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Review Article

Patterns of Self-Medication and Drug Storage: A Global Meta-Analysis

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Abstract

Self-medication, a universal public health issue, is an increasingly common concern. A meta-analysis of global self-medication patterns will be worthwhile for a comprehensive yet comparative consideration of the burden and related problems and planning for macro-health interventions and policies. This study aimed to determine the patterns of self-medication and drug storage behavior globally in various subgroups and its related factors. A systematic search detected relevant studies (1995 to 2018) in the English databases. The related observational study was concluded in this study. Studies that examined self-medication and drug storage at home in the general population were entered into the study. The pooled proportion and odds ratio of self-medication and drug storage at home were calculated by STATA -14. Of 25'225 titles found, 95 studies were included in the final analysis. The pooled prevalence of self-medication was calculated at 54.0% ±4.0% (60% for over-the-counter (OTC) drugs and 43.0% for prescription-only medicines (POM) drugs). The pooled prevalence of drug storage at home was estimated to be 53.0% (CI 95%: 36.0, 70.0). The proportion of self-medication and drug storage at home in continents was: Africa 64.0% and 39.0%, Asia 58.0% and 64.0%, Europe 39.0% (both), and America 32.0% and 8.0%, respectively. African countries had the highest consumers of POM drugs as well as antibiotics. Pharmacists provided the most information about drugs in African studies. The adjusted odds ratio of self-medication was higher in females with higher education status in European and African countries. The prevalence of self-medication for POM drugs was noteworthy, especially in Asian and African countries. Comprehensive education for pharmacists must be accomplished. Also, increasing drug information is critical for women who usually manage family health in households.

Keywords: Self-medication; Drug storage; Over-the-counter drugs; Prescription-only medicines; Antibiotics; Meta-analysis.

1. Introduction

Self-medication is defined as the selection and use of medicines for the prevention and treatment of disease or promotion of health without a medical prescription [1, 2]

Self-medication is a double-edged sword; when it is consumed consciously, it contributes to improving life quality. However, lots of users take medications without being fully informed about the related risks, adverse effects, and contradictions. Therefore, misuse of

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medications can obstruct desired treatment and cause harmful reactions [3]. Various studies have declared that a considerable section of diseases are handled by self-medication while not earning the attention of a health professional [3].

Overall, the prevalence of self-medication in developing countries has been reported to be more than in European or American countries. For example, the self-medication proportion is over 60% in India[4], Saudi Arabia[5], and Nigeria[6] in comparison with Lithuania (21%), Romania (19.8%) and Spain (15.2%) [7]. In recent years, there has been a vast increase in the per capita use of medications in developed and developing countries [8-10]. Self-medication is affected by numerous social and economic factors, which cause the prevalence range to be extensive. These factors included local regulations, accessibility to doctors or medicine, pharmaceutical companies' advertisements, the financial burden of visiting a doctor or other medical costs, and individual factors, such as age, gender, education level, income, and personality characteristics [1, 11, 12]. One of the important reasons for the increasing trend of self-medication is the habit of storing medication at home [12]. Some studies have found an association between medicine storage and self-medication practices [11].

Data on self-treatment are usually unavailable in large medical databases [13], and research on self-treatment is relatively limited in the literature. However, the role of self-treatment in health care should not be ignored, first because of its high prevalence[10, 13], second because of the considerable financial burden (due to poorly covered by insurance), possible dangers due to awareness lack, such as serious drug interactions, exposure to side-effects, poor response to treatment and antimicrobial resistances [10, 12-15].

Few literature and systematic reviews have been conducted recently [10]. In the systematic review study done in 2017, the range of self-medication was reported as 0.1% to 100 % [16]. This study was not a meta-analysis study. In another systematic that was executed in European and Anglo-Saxon countries, self-medication with antibiotics was surveyed [10, 13].

To our knowledge, no global meta-analysis provides comprehensive information on self-medication, drug storage at home, and its related factors. The meta-analysis study was conducted to fill the existing knowledge gap.

Our aims in this study were to conduct a meta-analysis to 1. Calculate a pooled prevalence of self-medication globally based on various subgroups such as demographic characteristics and sources for obtaining medication information; 2. Determine the prevalence of drug storage at home, and 3. Perform multiple Meta-regression on demographic and clinical-related factors in self-medication.

2. Materials and Methods

This study was conducted according to the PRISMA statement.

2.1. Eligibility Criteria and information source

Any published literature from any country between January 1995 and September 2018 that had studied self-medication and drug storage at home in the general population was entered into the study.

