

Self-medication among medical students: a systematic review and meta-analysis of prevalence, causes, common drugs, and sources of information

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Abstract

Self-medication is one of the most important public health challenges, especially for medical students. Despite the extensive studies conducted in this field, no comprehensive study has been undertaken regarding the various aspects of self-medication. Therefore, this study was conducted to determine the prevalence, causes, types of drugs used, and sources of information on self-medication among medical students. In the present systematic review and meta-analysis, four international databases (Web of Science, Scopus, PubMed, and Excerpta Medica Database) were searched from January 1, 2000, to December 30, 2019. The keywords used were: "Prevalence", "Self Medication", "Medical Students", "Causes", "Resources". To evaluate the quality of the included studies, the tool previously described by Hoy et al. was used. Of the 1 071, searched studies, 76 studies conducted on 29 726 students from 25 countries were selected for the final stage. The prevalence of self-medication in the past year (2019) was found to be 77.6% (95% confidence interval: 74.0–81.2; $I^2 = 99.0\%$). Healthcare workers (39.1%) were found to be the most important source of information on self-medication. In most studies, abdominal problems ($n = 30$) were the most common causes of self-medication. Based on the high prevalence of self-medication among medical students, training courses should be conducted to increase student awareness. Moreover, implementation of strict laws at national level can help to reduce the practice of self-medication.

Keywords: self-medication, prevalence, medical students, meta-analysis

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Introduction

Self-medication is currently one of the most prevalent public health problems worldwide.¹ According to statistical data from the World Health Organization (WHO), more than 50% of medications worldwide are not prescribed correctly or are used by individuals without a doctor's prescription.² Different political, cultural, and economic aspects increase the prevalence of self-medication.³ Although self-medication relieves illness and reduces symptoms, in some cases, such as in antibiotic use, it may be associated with various side-effects, increased drug resistance, long-term hospitalisation, and unsuccessful treatment, along with increased cost to educate the patient and the healthcare workers (HCWs).⁴ Furthermore, the use of antidepressants that are associated with several side-effects, such as weight gain and diabetes, has increased by more than 100% in recent years.⁵ The prevalence of self-medication in different populations depends on various factors, including age, sex, and degree of self-care and education.^{6,7} The prevalence of self-medication is higher in

medical science students than in other groups owing to easier access and communication with medical and pharmaceutical centres.⁸ Despite individual studies conducted to assess students in medical sciences, no comprehensive study has been performed in this field. Therefore, determining the prevalence of self-medication among medical science students is critical, as they will shape the future of the healthcare industry. Determining the prevalence of self-medication can also help health policy makers plan better strategies to control self-medication. Hence, this study aimed to investigate the prevalence of self-medication among medical students.

Methods

Eligibility criteria and registration

This systematic review and meta-analysis study was performed according to Cochrane's guideline and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement.⁹ The study protocol was registered with PROSPERO (CRD42020165531).

The inclusion criteria were as follows: 1) type of study: cross-sectional studies performed retrospectively and prospectively; 2) studies published in English; and 3) studies performed on medical students. The exclusion criteria were as follows: reviews, letters to the editor, and qualitative studies published before 2000 in non-English languages and performed on children or the elderly. In addition, articles lacking the required quality based on the Hoy tool or full text were excluded. This study aimed to investigate the prevalence of self-medication, the type of medications used, the causes of self-medication, and sources of information on self-medication. In the present study, self-medication was defined as "the use of medicinal products by the consumer to treat self-recognised disorders or symptoms, or the intermittent or continued use of medication prescribed by a physician for chronic or recurring diseases or symptoms," based on the WHO guidelines.¹⁰

Search strategy

International databases (Web of Science, Scopus, PubMed, and Excerpta Medica Database) were searched from January 1, 2000

to December 30, 2019. The search strategy was developed with the help of a librarian with experience in working on systematic reviews. The search strategy used for PubMed was adopted to search other databases. The PROSPERO database was used to search for the most recent review articles. The keywords were based on MeSH (Medical Subject Headings) and searches of related articles. The keywords used were: "Prevalence", "Self Medication", "Medical Students", "Causes", "Resources".

Selection of studies and data extraction

After searching the databases, the articles were entered into the Endnote software. Next, the articles were screened and duplicate items were excluded. Then, the articles were reviewed based on their titles and abstracts, and irrelevant items were removed. The full text of the articles was then evaluated based on the inclusion criteria and selected for the final stage. Finally, information was extracted. The screening and data extraction stages were separately performed by two researchers (XX and YQ). The consensus method was used when the researchers disagreed on specific studies. Extracted data items included author, year

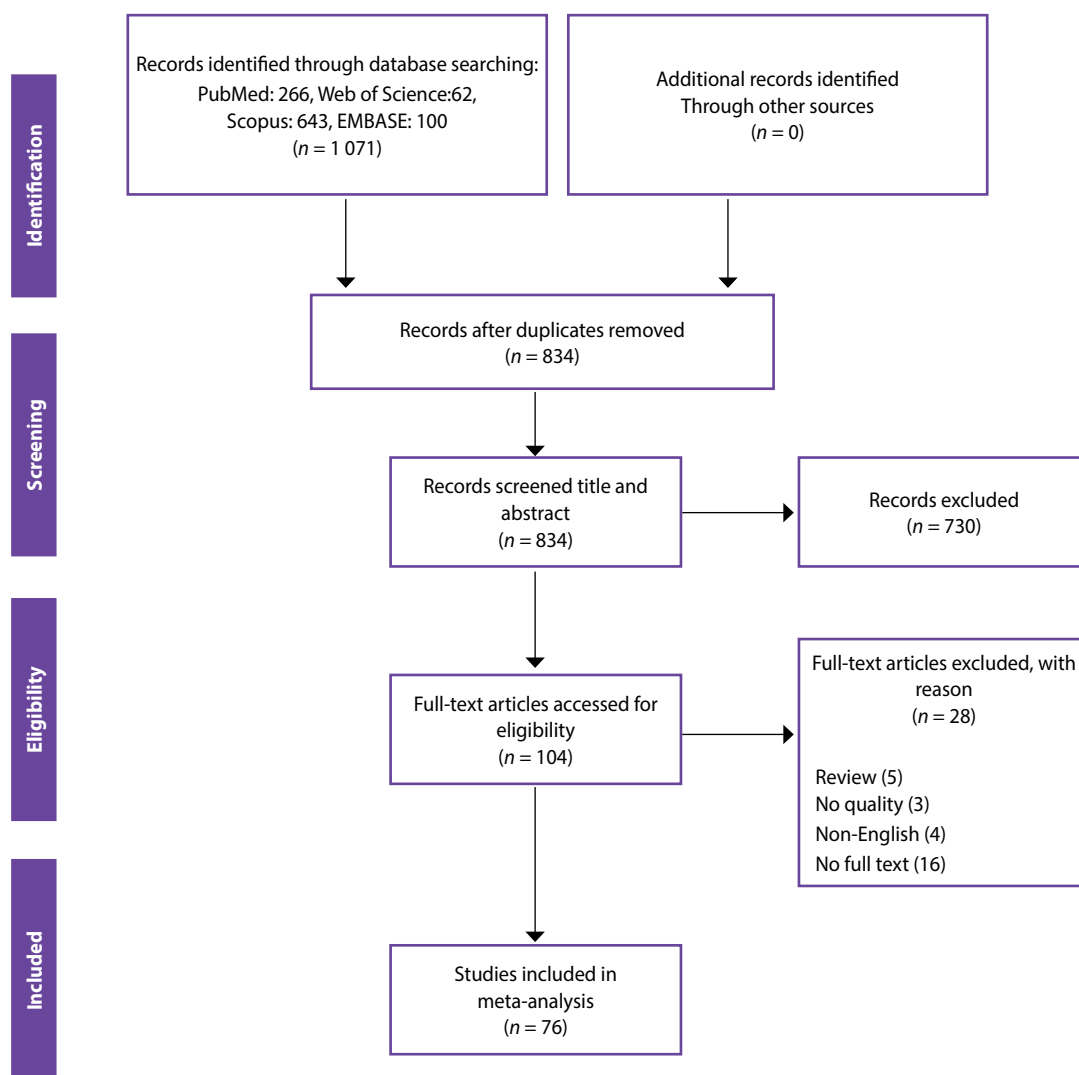


Figure 1: PRISMA Flow Diagram

of publication, country, region based on WHO category, Service Delivery Indicators (SDI) status based on World Bank category, sampling method, demographic characteristics (number of participants, age, sex [male/female]), risk of bias, prevalence of self-medication, source of information, type of drugs, indications for self-medication, and causes of self-medication.

