

Drug groups used for self-medication

A wide range of medicine classes, including painkillers, antibiotics, antivirals, vitamin/mineral supplements, and others, were among the medications utilised for self-medication. The most common drug group used for self-medication included pain-killers. (n=24.24%) followed by the usage of antibiotics. (n=9.08%)

Table 6. Drugs used for Self-medication Purpose

Drugs used for Self-medication practice	% of drug used (N=33)
Pain Reliever	8 (24.24)
Antibiotic	3 (9.09)
Anti-viral	3 (9.09)
Vitamin/mineral	4 (12.12)
Anti-fungal	2 (6.06)
Anti-allergy	4 (12.12)
NSAIDs	7 (21.21)
Herbal Medication	2 (6.06)

Self-medication Behaviours and COVID-19

Correlation and regression analysis in the context of COVID-19 showed important results. There is a very strong relationship between self-medication during COVID-19 and age. Similarly, co-morbid conditions lead to higher degree of significant relationship with self-medication in COVID-19. Correlation values of gender and education are non-significant and show a weak relationship. This shows that during the COVID-19 pandemic, gender and education level did not play a role in determining self-medication habits of individuals.

Table 7. Correlation Analysis

Variable	Coefficient	Age	Gender	Income	Education	Co-morbidity
Self-medication (during COVID-19)	Pearson's Correlation	.346*	.135	.456**	.237	.392*
	N	40	40	40	40	40

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

Regression analysis shows significant set of results. 1% increase in age would lead to 0.863% increase in self-medication behaviours in COVID-19. Similarly, 1% increase in co-morbid situations would lead towards 0.063% increase in self-medication behaviours in COVID-19.

Table 8. Regression Analysis

Variables	B	S.E	Sig.
Age	-.004	.068	.959
Gender	.059	1.050	.955
Income	.010	.006	.062
Co-morbidity	2.201	1.185	.063
Education	1.729	.877	.049
Constant	-7.454	2.862	.001

Discussion

The prevalence of self medication as indicated by this study is 70%. In this cross-sectional study, self-medication behaviour varies according to age, gender, income, education level, marital status, area of residence as well as presence of co-morbidities. Higher risks populations as indicated by this study include women in between the ages of 21 to 30 years. But exceptions are always there and these values vary from person to person and place to place. The differences in self-medication practices are attributed to socio-economic and demographic characteristics of people.

Ease of access to medications leads to rise in self-medication behaviours. A study conducted by Aziz et al. (2018) in Pakistan indicates that around 62.2% of customers purchased medicines without prescription and advice of a specialist. Although self-medication might provide benefits but in the long run it proves to have disastrous effects on human health. As discussed before, antibiotic resistance can lead to a huge public health disaster by causing complications and eventually death. Another study conducted by Afridi et al. (2012) indicated self-medication prevalence of around 84.8%. As evaluated by our study, self-medication rates have increased in the wake of COVID-19 pandemic. Self-medication proves to be cost-effective as indicated by the data. People in low-income countries like Pakistan prefer self-medication because of increased consultation costs and transportation costs. In this present study, the most used drugs included pain killers and antibiotics. Findings of previous studies by Jerez-Roig et al. 2014 and Domingues et al. 2017 indicates the same result.

Conclusion

Self-medication is prevalent 70% in Islamabad, Pakistan. There was strong statistical association between dependent and most of the independent variables.

References

- Afridi, M. I., Rasool, G., Tabassum, R., Shaheen, M., Siddiqullah, & Shujauddin, M. (2015). Prevalence and pattern of self-medication in Karachi: A community survey. *Pakistan journal of medical sciences*, 31(5), 1241–1245. <https://doi.org/10.12669/pjms.315.8216>
- Alam, N., Saffoon, N., & Uddin, R. (2015). Self-medication among medical and pharmacy students in Bangladesh. *BMC research notes*, 8, 763. <https://doi.org/10.1186/s13104-015-1737-0>