2.2. Information source

We used a web-based citation index to cite studies. Lists of references in searched studies were surveyed, too. Searching was conducted between June and September 2018.

2.3 Search

All published Articles in Cochrane Library, CINAHL, Current Contents, Database of Abstracts of Reviews of Effects (DARE), PubMed, Directory of Open Access Journals (DOAJ), Scopus, Google Scholar, and Thomson Reuters were surveyed.

Medical Subject Heading (MeSH) was used for keywords. The terms were: (self-medication OR self-prescription OR drug storage) AND (prevalence OR frequency OR proportion) AND (community OR drugstores OR household). (Self-medication OR self-prescription OR drug storage) AND (drug information OR pharmacies* OR physician* OR family* OR experience OR friend*). (Self-medication OR self-prescription OR drug storage) AND (therapeutic groups OR antibiotic* OR anti-parasitic drugs OR cold medication OR anti-allergic agents OR (anti-anxiety OR depressing drug) OR anti-inflammatory agents OR steroidal OR sedative OR vitamin* OR minerals OR NSAIDs OR gastrointestinal drug OR herbal drug OR cardiovascular drug OR topical drug). (Self-medication OR self-prescription OR drug storage) AND (age OR sex OR demographic* OR clinical). All authors approved the search strategy.

2.4. Study selection

We included cross-sectional studies that investigated self-medication or drug storage in the general population from 1995 to 2018, with a sample size above 15, and used frequency, percent, proportion, and mean (SD) for reporting self-medication, drug storage, and their related factors. Any study with special subgroups was excluded. Eligible studies were reviewed for determining relevancy and extracting related data.

2.5. Data Collection Process

Two authors selected data based on the Consumers and Communication Review Group's data extraction template. The pilot study was conducted on ten studies. Data extracted included study year, study design, geographical location, sample size, participants, eligibility criteria, setting, source of population, outcomes predicted, type of statistics, and analysis method by two authors. A third author surveyed disagreements.

2.6. Risk of bias in individual studies

Two reviewers surveyed the risk of bias in this study. Bias risk was rechecked using the Cochrane Collaboration's Tool (Higgins & Green 2011)

2.7. Summary measures

The pooled proportion of self-medication and drug storage among the population was estimated. Pooled proportion in subgroups as sample size, year of study, source of the population (households, community, drug stores, shopping malls or market and health centers), setting of the population (rural, urban or both), continents (Africa, America, Asia, and Europe), therapeutic groups and source of information about self-medication was

calculated by random-effects logit models. Univariate and multiple Meta regression by Knapp-Hartung modification method calculated the pooled odds ratio. All analyses used STATA 14 (Stata Corp. 2014. Stata Statistical Software: Release 14. College Station, TX: Stata Corp LP).

2.8. Synthesis of results and Additional analyses

Heterogeneity in meta-regression was examined by subgroups of study year (1995-2000, 2000-2010, after 2010), sample size in studies (<500, 500- 1000, and >1000), continents (Africa, America, Asia, and Europe), setting of study (rural, urban or both) and source of population (household, community, drug store- market and health center).

3. Results and Discussion

3.1. Study selection

In primary search, we found 25'225 titles. After the duplicates were removed, 17'372 titles remained. 17'299 titles were excluded after screening their titles and abstracts. Finally, 143 full-text articles were investigated. Overall, 95 studies were included in the analysis, and their data and findings were reviewed. The PRISMA flow diagram is accessible in **Figure 1**.

3.2. Study characteristics

Fifty-seven studies (58.8%) related to Asian countries, and in 52.3% of studies (51 articles), the source of information was households, and 51.7% (46 cases) were of urban origin. Basic information of the reviewed studies is demonstrated in **Table 1**.

3.3. Risk of bias within studies

Based on Egger's and Begg's tests on self-medication data, no publication bias was discovered in this meta-analysis (p=0.147 and 0.150, respectively). Also, Egger's and Begg's tests for the prevalence of drug storage at home gave p-values of 0.785 and 1.0, indicating no evidence of publication bias.

Table 1: Basic information of reviewed studies.

Variables	Cofactors	N (%)
Sample size	<500	45(46.4)
	500-1000	26 (26.8)
	>1000	26(26.8)
Location (continent)	Africa	14(14.4)
	America	8(8.2)
	Asia	57(58.8)
	Europe	18(18.6)
Source of population	Household	41(42.3)
	Community	18(18.6)
	Drug store-market	27(27.8)
	Health center	11(11.3)
Year of study	1995-2000	10(10.3)
	2000-2010	34(35.1)
	2010-2018	53(54.6)
Setting of population	Rural-urban	30(33.7)
	rural	13(14.6)
	urban	46(51.7)

3.4. Results of individual studies and Synthesis of results

Finally, 95 articles (of 143 full-text articles) were included in the analysis, and 48 articles were excluded from the study due to the different types of effect sizes or the incompleteness of the indicators required for the statistical test.