Quality assessment

The Hoy et al.-proposed tool was used to evaluate the quality of the entered studies.¹¹ This 10-item tool examines studies in terms of bias risk, including internal validity (items 1–4 assess target population, sampling frame, sampling method, and non-response minimal bias) and external validity (items 1–4 assess target population, sampling frame, sampling method, and non-response minimal bias). The quality of the studies entered by the two researchers was evaluated separately, and disagreements were resolved by consulting a third person.

Data analysis

All eligible studies were included after the systematic review. The data were combined using forest plots. The overall prevalence of self-medication, types of drug use, and sources of information were evaluated using a random effects model. Heterogeneity of the preliminary studies was evaluated using the I^2 test. Subgroup analysis was performed to determine the heterogeneity based on the study location and instruments. The meta-analysis was performed using STATA 14 (StataCorp, Texas, United States of America).

Results

Study selection

A total of 1 071 articles were retrieved from the initial searches of the four databases. Of the 834 non-duplicated studies, 730 were excluded due to unrelated titles and abstracts. Of the remaining 104 studies, 76 met the eligibility criteria; among the 28 excluded studies, five were review studies, four were published in non-English languages, three were not of good quality, and 16 did not have full text available (Figure 1).

Study characteristics

A total of 76 studies were conducted with 29 726 students from 25 countries. The age range of the participants was 18–31 years old. Most studies were conducted at the Eastern Mediterranean Region ($n = 36$) and India ($n = 19$). In terms of economic status, most studies were performed in countries with low-middle SDI ($n = 35$). The sampling method used in most of the studies ($n = 42$) was convenience sampling. Most studies ($n = 67$) had a low bias risk (Table I).

Prevalence of self-medication

The prevalence of self-medication was assessed in 76 studies conducted across 25 countries. Prevalence was reported according to five time intervals. The time interval lasted one year for 60

studies (78.9%) and the last six months for 10 studies. Furthermore, the last six months, last one month, and last two months were the time intervals for two, three, and one study, respectively.

Prevalence of self-medication in the last year time interval

Of all studies that assessed the prevalence in the last one-year time interval, 44 studies assessed the prevalence of no specific drug, and 11, 4, and 1 assessed self-medication with only antibiotic, analgesic, and sedative or anti-stress drugs, respectively.

The prevalence of self-medication at least once in the last one-year time interval in 44 studies was between 44.8 and 100%, and according to the meta-analysis results, the pooled prevalence of no specific drug self-medication in 16 442 medical science students was 77.6% (95% confidence interval [CI]: 74.0–81.2; $I^2 = 99.0\%$). The pooled prevalence of antibiotic and analgesic drug self-medication was 47.4 and 69.9%, respectively (Figure 2).

Of the 44 studies (no specific drug), 27 studies assessed the prevalence of self-medication based on the type of drug and reported the prevalence of at least one type of drug, such as antibiotics. Of the 44 studies (no specific drug), 24 reported the prevalence of antibiotic self-medication and 11 specifically assessed the antibiotic self-medication. The prevalence of antibiotic self-medication at least once in the last one-year time interval in 35 studies was between 3.0 and 81.1%, and based on the results of the random effect method, the pooled prevalence in 15 361 medical science students was 34.8% (95% CI: 28.1–41.6; $I^2 = 99.1\%$) (Table II).

Of the 44 studies (no specific drug), 19 studies reported the prevalence of an analgesic or antispasmodic drug self-medication, and four studies specifically assessed the analgesic self-medication. The prevalence of analgesic or antispasmodic self-medication at least once in the last one-year time interval in 23 studies was between 7.1 and 86.8%, and based on the results of the random effects method, the pooled prevalence in 9 561 medical science students was 47.1% (95% CI: 36.4–57.9; $I^2 = 99.4\%$). The meta-analysis results for the type of drug showed that the pooled prevalence for analgesics/antispasmodic (47.1%), antipyretics (46%), and non-steroidal anti-inflammatory drugs (NSAIDs 43.5%) were higher than that for other types of drugs (Table II).

Subgroup analysis based on sex showed that the prevalence of self-medication in females was higher than that in males in most studies. Therefore, the overall pooled prevalence of no specific drug self-medication at least once in the last one year time interval in 3 283 male and 6 594 female medical students was 73.9% (95% CI: 66.9–80.9; $I^2 = 98.7\%$) and 77.6% (95% CI: 74.3–81; $I^2 = 98.8\%$), respectively. In addition, the pooled prevalence of analgesic drugs in males and females was 67.3 and 75.6%, respectively (Table III).

Subgroup analysis based on SDI status showed that the pooled prevalence of at least one non-specific drug self-medication in the last year was highest in the high SDI group (82.4%; 95% CI: 75.1–89.7) and lowest in the the low SDI group (72.6%; 95% CI: 55.7–89.4); however, these differences were not significant (Figure 3).

Table I: Summary of included studies

Author (Year)	Country	Region (WHO)	SDI status	Sampling method	Demographic characteristics 1. Participants 2. Age 3. Gender (M/F)	Risk of bias	Prevalence of SM
Abay SM (2010) ¹⁸	Ethiopia	African	Low SDI	Stratified Random	1. 213 2. 17–24 3. 174/39	low	38.4
Abdi A (2018) ¹⁹	Iran	EMRO	High-middle SDI	Stratified Random	1. 250 2. 18–25 3. 69/181	low	89.6
Ahmadi SM (2016) ²⁰	Iran	EMRO	High-middle SDI	Stratified Random	1. 364 2. 21.63 3. 122/242	low	33.7
Akbar I (2017) ²¹	Pakistan	EMRO	Low-middle SDI	Simple Random	1. 175 2. 21 3. 78/194	low	45.7
Al Essa M (2019) ²²	Saudi Arabia	EMRO	High SDI	Census	1. 272 2. NR 3. 78/194	low	73.1
Alam N (2015) ²³	Bangladesh	South-East Asia	Low-middle SDI	Census	1. 500 2. NR 3. 200/3	low	100
Albasheer O B (2016) ²⁴	Saudi Arabia	EMRO	High SDI	Simple Random	1. 300 2. NR 3. 150/15	low	83.7
Albusalih FA (2017) ²⁵	Saudi Arabia	EMRO	High SDI	Purposive sampling	1. 450 2. NR 3. 249/201	low	55.1
Al-Hussaini M (2014) ²⁶	Kuwait	EMRO	High SDI	Simple Random	1. 813 2. NR 3. 213/606	low	97.8
Ali AS (2016) ²⁷	Pakistan	EMRO	Low-middle SDI	Simple Random	1. 150 2. 23.5 3. 71/79	low	52.7
Alkhatatbeh MJ (2016) ²⁸	Jordan	EMRO	High-middle SDI	Census	1. 1 317 2. NR 3. 364/953	Moderate	78.5
Al-Rashidi A (2018) ²⁹	Saudi Arabia	EMRO	High SDI	Census	1. 237 2. NR 3. 0/237	Moderate	73.8
Al-Shagawi MA (2017) ³⁰	Saudi Arabia	EMRO	High SDI	Convenience	1. 213 2. NR 3. 0/213	low	30
Alshahrani SM (2019) ³¹	Saudi Arabia	EMRO	High SDI	Convenience	1. 528 2. NR 3. 237/291	Moderate	98.7
Alshogran OY (2018) ³²	Jordan	EMRO	High-middle SDI	Convenience	1. 504 2. NR 3. 223/281	low	97.2
Alsous M (2018) ³³	Jordan	EMRO	High-middle SDI	Convenience	1. 256 2. 21.56 3. 25/231	low	86.7
Badiger S (2012) ³⁴	India	South-East Asia	Low-middle SDI	Convenience	1. 200 2. NR 3. 79/121	low	92
Banerjee I (2016) ³⁵	Nepal	South-East Asia	Low SDI	Convenience	1. 488 2. NR 3. NR	low	81.35