- Araia, Z. Z., Gebregziabher, N. K., & Mesfun, A. B. (2019). Self medication practice and associated factors among students of Asmara College of Health Sciences, Eritrea: a cross sectional study. *J of Pharm Policy and Pract* 12(3), <https://doi.org/10.1186/s40545-019-0165-2>
- Atif, M., Asghar, S., Mushtaq, I., Malik, I., Amin, A., Babar, Z. U., & Scahill, S. (2019). What drives inappropriate use of antibiotics? A mixed methods study from Bahawalpur, Pakistan. *Infection and drug resistance*, 12, 687–699. <https://doi.org/10.2147/IDR.S189114>
- Banda, O., Vlahakis, P. A., Daka, V., & Matafwali, S. K. (2021). Self-medication among medical students at the Copperbelt University, Zambia: A cross-sectional study. *Saudi pharmaceutical journal : SPJ : the official publication of the Saudi Pharmaceutical Society*, 29(11), 1233–1237. <https://doi.org/10.1016/j.jsps.2021.10.005>
- Behzadifar, M., Behzadifar, M., Aryankhesal, A., Ravaghi, H., Baradaran, H. R., Sajadi, H. S., Khaksarian, M., & Bragazzi, N. L. (2020). Prevalence of self-medication in university students: systematic review and meta-analysis. *Eastern Mediterranean health journal* 26(7), 846–857. <https://doi.org/10.26719/emhj.20.052>
- Bennadi D. (2013). Self-medication: A current challenge. *Journal of basic and clinical pharmacy*, 5(1), 19–23. <https://doi.org/10.4103/0976-0105.128253>
- Bilal, M., Haseeb, A., Khan, M. H., Arshad, M. H., Ladak, A. A., Niazi, S. K., Musharraf, M. D., & Manji, A. A. (2016). Self-Medication with Antibiotics among People Dwelling in Rural Areas of Sindh. *Journal of clinical and diagnostic research : JCDR*, 10(5), <https://doi.org/10.7860/JCDR/2016/18294.7730>
- Domingues, P. H., Galvão, T. F., Andrade, K. R., Araújo, P. C., Silva, M. T., & Pereira, M. G. (2017). Prevalence and associated factors of self-medication in adults living in the Federal District, Brazil: a cross-sectional, population-based study. *Epidemiologia e Serviços de Saúde*. 26, 319–330.
- Gaviria-Mendoza, A., Mejía-Mazo, D. A., Duarte-Blandón, C., et al. (2022). Self-medication and the 'infodemic' during mandatory preventive isolation due to the COVID-19 pandemic. *Therapeutic Advances in Drug Safety*. ;13:20420986221072376. DOI: 10.1177/20420986221072376.
- Hughes, C. M., McElnay, J. C., & Fleming, G. F. (2001). Benefits and risks of self medication. *Drug safety*, 24(14), 1027–1037. <https://doi.org/10.2165/00002018-200124140-00002>
- Jerez-Roig, J., Medeiros, L. F., Silva, V. A., Bezerra, C. L., Cavalcante, L. A., Piuvezam, G. et al. (2014). Prevalence of self-medication and associated factors in an elderly population: a systematic review. *Drugs & aging* 31(12), 883–896.
- Lukovic, J. A., Miletic, V., Pekmezovic, T., Trajkovic, G., Ratkovic, N., Aleksic, D., & Grgurevic, A. (2014). Self-medication practices and risk factors for self-medication among medical students in Belgrade, Serbia. *PloS one*, 9(12), e114644. <https://doi.org/10.1371/journal.pone.0114644>
- Mahadi, A. R. (2021). Post COVID Antimicrobial Resistance Threat in Lower- and Middle-Income Countries: Bangladesh. *Frontiers in public health*, 9, 770593. <https://doi.org/10.3389/fpubh.2021.770593>
- Noone, J., & Blanchette, C. M. (2018). The value of self-medication: summary of existing evidence. *Journal of medical economics*, 21(2), 201–211. <https://doi.org/10.1080/13696998.2017.1390473>

- Ruiz M. E. (2010). Risks of self-medication practices. *Current drug safety*, 5(4), 315–323. <https://doi.org/10.2174/157488610792245966>
- Ullah, H., Khan, S. A., Ali, S., Karim, S., Baseer, A., Chohan, O., Hassan, S. M., Khan, K. M., & Murtaza, G. (2013). Evaluation of self-medication amongst university students in Abbottabad, Pakistan; prevalence, attitude and causes. *Acta poloniae pharmaceutica*, 70(5), 919–922.
- Yasmin, F., Asghar, M. S., Naeem, U., Najeeb, H., Nauman, H., Ahsan, M. N., et al. (2022). Self-Medication Practices in Medical Students During the COVID-19 Pandemic: A Cross-Sectional Analysis. *Frontiers. Collection*. <https://doi.org/10.3389/fpubh.2022.803937>
- Zafar, S. N., Syed, R., Waqar, S., Zubairi, A. J., Waqar, T., Shaikh, M., Yousaf, W., Shahid, S., & Saleem, S. (2008). Self-medication amongst university students of Karachi: prevalence, knowledge and attitudes. *JPMA. The Journal of the Pakistan Medical Association*, 58(4), 214–217.
- Zeid, W., Hamed, M., Mansour, N. et al. (2020). Prevalence and associated risk factors of self-medication among patients attending El-Mahsama family practice center, Ismailia, Egypt. *Bull Natl Res Cent* 44, 92. <https://doi.org/10.1186/s42269-020-00351-7>