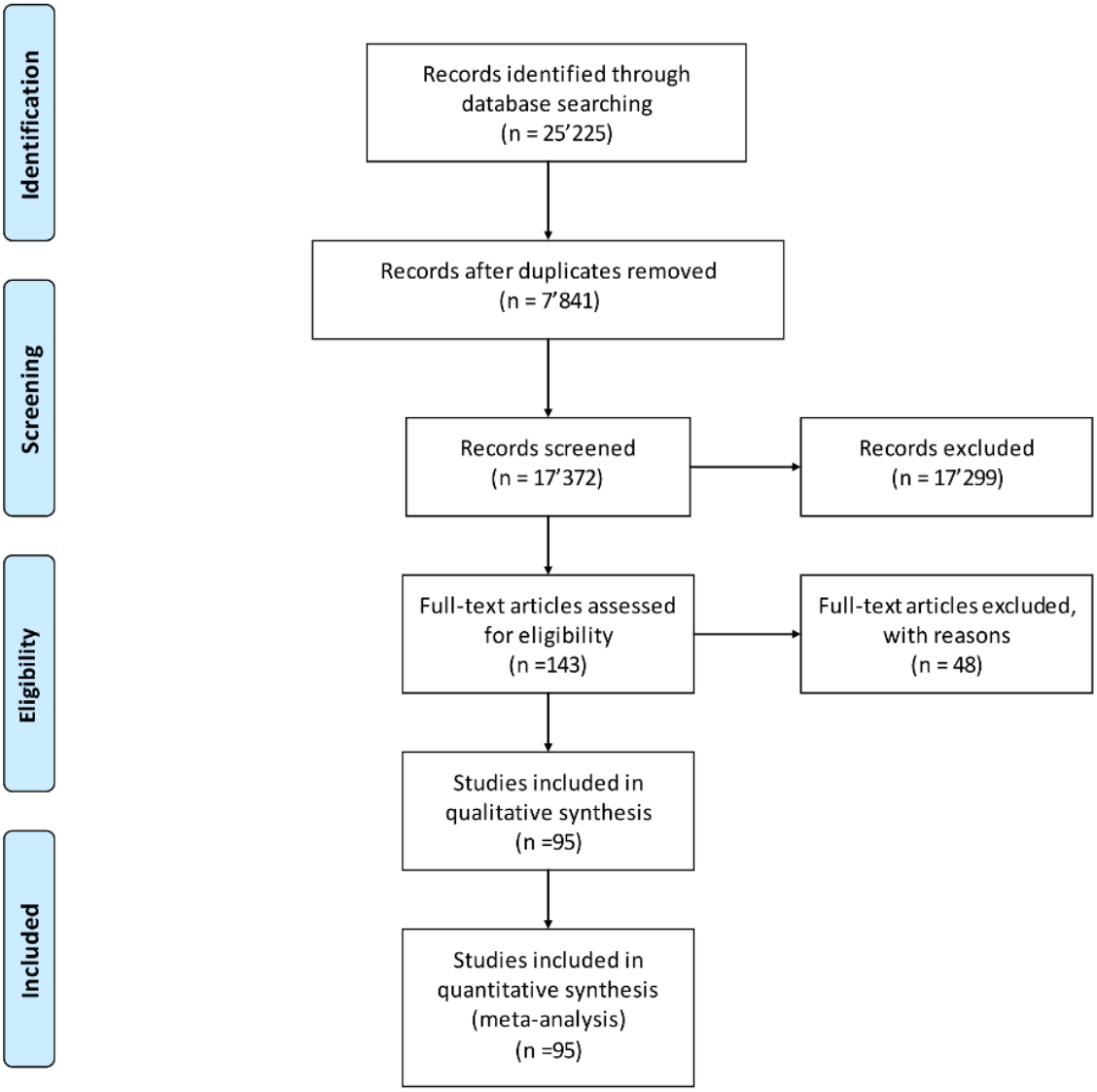

Figure 1 Flow chart of the included and analyzed studies in the meta-analysis.