Author (Year)	Country	Region (WHO)	SDI status	Sampling method	Demographic characteristics 1. Participants 2. Age 3. Gender (M/F)	Risk of bias	Prevalence of SM
Barkus A (2016) ³⁶	Lithuania	Europe	High SDI	Convenience	1. 180 2. NR 3. NR	low	39.4
Benameur T (2019) ³⁷	Saudi Arabia	EMRO	High SDI	Convenience	1. 150 2. 20.96 3. NR	low	42.6
Betancourt J (2013) ³⁸	Puerto Rico	American	High SDI	Convenience	1. 275 2. NR 3. 89/186	low	76
Brlić KČ (2014) ³⁹	Croatia	Europe	High SDI	Convenience	1. 389 2. NR 3. 92/297	Moderate	74.6
Donkor ES (2012) ⁴⁰	Ghana	African	Low-middle SDI	Convenience	1. 100 2. NR 3. NR	low	42
Dutta S (2016) ⁴¹	India	South-East Asia	Low-middle SDI	Convenience	1. 292 2. 21.5 3. 172/12	Moderate	71
El Ezz NF (2011) ⁴²	Egypt	EMRO	Low-middle SDI	Simple Random	1. 300 2. 19.1 3. 99/201	Moderate	55.2
Fatima A (2017) ⁴³	India	South-East Asia	Low-middle SDI	Convenience	1. 210 2. 22.3 3. NR	low	62.98
Gama AS M. (2017) ⁴⁴	Brazil	American	Upper-middle SDI	Convenience	1. 88 2. NR 3. 34/54	low	76
Gyawali S (2015) ⁴⁵	Nepal	South-East Asia	Low SDI	Census	1. 276 2. NR 3. 118/158	low	81.9
Harakeh S (2015) ⁴⁶	Saudi Arabia	EMRO	High SDI	Simple Random	1. 1042 2. NR 3. 493/549	low	49
Haroun MF (2017) ⁴⁷	Syria	EMRO	Low SDI	Simple Random	1. 436 2. NR 3. 207/229	low	54.3
Helal RM (2017) ⁴⁸	Egypt	EMRO	Low-middle SDI	Stratified cluster sampling	1. 503 2. 20 3. 92/411	low	62.9
Hu Y (2018) ⁴⁹	China	Western Pacific	High-middle SDI	Cluster sampling	1. 1 819 2. 22 3. 661/1 158	low	15.6
Ibrahim NK (2015) ⁵⁰	Saudi Arabia	EMRO	High SDI	Stratified Random Sampling	1. 504 2. 22.9 3. 242/262	low	75.2
Iqbal A (2018) ⁵¹	Pakistan	EMRO	Low-middle SDI	Purposive sampling	1. 300 2. 20.76 3. 240/60	low	85.7
Jabeen N (2015) ⁵²	India	South-East Asia	Low-middle SDI	Convenience	1. 100 2. NR 3. 52/48	low	88
Jairoun A (2019) ⁵³	UAE	EMRO	High SDI	Simple Random	1. 600 2. NR 3. 486/14	Moderate	45
James H (2006) ⁵⁴	Bahrain	EMRO	High SDI	Convenience	1. 134 2. 18.01 3. 43/91	low	44.8

Author (Year)	Country	Region (WHO)	SDI status	Sampling method	Demographic characteristics 1. Participants 2. Age 3. Gender (M/F)	Risk of bias	Prevalence of SM
Jamshed SQ (2016) ⁵⁵	Malaysia	Western Pacific	High-middle SDI	Convenience	1. 461 2. 19.55 3. NR	low	57.2
Jayanthi B (2014) ⁵⁶	India	South-East Asia	Low-middle SDI	Convenience	1. 162 2. NR 3. NR	low	52.4
Johnson D (2016) ⁵⁷	India	South-East Asia	Low-middle SDI	Convenience	1. 736 2. NR 3. 220/516	low	92.39
Kanwal ZG (2018) ⁵⁸	Pakistan	EMRO	Low-middle SDI	Simple Random	1. 300 2. NR 3. 92/208	low	N
Karamata VV (2017) ⁵⁹	India	South-East Asia	Low-middle SDI	Convenience	1. 518 2. NR 3. 228/29	low	59.2
Kasulkar AA (2015) ⁶⁰	India	South-East Asia	Low-middle SDI	Simple Random	1. 488 2. 19.89 3. 230/258	low	71.7
Kitikannakorn N (2007) ⁶¹	Thailand	South-East Asia	High SDI	Convenience	1. 266 2. NR 3. NR	low	92
Klemenc-Ketis Z (2010) ⁶²	Slovenia	Europe	High SDI	Convenience	1. 650 2. 22.4 3. 524/126	low	92.8
Kumar A (2016) ⁶³	India	South-East Asia	Low-middle SDI	Convenience	1. 308 2. 21.4 3. NR	low	49.7
Kumar N (2013) ⁶⁴	India	South-East Asia	Low-middle SDI	Convenience	1. 440 2. 20.3 3. 190/25	low	78.6
Kumar R (2016) ⁶⁵	India	South-East Asia	Low-middle SDI	Simple Random	1. 327 2. 20.8 3. NR	low	74.6
Kumari K (2018) ⁶⁵	India	South-East Asia	Low-middle SDI	Census	1. 269 2. NR 3. NR	low	83.2
Latifi A (2017) ⁶⁶	Iran	EMRO	High-middle SDI	Cluster sampling	1. 1 269 2. 21.13 3. 503/766	low	80.7
Lukovic JA (2014) ⁶⁷	Serbia	Europe	Upper-middle SDI	Convenience	1. 1 293 2. NR 3. 499/794	Moderate	79.9
Martinez JE (2014) ⁶⁸	Brazil	American	Upper-middle SDI	Convenience	1. 247 2. 22.35 3. 110/137	low	63.8
Mosaddek ASM (2014) ⁶⁹	Bangladesh	South-East Asia	Low-middle SDI	Census	1. 421 2. NR 3. 167/245	low	77.55
Mosaddek AS Md (2017) ⁷⁰	Bangladesh	South-East Asia	Low-middle SDI	Census	1. 52 2. NR 3. 21/31	low	47.06
Mumtaz Y (2011) ⁷¹	Pakistan	EMRO	Low-middle SDI	Convenience	1. 104 2. NR 3. NR	low	80.4
Naqvi AA (2016) ⁷²	Pakistan	EMRO	Low-middle SDI	Convenience	1. 235 2. NR 3. 37/198	low	67.2
Niroomand N (2019) ⁷³	Iran	EMRO	High-middle SDI	Stratified Random	1. 396 2. NR 3. NR	low	72