3.5. Self-Medication Prevalence

Overall, Meta prevalence of self-medication (in 79 studies) [1, 4, 11, 17-92] was calculated as 54.0% (CI 95%: 48.0, 59.0, $P_{\text{heterogeneity}}$ <0.001) (**Figure S1**). Self-medication with over-the-counter (OTC) or prescription-only medicines (POM) was specified in 15 [23, 25, 37, 38, 48, 52, 62, 65, 67, 72, 76, 79, 80, 87, 90] and 11 [23, 25, 37, 38, 48, 52, 65, 67, 72, 76, 85] of 79 the studies respectively. The pooled prevalence of OTC and POM drugs self-medication was estimated to be 60.0 (CI 95%: 44.0, 76.0) and 43.0% (CI 95%: 30.0, 56.0), respectively.

These results were heterogenic ($I^2_{\text{heterogeneity}}$= 99.43 and 99.46, respectively; P-Value<0.0001). The pooled prevalence of self-medication among females (n=27) was higher than males (n=27). This proportion was equal to 49.0% (CI 95%: 37, 60) in males and 53.0% (CI 95%: 40.0, 65.0) in females. Heterogeneity was statistically significant in both estimates (P<0.0001).

Table 2: Meta prevalence of self-medication by continents, sample size, years of study, setting of population, and source of population.

Variables	Cofactors	Prevalence %	CI 95%	I^2 (P-Value)	Number of study
Continent	Africa	64.0	52.0-75.0	99.31(<0.0001)	12
	America	32.0	28.0-37.0	99.34(<0.0001)	5
	Asia	58.0	49.0-68.0	99.85(<0.0001)	48
	Europe	39.0	32.0-47.0	99.85(<0.0001)	12
Year of study	1995-2000	37.0	28.0-45.0	99.65(<0.0001)	9
	2000-2010	56.0	43.0-63.0	99.88(<0.0001)	23
	2010-2018	56.0	48.0-64.0	99.91(<0.0001)	48
Population source	Household	47.0	40.0-55.0	99.91(<0.0001)	31
	Drugstore	53.0	43.0-64.0	99.79(<0.0001)	22
	Community	60.0	48.0-71.0	99.76(<0.0001)	18
	Health center	66.0	40.0-92.0	99.95(<0.0001)	9
Sample size	<500	64.0	51.0-77.0	98.87(<0.0001)	13
	500-1000	59.0	49.0-68.0	99.74(<0.0001)	40
	>1000	42.0	35.0-49.0	99.93(<0.0001)	27
Season	Spring	52.0	33.0-71.0	99.82(<0.0001)	11
	Summer	52.0	31.0-74.0	99.92(<0.0001)	15
	Autumn	55.0	34.0-75.0	99.85(<0.0001)	14
	Winter	52.0	31.0-74.0	99.93(<0.0001)	9
Setting	Rural	53.0	34.0-72.0	99.81 (<0.0001)	12
	Urban	58.0	49.0-67.0	99.92(<0.0001)	22
	Rural-Urban	49.0	39.0-60.0	99.91(<0.0001)	39

The prevalence of self-medication in subgroups, based on continent, sample size, year of study, setting of study, and source of population, are shown in **Table 2**.

The highest pooled prevalence of self-medication between continents was estimated at 64% (CI 95%: 52.0, 75.0) in African studies, followed by 58.0 %(CI 95%: 49.0, 68.0) in Asian studies. The lowest prevalence was in American studies with 32.0% (CI 95%: 28.0, 37.0) and European studies with 39.0 % (CI 95%:32.0, 47.0). Heterogeneity was significant in all four subgroups ($P_{\text{heterogeneity}}$ <0.001). Yemen [22, 33], Nigeria (92.0%) [18, 57], and Egypt (84.0%) had the highest pooled prevalence of self-medication among the 37 countries studied, Sri Lanka (10.0%) [88] and Spain [35, 43, 59] - Portugal (23.0%) [60, 65] had the lowest prevalence. The pooled prevalence of self-medication in different continents was calculated and is available in **Figure 2**.

The most common therapeutic agent used for self-medication and their prevalence in various continents is shown in **Table 3**. Evaluation of drug agents investigated in more than three studies revealed that self-medication with herbal agents was most prevalent in African countries (44% - CI 95%: 17.0, 71.0). Analgesic drugs were the most common therapeutic agent used for self-medication in American countries (59% - CI 95%: 40.0, 76.0), Asian countries (56% - CI 95%: 40.0, 72.0) and European countries (25% - CI 95%: 13.0, 36.0).

3.6. Source of information for self-medication

The most common source of information for drug use in African studies was pharmacies (40.0%; CI 95%: 29.0, 51.0), followed by previous experience (35.0 %; CI 95%14.0, 56.0).

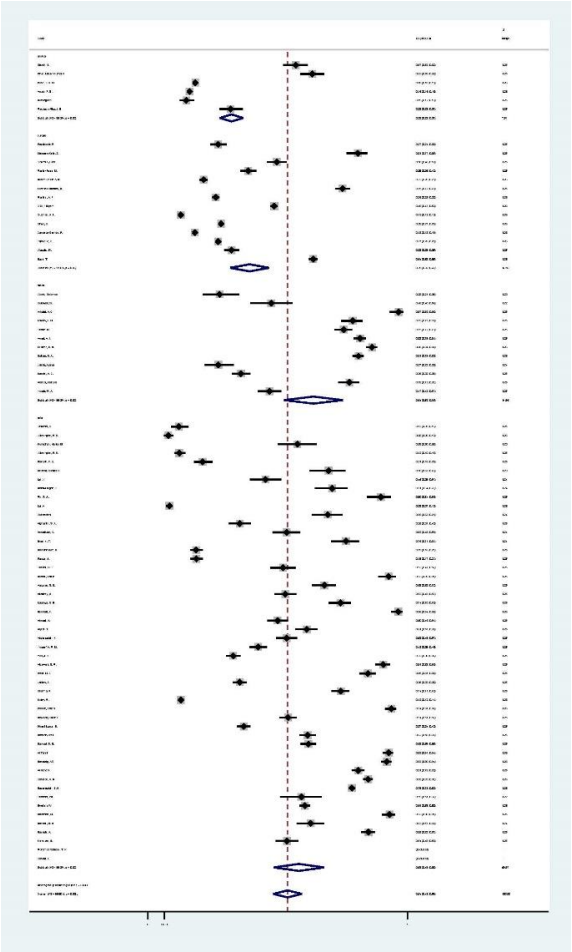

Figure 2 Forest plot of pooled prevalence of self-medication in different continents.

The prevalence of consulting a physician for using drugs in African studies was 22% (CI 95% 11.0, 25.0). In Asian studies, the most common source of information (42.0%, CI 95%: 31.0, 53.0) was reported as previous experience. In European countries, obtaining information about self-medication from pharmacies and previous experience had equal prevalence (36%).

3.7. Drug storage at home prevalence

Out of 12 studies that investigated drug storage at home, the prevalence of drug storage was calculated as 53.0% (CI 95%: 36.0, 70.0; I^2 heterogeneity= 99.9, p-value<0.0001) [1, 11, 12, 26, 29, 44, 45, 47, 50, 64, 87, 92]. The pooled proportion of drug storage at home was highest in Asian countries (5 studies) (64.0%; CI 95%: 45.0, 83.0). This proportion was 58.0% (CI 95%: 10.0, 100.0) in European countries (2 studies), 39.0% (CI 95%: 4.0, 82.0) in African countries (4 studies), and 8.0% (CI 95%: 6.0, 11.0%) in American countries (1 study). The therapeutic agents mostly stored at home in various continents are presented in **Table S1**.

3.8. Heterogeneity analysis

In the heterogeneity test between different subgroups of studies, there was a significant difference between years of conducted studies ($X^2_{\text{heterogeneity}}$ = 8.44; P-Value<0.001). The prevalence of self-medication in different studies was reanalyzed using the restriction method on continents. In studies from Asian countries, the heterogeneity test between subgroups of the study year was not significant ($X^2_{\text{heterogeneity}}$= 0.43; P-Value=0.8); in African and European countries, heterogeneity was significant ($X^2_{\text{heterogeneity}}$ = 24.80 and 8.16; P-Value<0.001 and 0.02 respectively). Data from American countries was not sufficient for analysis. European studies revealed an increasing trend in self-medication. The prevalence of self-medication was calculated to be 21.0 % (CI 95% = 14.0, 31.0), 38% (CI 95%: 23.0, 55.0), and 50 % (31.0, 69.0) in the years 1995-2000, 2001-2010 and 2011-2018 using the logit method, respectively. In African studies, the proportion by logit method was 82% (CI 95%: 59, 94%) between 1995-2000, 42% (CI 95%: 38.0, 46.0) in 2001- 2011, and 66.0% (CI 95%: 46.0, 82.0%) in 2011 to 2018 years.

Table 3: Pooled prevalence of self-medication based on therapeutic groups in various continents.