Author (Year)	Country	Region (WHO)	SDI status	Sampling method	Demographic characteristics 1. Participants 2. Age 3. Gender (M/F)	Risk of bias	Prevalence of SM
Pan H (2012) ⁷⁴	China	Western Pacific	High-middle SDI	Convenience	1. 634 2. NR 3. NR	Moderate	59.2
Parihar A (2018) ⁷⁵	India	South-East Asia	Low-middle SDI	Convenience	1. 200 2. NR 3. NR	low	86.5
Patil SB (2014) ⁷⁶	India	South-East Asia	Low-middle SDI	Convenience	1. 440 2. 20.4 3. 268/172	low	88.18
Pirzadeh A (2014) ⁷⁷	Iran	EMRO	High-middle SDI	Stratified Random	1. 197 2. NR 3. 65/132	low	84.98
Rajesh B (2017) ⁷⁸	India	South-East Asia	Low-middle SDI	Convenience	1. 267 2. NR 3. NR	low	66.8
Sajith M (2017) ⁷⁹	India	South-East Asia	Low-middle SDI	Convenience	1. 318 2. NR 3. 152/166	low	87.5
Sarahroodi S (2010) ⁸⁰	Iran	EMRO	High-middle SDI	Simple Random	1. 99 2. NR 3. 49/50	low	81
Sarahroodi S (2012) ⁸¹	Iran	EMRO	High-middle SDI	Simple Random	1. 564 2. NR 3. 256/308	low	76.6
Sarraf DP (2017) ⁸²	Nepal	South-East Asia	Low SDI	Convenience	1. 520 2. NR 3. NR	low	48.3
Sawalha A F.(2008) ⁸³	Palestine	EMRO	Low-Middle SDI	Census	1. 468 2. 19.9 3. NR	low	96.6
Shafiq F (2018) ⁸⁴	Pakistan	EMRO	Low-middle SDI	Convenience	1. 73 2. NR 3. 41/32	Moderate	100
Sharif SI (2012) ⁸⁵	UAE	EMRO	High SDI	Convenience	1. 169 2. 19.5 3. 153/16	low	86
Sharma A (2015) ⁸⁶	India	South-East Asia	Low-middle SDI	Convenience	1. 314 2. 19.03 3. 131/183	low	84.4
Shkreli R (2019) ⁸⁷	Albania	Europe	Upper-middle SDI	Convenience	1. 229 2. NR 3. 103/126	low	79.1
Somashekara SC (2019) ⁸⁸	India	South-East Asia	Low-middle SDI	Convenience	1. 185 2. NR 3. 95/9	low	81.6
Syed N (2104) ⁸⁹	Pakistan	EMRO	Low-middle SDI	Convenience	1. 200 2. NR 3. NR	low	81
Tameez-ud-din A (2019) ⁹⁰	Pakistan	EMRO	Low-middle SDI	Convenience	1. 244 2. 21.2 3. NR	low	50.4
Virmani S (2017) ⁹¹	India	South-East Asia	Low-middle SDI	Simple Random	1. 456 2. NR 3. 205/251	low	58
Zhu X (2016) ⁹²	China	Western Pacific	High-middle SDI	Convenience	1. 279 2. NR 3. NR	low	60.6

NR: none reported

Table II: The result of meta-analysis and pooled prevalence of self-medication in medical students by time interval and type of drug

	Last one year			Last six months			Last one to three months		
	n Sample size	Range of prevalence	Pooled prevalence (95% CI)	n Sample size	Range of prevalence	Pooled prevalence (95% CI)	n Sample size	Range of prevalence	Pooled prevalence (95% CI)
Antibiotics	35, 15361	3.0–81.1	34.8 (28.1, 41.6)	8, 4008	4.3–53.6	29.7 (16.8, 42.6)	4, 1124	8.9–42.3	15.2 (6.2, 24.1)
NSAIDs	3, 592	34.5–37.1	43.5 (27.2, 59.8)	2, 820	38.1–74.3	53.2 (50.0, 56.4)	1, 213	-	9.4 (6.2, 14.1)
Antacids/Antiulcer	13, 7007	4.9–39.3	18.7 (13.7, 23.7)	5, 3261	6.3–44.1	17.7 (9.2, 26.1)	2, 663	4.7–36.4	13.9 (11.5, 16.3)
Acetaminophen/ Antitussives	15, 7444	2.9–53.6	26.1 (18.0, 34.3)	6, 3204	1.0–84.6	49.0 (8.9, 89.0)	3, 1027	17.8–21.3	19.3 (16.9, 21.7)
Analgesics/ Antispasmodic	23, 9561	7.1–86.8	47.1 (36.4, 57.9)	6, 3188	48.4–81.4	58.8 (48.2, 69.4)	3, 1378	16.8–76.6	44.3 (7.6, 81.0)
Vitamins	18, 7993	1.3–51.8	22.1 (14.6, 29.6)	7, 3708	0.6–67.0	30.9 (12.7, 49.0)	2, 814	11.0–16.7	13.6 (11.3, 16.0)
Herbal medicine	7, 4516	3.1–39.3	20.5 (12.4, 28.6)	5, 2544	2.7–25.9	13.9 (7.6, 20.1)	1, 364	-	6.9 (4.7, 9.9)
Gastrointestinal drugs	14, 7180	0.4–45.9	16.0 (11.0, 21.1)	6, 2984	0.6–22.8	11.9 (5.3, 18.5)	2, 814	9.3–47.3	20.6 (18.1, 23.1)
Anti-allergic	18, 7998	4.1–40.9	18.3 (13.7, 22.8)	8, 4008	4.7–48.0	20.9 (11.6, 30.2)	1, 364	-	7.1 (4.9, 10.3)
Psychoactive	-	-	-	2, 525	14.0–32.0	20.8 (17.4, 24.2)	1, 364	-	6.6 (4.5, 9.6)
Tranquilisers/ Sedatives	11, 3861	1.0–58.7	10.9 (6.2, 15.7)	5, 2511	0.8–58.4	24.7 (4.6, 44.7)	-	-	-
Antipyretics	14, 5978	3.8–92.0	46.0 (30.7, 61.3)	6, 3188	2.1–51.8	19.9 (6.6, 33.1)	1, 364	-	2.7 (1.5, 5.0)
Skin	7, 3803	2.6–43.2	25.1 (14.2, 35.9)	2, 778	10.0–12.0	11.8 (9.5, 14.1)	1, 364	-	5.2 (3.4, 8.0)
Ophthalmic	2, 1778	15.7–34.3	18.9 (17.1, 20.7)	2, 778	5.6–26.7	13.3 (11.0, 15.5)	-	-	-
Opioids	1, 247	-	4.5 (2.5, 7.8)	-	-	-	1, 364	-	1.9 (0.9, 3.9)
Nasal preparations	3, 1790	3.1–10.0	6.4 (0.8, 11.9)	-	-	-	-	-	-
Ear preparations	6, 3243	2.9–13.9	7.6 (4.5, 10.6)	-	-	-	-	-	-

Of all countries, 18 reported a prevalence of at least one non-specific drug self-medication in the previous year. Of these, 11 countries had only one study, in which the self-medication prevalence was highest in Kuwait (97.8%) and lowest in Bahrain (44.8%). In addition, among the seven countries with two or more studies, the pooled prevalence was highest in Jordan (87.4%) and lowest in Egypt (66%) (Table IV).

Prevalence of self-medication in the last six months time interval

The prevalence of self-medication in the last six months time interval was assessed in 10 studies, of which nine studies assessed the prevalence of no specific drug and one study assessed self-medication of only sedative or anti-stress drug. The prevalence of no specific drug self-medication in the last six months time interval in nine studies was between 48.3% and 99%, and the pooled prevalence was 81.9% (95% CI: 74–89.9; I² = 99%) (Figure 4). Among the various types of pharmaceutical groups, the pooled prevalence of analgesics/antispasmodics (58.8%) and NSAIDs (53.2%) was higher than that of the other types of drugs (Table II).

Prevalence of self-medication in the last one to three months time interval

The prevalence of self-medication in the last one to three months time interval was assessed in six studies, of which four studies assessed the prevalence of no specific drug and the pooled prevalence was 43.2% (95% CI: 32.7–53.8; I² = 92.8%) (Figure 4). Among the various types of pharmaceutical groups, the pooled prevalence of analgesics/antispasmodics (58.8%) and NSAIDs (53.2%) was higher than that of the other types of drugs (Table II).