Therapeutic Groups	Africa			America			Asia			Europe		
	1*	**2¥**	**n**	**1***	**2¥**	**n**	**1***	**2¥**	**n**	**1***	**2¥**	**n**
Cold Medication	93.0 (92-95)	-	2	8.0 (7-9)	-	2	44.0 (30-58)	99.67	18	24.0 (12-37)	99.89	7
Fever Reducing	83.0 (76-90)	-	2	-	-	0	53.0 (39-67)	99.38	10	-	-	0
Antidepressant	-	-	0	9 .0 (5-17)	-	3	4.1 (1-9)	97.28	4	-	-	0
Hormone-Medication	-	-	0	1 .0 (1-2)	-	2	6.0 (3-8)	97.37	10	4 .0 (1-6)	96.58	4
Vitamin _Mineral	73.0 (70 -76)	-	1	5.0 (4 -5)	-	2	28.0 (16-39)	99.61	19	17.0 (5-28)	99.78	5
Analgesics	29.0 (17-40)	97.21	5	59.0 (41-76)	97.60	4	56.0 (40-72)	99.75	8	25.0 (13-36)	99.82	23
Sedative	-	-	-	16.0 (10-24)	-	1	13.0 (7-10)	99.42	8	8.0 (4-13)	98.68	4
NSAID	12.0 (9-15)	-	1	16.0 (15-16)	-	2	48.0 (38-58)	97.38	10	44.0 (6-82)	-	3
Anti _Allergy	11.0 (9-13)	-	1	11.0 (7-18)	-	1	16.0 (12-20)	98.97	17	2.0 (1-2)	79.22	5
Anti-Acid	5.0 (4-7)	-	3	7.0 (3-11)	-	3	29.0 (11-47)	99.80	14	4.0 (3-5)	60.63 (0.05)	4
Gastrointestinal-Medication	22.0 (1-44)	99.73	4	4.0 (3-4)	-	3	21.0 (16-27)	99.03	23	9.0 (5-12)	99.26	8
Cough Medicine	30 (9-52)	-	3	-	-	0	31 (18-44)	99.15	11	31 (-4-66)	-	3
Cardiovascular-Medication	12.0 (11-13)	-	2	10.0 (6-18)	-	1	8.0 (5-11)	96.0	12	5.0 (1-9)	99.25	5
Antibiotics	33.0 (16-49)	98.99	6	3.0 (3-3)	-	2	8.0 (5-11)	98.03	6	24.0 (14-35)	99.76	30
Anti-Parasite	19.0 (3-34)	98.24	4	-	-	0	4.0 (1-6)	88.97	4	14.0 (12-15)	-	1
Herbal Therapy	44.0 (17-71)	99.86	14	3.0 (3-4)	99.50	5	25.0 (4-46)	-	1	-	-	0
Renal-Medication		-	0	-	-	0	2.0 (1-4)	-	1	-	-	0
Topical Medication	1.0 (8-11)	-	1	-	-	0	12.0 (7-17)	98.65	11	4.0 (3-4)	-	2
Steroids	7.0 (5-9)	-	1	-	-	0	13.0 (1-25)	-	3	3.0 (2-6)	-	1

*1 is Prevalence (CI95%). ¥2 is I^2 P-Value and for all data was (0<0.001).

The heterogeneity of self-medication in year ranges by restriction of seasons was also evaluated. There was no heterogeneity in studies conducted during spring and autumn ($X^2_{\text{heterogeneity}}$ =0.0 and 0.58; P-Value=0.98 and 0.44, respectively). Prevalence of self-medication among studies during summer since 2001-2010 was lower compared to studies from 2011- 2018 (P= 30.0%, CI 95%: 14.0, 53.0, and P= 57%, CI 95%: 40.0, 73.0; $X^2_{\text{heterogeneity}}$ = 8.07, P-Value< 0.001), additionally in studies restricted to winter, there was heterogeneity between year groups ($X^2_{\text{heterogeneity}}$ =8.92, p-value= 0.01) and there was also an increasing trend in self-medication by year (P-values $_s$ =27.0 % (CI 95% = 13.0, 46.0), 60.0% (CI 95%: 31.0, 83.0) and 63.0% (CI 95%: 42.0,83.0) in 1995-2000, 2001-2010 and 2011- 2018 respectively.

Furthermore, there was heterogeneity between self-medication restricted to mean age ($X^2_{\text{heterogeneity}}$ = 15.48 and 11.63; P-Value$_s$

<0.001) in populations with <35 and ≥35 years old, respectively.

3.9. Relationship of some variables with self-medication

In univariate meta-regression on sample size dummies (<500, 500-1000, and >1000), year of study dummies (1995-2000, 2001-2010, and >2010), source of the population (households, community, drug stores, mall, and market and health centers), setting of the population (rural, urban or both), continent (Africa, America, Asia, and Europe), mean age of population, education status dummies (primary school/lower, intermediate, high school/ diploma and collegiate) and job groups dummies (employee, housewife, self-employed, student and unemployed), cofactors with p-value<0.1 were entered to model for multiple regression. The odds ratio of self-medication was 2.49 in women compared to men (CI 95%: 2.19, 2.84) (I^2 $_{heterogeneity}$ = 95.6). [4, 11, 23, 26-28, 31, 36, 41, 50, 52, 55, 56, 59, 60, 63, 66, 68-70, 81, 82, 85, 88, 89]. More details are accessible in **Table 4**.

In multiple Meta-regression, the odds ratio of self-medication was more significant in females with higher education status from European and African countries. In Asian countries, female participants in studies from drug stores had a high odd ratio (**Table S2**).

The bubble plot of Meta-analysis between self-medication and gender based on age and year of study are illustrated in **Figures S2** and **S3**. According to Figure 2, there was a decreasing gentle slope in the odds ratio of self-medication in females with increasing age. The current study was the first global meta-analysis that reviewed self-medication and drug storage at home in various subgroups and identified adjusted factors associated with self-medication. Previous studies have reviewed literature systematically on self-medication in some regions of the world, such as Ethiopia [15], Brazil [10], the Middle East [93], Iran [15], and India [94]. The aim of this research was to Meta analyze the prevalence of self-medication and drug storage at home among people over 18 years old in all countries of the world where reports were available. This study was conducted following PRISMA statements [10].

Pooled analysis of data from 31 countries revealed the prevalence of self-medication varying from 10.0% in Sri Lanka [88] to 92.0% in Yemen [22, 33] and Nigeria [18, 57]. The global pooled prevalence of Self-medication was estimated at 54%, and, as expected, this proportion for OTC drugs was higher than for POM drugs (60% vs. 43%). Noticeably, heterogeneity between studies was significant. Given that this was a universal study from all available studies between 1995 and 2018, heterogeneity in findings was expected.

Among the studies conducted in different continents, the highest prevalence of self-medication was in African studies, with 65%, and then in Asia (50%), the pooled prevalence of self-medication in European and American studies was about the same (39 % and 32%). In a review article by Shehnaz (2014), the overall prevalence of self-medication varied between 2% and 92% [3]. Generally, self-medication has been reported to be higher in developing countries [3, 10].

Table 4: Univariate meta-regression of self-medication odds ratio by some variables

Variables		n	τ^2	I^2	R^2%	OR	SE	CI	p
Female/ Male		26	0.09	95.66	-	2.50	0.16	2.19-2.84	<0.001
Age; (mean)		12	0.09	90.8	-1.96	0.99	0.01	0.96-1.02	0.180
Study's year	1995-2000	26	0.08	95.52	2.94	0.74	0.19	0.44-1.24	0.216
	2001-2010	26	0.07	95.77	16.70	1.42	0.21	1.05-1.91	0.024
	2011-2018	26	0.08	95.84	2.79	0.82	0.12	0.62-1.10	0.187
Sample size	>500	26	0.09	95.81	-3.41	1.10	0.23	0.71-1.68	0.667
	500-1000	26	0.09	95.83	-2.54	0.90	0.11	0.69-1.67	0.405
	>1001	26	0.09	95.80	-4.72	1.09	0.15	0.82-1.43	0.550
Setting of population*	Setting 1	23	0.08	90.11	-5.96	1.04	0.15	0.77-1.41	0.788
	Setting 2	23	0.08	90.83	-4.72	1.10	0.14	0.50-0.83	1.437
	Setting 3	23	0.07	91.49	4.33	0.75	0.15	0.15-0.50	1.121
Source of population**	Source 1	26	0.08	94.93	3.31	0.84	0.10	0.65-1.08	0.177
	Source 2	26	0.90	95.26	-4.76	0.93	0.14	0.69-1.27	0.650
	Source 3	26	0.89	95.73	-4.22	1.16	0.27	0.71-1.89	0.535
	Source 4	26	0.76	95.74	11.57	1.39	0.22	0.99-1.93	0.051
Continents	Asia	26	0.06	93.73	23.67	1.32	0.15	1.04-1.68	0.023
	Africa	26	0.09	95.83	-4.75	0.93	0.19	0.61-1.43	0.743
	Europe	26	0.07	90.12	16.2	0.75	0.11	0.56-1.02	0.063
	America	26	0.09	95.69	-1.59	0.82	0.19	0.51-1.33	0.412
Season	Autumn	26	0.09	94.22	-2.39	0.90	0.14	0.65-1.24	0.513
	Summer	26	0.09	95.83	0.27	1.20	0.19	0.87-1.68	0.256
	Spring	26	0.09	95.82	-1.64	1.17	0.20	0.82-1.68	0.366
	Winter	26	0.09	95.76	-3.55	1.87	0.22	0.71-1.67	0.690
Job status (proportion)	Employee	23	0.30	79.15	58.04	2.38	0.50	1.55-3.64	<0.001
	Housewife	13	0.09	0.0	20.2	1.66	0.70	0.65-4.20	0.257
	Self-employed	3	0.029	77.91	-121.5	1.41	0.47	0.64-3.08	0.341
	Student	10	0.012	0	-	2.10	1.50	0.41-0.85	0.344
	Unemployed	16	0.50	88.93	-.148	0.39	0.39	0.09-2.69	0.309
Education status (proportion)	Primary school/lower	50	0.04	82.14	30.13	0.50	0.15	0.29-0.91	0.043
	Intermediate school	44	0.69	81.93	-6.89	1.20	0.40	0.70-2.41	0.400
	High school /diploma	41	0.69	81.93	-6.89	1.30	0.40	0.20-2.41	0.400
	Collegiate	38	0.30	79.15	58.04	2.38	0.50	1.55-3.64	<0.001
Chronic disease (proportion)		22	0.81	88.86	-17.76	0.98	0.51	0.34-2.88	0.336