Sources of information on self-medication

Among the important sources of information on student self-medication, the pooled prevalence of advice from HCWs (39.1%), followed by reading materials and books (32.6%), was higher than that from other sources. The internet was assessed as a source of information in 15 studies, demonstrating a pooled prevalence of 21.6% (95% CI: 15.1, 28.1; I² = 97.8%) (Figure 4). The most important sources of information on self-medication

Table III: The result of meta-analysis and pooled prevalence of self-medication in medical students by sex and assessed type of drug in last year

First author, year Drug type	Male		Female	
	Sample size	ES (Estimation statistics)* (95% CI)	Sample size	ES* (95% CI)
Not a specific drug				
Alam N 2015 ²³	200	100 (98.1, 100)	300	100 (98.7, 100)
Albasheer OB 2016 ²⁴	150	81.3 (74.3, 86.8)	150	86(79.5, 90.7)
Alkhatabeh MJ 2016 ²⁸	364	76.4 (71.7, 80.4)	953	79.3 (76.6, 81.8)
Al-Rashidi A 2018 ²⁹	0	-	237	73.8 (67.9, 79)
Alshogran OY 2018 ³²	223	33.6 (27.8, 40.1)	281	61.6 (55.8, 67.1)
Badiger S 2012 ³⁴	79	93.7 (86, 97.3)	121	90.9 (84.5, 94.8)
El Ezz NF 2011 ⁴²	99	100 (96.3, 100)	201	100 (98.1, 100)
Fatima A 2017 ⁴³	0	-	210	62.4 (55.7, 68.7)
Gama ASM 2017 ⁴⁴	50	68 (54.2, 79.2)	66	81.8 (70.9, 89.3)
Gyawali S 2015 ⁴⁵	118	78 (69.7, 84.5)	158	84.8 (78.4, 89.6)
James H 2006 ⁵⁴	43	44.2 (30.4, 58.9)	91	45.1 (35.2, 55.3)
Jamshed SQ 2016 ⁵⁵	0	-	461	57 (52.5, 61.5)
Jayanthi B 2014 ⁵⁶	0	-	162	52.5 (44.8, 60)
Johnson D 2016 ⁵⁷	220	81.4 (75.7, 86)	516	97.1 (95.3, 98.2)
Karamata VV 2017 ⁵⁹	228	47.8 (41.4, 54.3)	290	68.3 (62.7, 73.4)
Kasulkar AA 2015 ⁶⁰	230	71.7 (65.6, 77.2)	258	71.7 (65.9, 76.9)
Kitikannakorn N 2007 ⁶¹	0	-	266	100 (98.6, 100)
Kumar N. 2013 ⁶⁴	190	75.3 (68.7, 80.9)	250	81.2 (75.9, 85.6)
Kumar R 2016 ⁶⁵	290	69.7 (64.1, 74.7)	373	74.0 (69.3, 78.2)
Kumari K 2018 ⁹³	133	84.2 (77.1, 89.4)	136	82.4 (75.1, 87.8)
Lukovic JA 2014 ⁶⁷	499	74.3 (70.3, 78)	794	83.4 (80.6, 85.8)
Mosaddek ASM 2017 ⁷⁰	21	47.6 (28.3, 67.6)	31	45.2 (29.2, 62.2)
Naqvi AA 2016 ⁷²	37	67.6 (51.5, 80.4)	198	67.2 (60.4, 73.3)
Parihar A 2018 ⁷⁵	109	91.7 (85.0, 95.6)	91	80.2 (70.9, 87.1)
Overall Random pooled ES	3 283	73.9 (66.9–80.9)	6 594	77.6 (74.3–81)
Analgesics drug				
Al Essa M 2019 ²²	78	100 (95.3, 100)	194	100 (98.1, 100)
Brlić KČ 2014 ³⁹	92	54.3 (44.2, 64.1)	297	80.8 (75.9, 84.9)
Kumar, A., 2016 ⁶³	176	47.2 (39.9, 54.5)	155	45.2 (37.5, 53)
Overall Random pooled ES	346	67.3 (27.3–100)	646	75.6 (50–100)
Antibiotic drug				
Ali AS 2016 ²⁷	71	69.0 (57.5, 78.6)	79	38(28.1, 49)
Hu Y 2018 ⁴⁹	661	14.8 (12.3, 17.7)	1 158	16.1 (14.1, 18.4)
Overall Random pooled ES	732	18.1 (15.4–20.7)	1 237	17.0 (14.9–19.1)

among students of medical sciences were HCWs (39.1%), followed by books and other resources (32.6%).

Reasons for self-medication

The reasons for self-medication were documented in 33 studies. The most common causes of self-medication included abdominal problems ($n = 30$), pain ($n = 29$), cough, and the common cold ($n = 27$) (Table V).

Meta-regression analyses

Meta-regression analyses were conducted for the prevalence of at least one and no specific drug self-medication in the last year time

intervals (44 studies). The results of univariate meta-regression analyses showed that the publication year of the study variable did not significantly contribute to the heterogeneity of self-medication prevalence (Coef. = 0.45, p -value = 0.889). Moreover, the sex of the participants (female-to-male ratio) variable was also not significant (Coef. = -0.26, p -value = 0.976).

Discussion

Despite several efforts to increase awareness, self-medication is one of the main problems faced by people, especially medical science students. In some cases, self-medication results in drug resistance, unwanted side-effects, and mortality. To the best of our

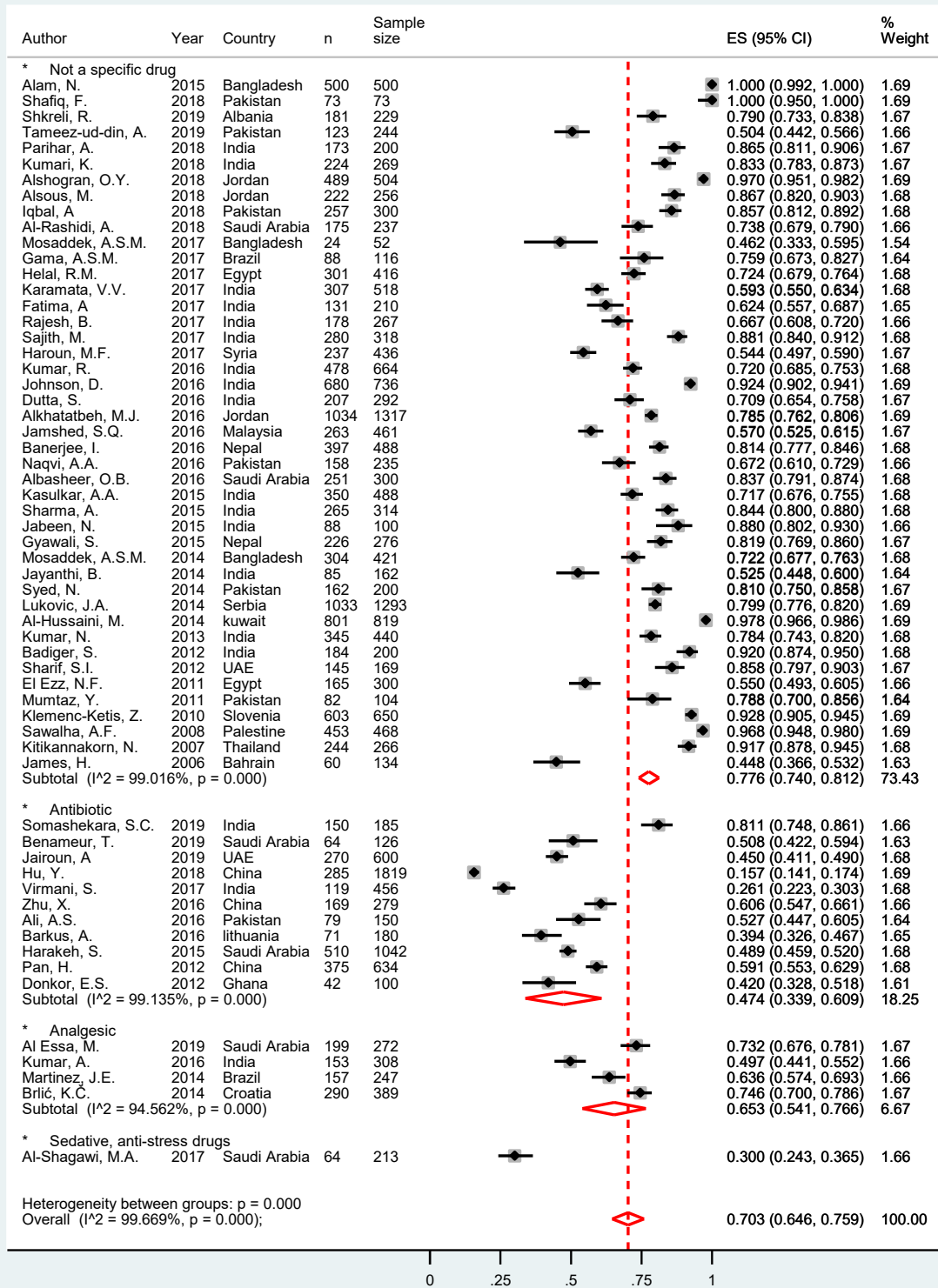


Figure 2: The forest plot of self-medication by type of drug assessed included a study in medical students' last year

knowledge, this is the first systematic review and meta-analysis on the prevalence of self-medication in medical science students. The present analysis included 76 studies involving 29 726 participants, conducted between 2000 and 2019. In most studies, the prevalence of self-medication was calculated over the past year. The findings of this study demonstrated a self-medication prevalence of > 77.6% among medical science students.

In the case of medical science students, the high prevalence of self-medication may be attributed to the easy access to medications and information regarding different types of medications. Furthermore, the prevalence of self-medication demonstrated a large variation, between 28% and 81% in different countries, which can be attributed to methodological differences, including sample size, study method, study duration, information collection

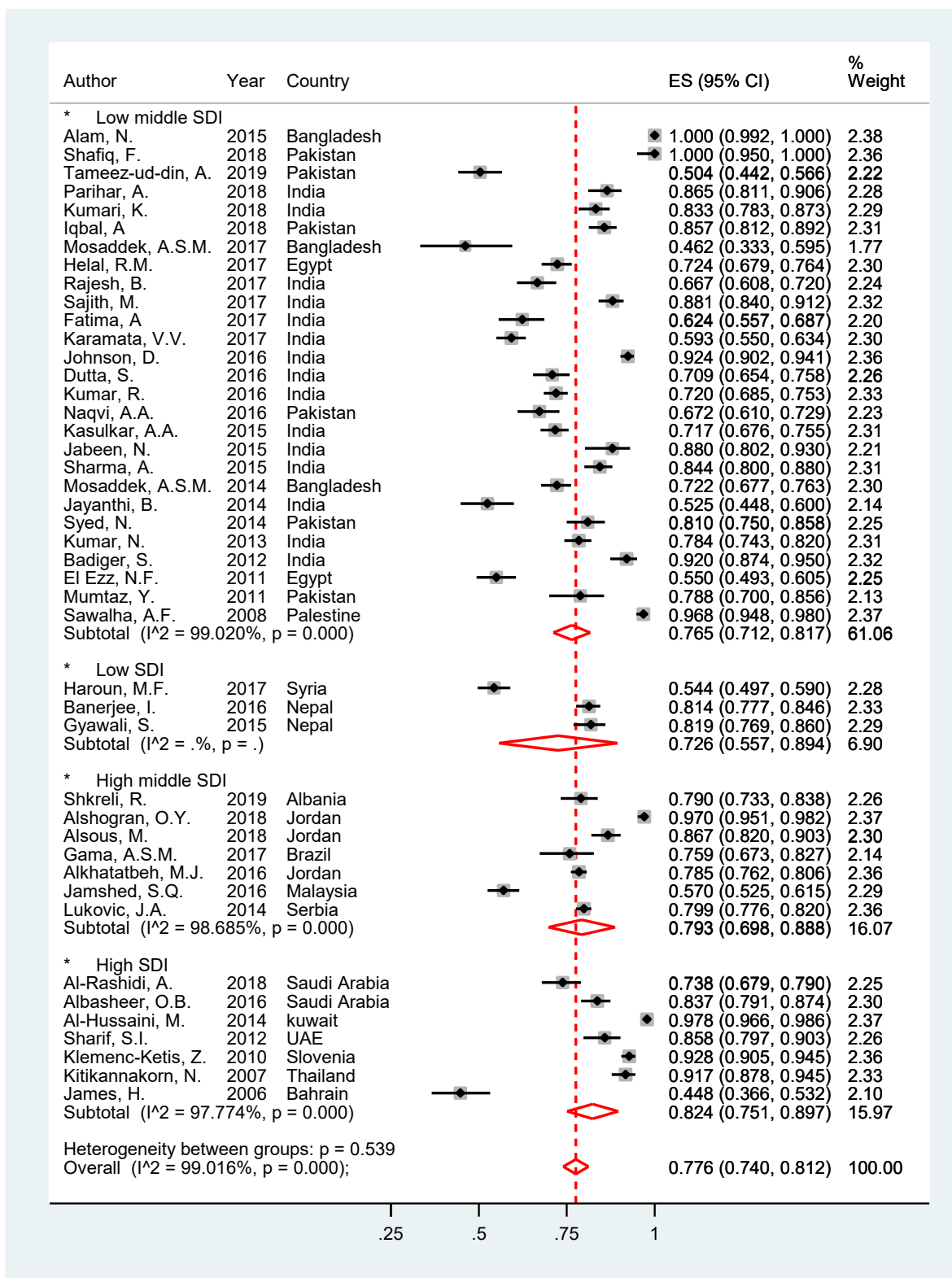


Figure 3: The forest plot of at least one non-specific drug self-medication in medical student in the last year by Socio-Demographic Index (SDI)

method, the country conducting the study, and the location of the study. Additionally, the high prevalence of self-medication among medical science students can be due to the lack of strict regulations for medications prescribed by physicians as well as the distribution and sale of medications in pharmacies. Notably, no similar study has investigated these aspects. However, in a study

conducted in the general Indian population, the prevalence of self-medication was 53.57%, which was lower than that observed in the present study.¹² This can be attributed to differences in the sample size investigated, number of studies selected, location of the studies, and the communities assessed in the studies. Furthermore, the prevalence of antibiotic and analgesic use was

Table IV: The result of meta-analysis and pooled prevalence of not specific drug self-medication in medical students last year by country

Country	n, Sum of sample size	Range of prevalence	Pooled prevalence (95% CI)	Ref.
Kuwait	1,819	-	97.8 (96.5 to 98.6)	
Palestine	1,468	-	96.8 (94.8 to 98)	
Slovenia	1,650	-	92.8 (90.5 to 94.5)	
Thailand	1,266	-	91.7 (87.8 to 94.5)	
Jordan	3,2077	78.5 to 97.0	87.4 (74.3 to 100)	
Nepal	2,764	81.4 to 81.9	81.5 (78.8 to 84.3)	
Saudi Arabia	2,537	73.8 to 83.7	80.1 (76.8, 83.5)	
Serbia	1,1293	-	79.9 (77.6 to 82)	
Albania	1,229	-	79 (73.3 to 83.8)	
Pakistan	6,1156	50.4 to 100	77.3 (62.4, 92.2)	
India	15,5178	52.5 to 92.4	76.7 (70.7, 82.8)	
Brazil	1,116	-	75.9 (67.3, 82.7)	
Bangladesh	3,973	46.2 to 100	73.6 (48.5 to 98.8)	
Egypt	2,716	55.0 to 72.4	66 (62.5 to 69.4)	
UAE	1,169	-	59.8 (56.7 to 63)	
Malaysia	1,461	-	57(52.5, 61.5)	
Syria	1,436	-	54.4 (49.7 to 59)	
Bahrain	1,134	-	44.8 (36.6 to 53.2)	

Table V: Common causes of self-medication among medical students

Type of drug	Fever	Pain	Abdominal problems	Headache	Cough Common cold	Skin and hair	Neurological diseases	Musculoskeletal disorders	Psychological problems	Allergy	Menstruation	Infection	Others
Abay SM (2010) ¹⁸	✓	✓	✓	✓	✓	✓							✓
Abdi A (2018) ¹⁹	✓			✓	✓	✓	✓	✓					
Ahmadi SM (2016) ²⁰	✓			✓	✓	✓			✓	✓			
Al Essa M (2019) ²²	✓	✓	✓	✓				✓		✓			
Albasheer OB (2016) ²⁴		✓	✓	✓	✓	✓			✓				
Albusalih FA (2017) ²⁵	✓	✓	✓	✓	✓	✓					✓		✓
Al-Hussaini M (2014) ²⁶	✓	✓	✓	✓	✓	✓					✓	✓	
Ali AS (2016) ²⁷	✓	✓	✓		✓							✓	✓
Alkhatatbeh MJ (2016) ²⁸	✓	✓	✓	✓	✓	✓				✓			✓
Alshahrani SM (2019) ³¹	✓	✓	✓	✓	✓	✓			✓			✓	✓
Alshogran OY (2018) ³²	✓	✓	✓	✓	✓	✓					✓	✓	✓
Alsous M (2018) ³³	✓	✓	✓	✓	✓	✓			✓	✓			
Badiger S (2012) ³⁴	✓		✓	✓	✓				✓				✓
Banerjee I (2016) ³⁵	✓		✓	✓	✓								
Barkus A (2016) ³⁶						✓						✓	
Benameur T (2019) ³⁷	✓		✓		✓	✓						✓	
Fatima A (2017) ⁴³		✓	✓										
Harakeh S (2015) ⁴⁶	✓				✓								

Haroun MF (2017) ⁴⁷	✓		✓	✓	✓				✓		✓	
Helal RM (2017) ⁴⁸		✓	✓				✓					
Hu Y (2018) ⁴⁹	✓	✓	✓	✓	✓							
Jayanthi B (2014) ⁵⁶		✓	✓			✓		✓				
Kanwal ZG (2018) ⁵⁸	✓		✓	✓	✓				✓			
Kasulkar AA (2015) ⁶⁰	✓		✓	✓	✓	✓						
Kumar N (2013) ⁶⁴	✓	✓	✓	✓	✓	✓	✓					
Mosaddek ASM (2014) ⁶⁹	✓		✓	✓	✓				✓			
Mosaddek AS Md (2017) ⁷⁰	✓	✓	✓	✓	✓							
Mumtaz Y (2011) ⁷¹	✓	✓	✓	✓	✓				✓			
Parihar A (2018) ⁷⁵	✓		✓	✓	✓					✓		
Patil SB (2014) ⁷⁶	✓	✓	✓	✓	✓							
Sajith M (2017) ⁷⁹	✓	✓	✓		✓						✓	✓
Shafiq F (2018) ⁸⁴	✓		✓	✓					✓			
Sharma A (2015) ⁸⁶	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓

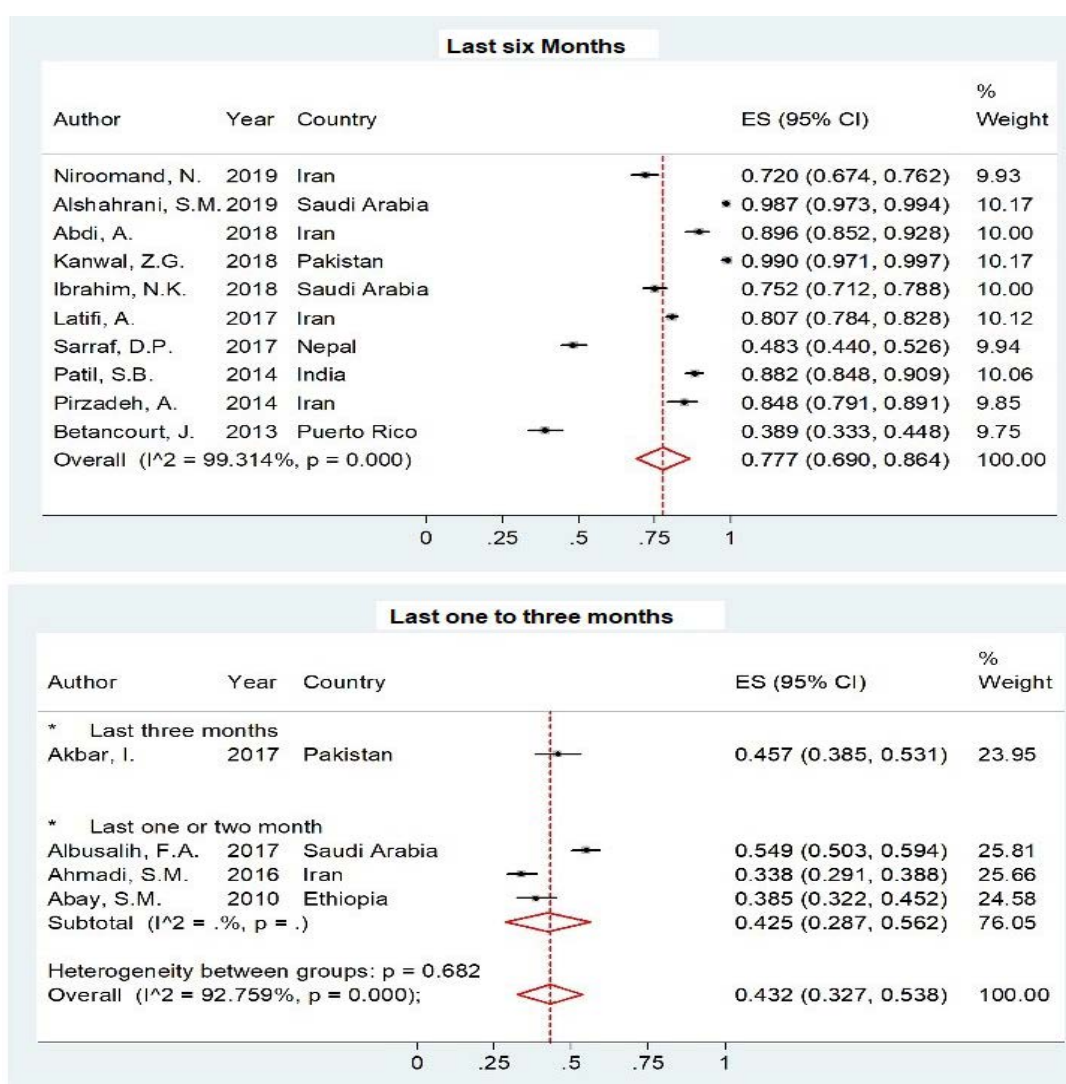


Figure 4: Forest plot of self-medication with no specific drug at least once in the last six months and last one to three months time intervals in medical science students

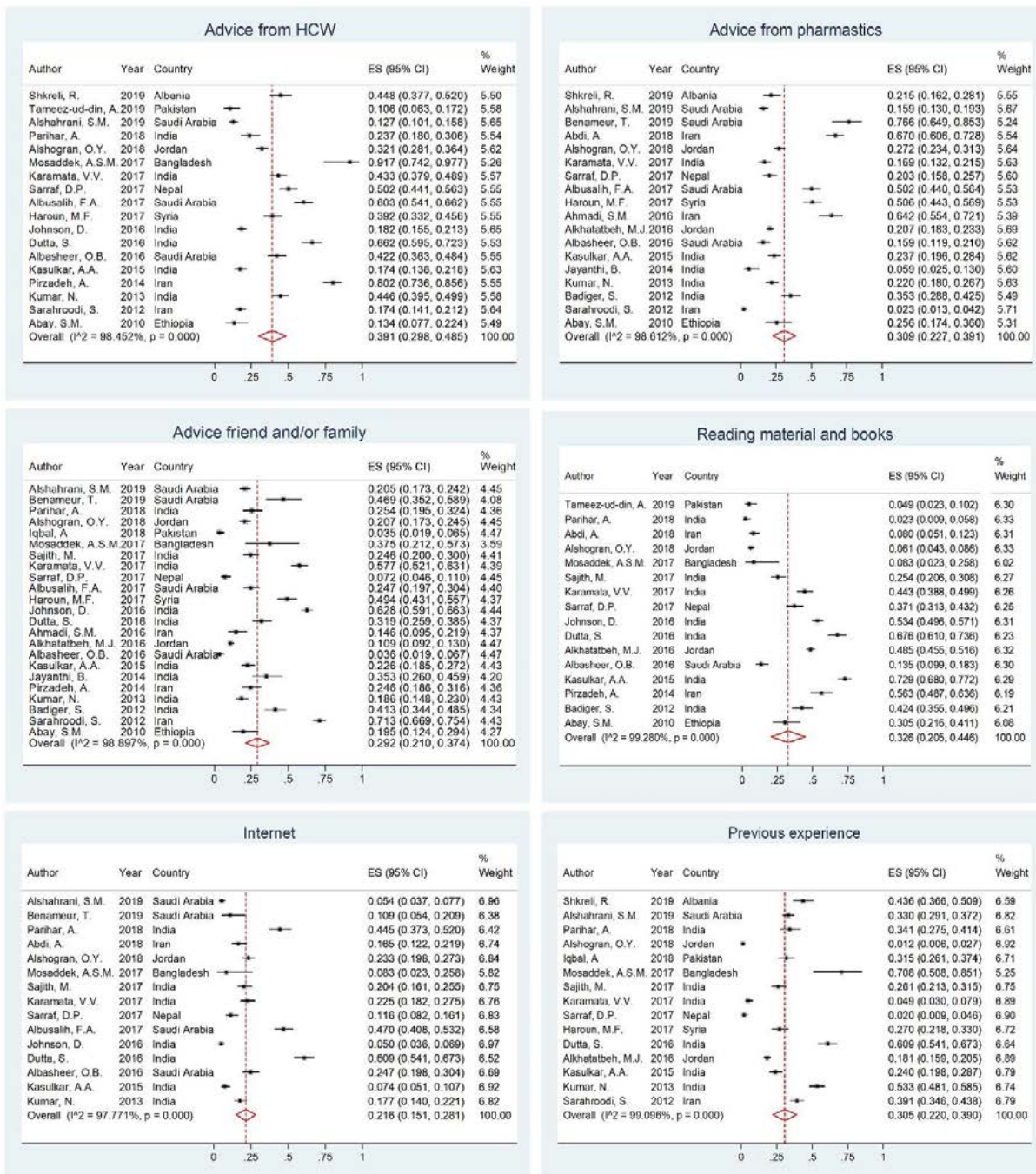


Figure 5: The forest plot of sources of information for self-medication in the medical student had at least one self-medication in the last month to last one year

47.4% and 69.9%, respectively. However, in a previous study, the prevalence of antibiotic use in the general population was reported to be between 18% and 82%.¹³

In a study performed by Ocan et al. on the general population including housewives, the reported prevalence of antibiotic self-medication was 38.8%, which was lower than that in the present study. This difference can be attributed to the type of population studied in the two studies, number of studies included, and the sample size.¹⁴ In studies investigating the general population in Euro-Mediterranean countries, India, and Ethiopia, the prevalence of self-medication was reportedly 40.9%, 53.57%, and 44%,

respectively, all of which were lower than those found in the present study.^{12,13,15} In the present study, the higher prevalence rates can be due to differences in the target population, number of studies selected, and the greater familiarity of medical science students with medications.

Moreover, the results demonstrated that the most common types of medications used were analgesics (47.1%) and antipyretics (46%). In a study conducted among adolescents by Gualano et al., the most common type of medication used was analgesics.¹⁶ In the present study, the prevalence of self-medication among female students was higher than that observed among male

students (75.6%). In contrast to a previous study that assessed the general population, the prevalence of self-medication in men was higher than that in women.¹³ Furthermore, the results demonstrated that the prevalence of self-medication among medical science students was higher in countries with a high SDI status (82.4%). However, the exact cause of the high prevalence of self-medication in countries with higher economic levels remains unclear. In contrast to the current study, the prevalence of self-medication in less developed countries has been reported to be higher in studies assessing the general population owing to the lack of rules and regulations regarding the use of prescription medications.¹⁵

Among medical science students, the most common sources of information on self-medication were HCWs (39.1%), books and resources (32.6%), and pharmacists. In a study conducted by Alhomoud et al. on the general population, pharmacists were the most common source of information.¹³ In India, a study conducted by Rashid et al. revealed that pharmacists, similar to HCWs, were the most important sources of information on self-medication.¹² Therefore, the healthcare sector plays a crucial role in providing training regarding the accurate use of medications, preventing the overuse of medications, and reducing the sale of medications without appropriate prescription. In the present study, students received the necessary information from various sources, including family, friends, and the internet. This illustrates the importance of providing comprehensive and holistic training to the general population through the internet and social networks to ensure the correct use of medications. The most common causes of self-medication include abdominal problems ($n = 30$), pain ($n = 29$), cough, and the common cold ($n = 27$). Systematic reviews have reported that the most common cause of self-medication is the common cold.^{13,15,16} However, in a study conducted by Rashid et al., the most common cause of self-medication was headache relief.¹² The exact reason for this difference remains unclear, but can be attributed to variations in the types of communities investigated. Among different populations, presence of different models of self-medication can be attributed to varying and poor levels of knowledge regarding the drug-associated side-effects. Increase in public awareness about the proper use of medications and establishment of strict rules for medication supply, especially among medical science students, can positively impact and reduce the practice of self-medication.^{16,17} Furthermore, awareness among medical science students can be increased via brochures, posters, public speeches, and seminars.

Limitations

The most important limitations of the present study are as follows: the studies selected were descriptive; therefore, the specific limitations of these studies should be considered when interpreting the results. Additionally, the selected studies measured the prevalence of self-medication at different time points, making it difficult to determine the overall prevalence. To overcome this limitation, the prevalence of self-medication was reported based on a specific time period. Only studies conducted

in English were included in this meta-analysis; hence, non-English studies should also be investigated in the future. The sample sizes of the included studies were small, which needs to be increased in future studies. In most studies, convenience sampling was used based on the researcher's judgment, which could have impacted the study results. Furthermore, homogeneity was higher among studies that used the random effects model to perform the meta-analysis. As a limitation due to gap for publication there may be some new studies which have not been included.

Strengths

To the best of my knowledge, this is the first systematic review to assess the prevalence of self-medication in medical science students. In this study, all possible aspects of self-medication, including prevalence, causes of use, information sources, and types of medications used, were examined. Furthermore, only studies published in high quality scientific journals were included, and the prevalence of self-medication was investigated based on the economic levels of the countries and WHO-defined regions.

Conclusion

This study revealed a high prevalence of self-medication among medical students. The results showed that HCWs were the most important sources of information on self-medication; hence, providing them with accurate information is crucial. To reduce the prevalence of self-medication, our findings can be used as a basis for decision-making by policymakers in the healthcare sector in clinical settings. The results of the present study can help policymakers to better understand the more vulnerable participants, the most important causes of self-medication and common drugs used so as to better manage and limit their use.

Providing and implementing educational interventions to increase the awareness of students regarding the early and late effects of self-medication can help to reduce the prevalence of self-medication among medical science students. In future studies, it is recommended that a standard tool be used to evaluate the prevalence of self-medication. Further qualitative studies in this field can improve our understanding of the sociocultural causes of self-medication.

Conflict of interest

The authors declare no conflict of interest.

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