A systematic review of studies in the Middle East region indicated that uncontrolled consumption and insufficient control over the purchase and use of drugs in the Middle East is an important reason for Self-medication. Ease of access and convenience in obtaining prescription medication are among other contributing factors to the high prevalence of self-medication in the Middle East [93].

We estimated the pooled prevalence of self-medication with OTC and POM drugs (The denominator was equal to all studies (n)) too. According to this, the highest prevalence of self-medication with POM drugs was in African countries, followed by Asian countries (24% and 18%). The most common source of information for using non-prescribed medication in African studies was pharmacies, followed by previous experience. Notably, obtaining information by consulting a physician in African studies was only 22%. In Asian studies, the most common source of information (42%) was reported as previous experience, which seems to be a great concern.

In European research, getting information for self-medication from pharmacies or previous experience was one (36%). Ayalew found that POM self-medication is more common among whites and illicit drug users. Also, this study reported a higher prevalence of POM self-medication in the USA compared to other countries [15].

In a literature review by Bennadi (2014), the common sources of self-medication information were reported as previous prescriptions, friends, advertisements, and pharmacies [95]. Khalifeh et al., in a systematic review of Middle East studies, also stated that the main source of drugs used for self-medication was previously prescribed pharmaceuticals stored in households [93]. In a review of Ethiopian studies [15], previous experience had the highest prevalence, too.

Even though African countries had the highest rate of self-medication, household drug storage was relatively lower in African studies. This contrast could be attributed to low economic status in African countries, where accessibility and affordability of medication are limited; therefore, it is less likely to be any leftover medicine. In addition to the significant rate of self-medication in Asian countries, it seems that these countries also have the highest rate of drug storage in their houses (64%).

Analysis in European studies revealed that there was an absolute agreement between the prevalence of self-medication and drug storage at home (39% in both). Unfortunately, there was only one eligible study for determination of keeping drugs at home among American studies (8%).

Among therapeutic agents investigated in more than three studies, analgesics were the most common agent used for self-medication in European, Asian, and American studies. However, in African countries, herbal medicine was the most prevalently used. In agreement with our study, most studies reported analgesics as the most commonly consumed drugs in self-medication [10, 77, 96-100]. Additionally, Gualano [15], in a meta-analysis carried out on adolescents, reported that painkillers are the most commonly consumed drug for self-medication by adolescents. Also, in another review by Biset Ayalew, analgesics/antipyretics, antimicrobials, gastrointestinal drugs, and

respiratory drugs were Ethiopia's most frequently used drug classes [15]. The most important groups of medication that were self-prescribed in Iran were analgesics, antibiotics, and cold medications, as reported by Azami-Aghdash in a review [15].

The pooled prevalence of self-medication with antibiotics was estimated at 33% in African studies, 24% in European and 8% in Asian studies. Measuring heterogeneity tests between studies indicated that the year of the study significantly affects the variety in pooled prevalence of self-medication. In the finding of this study, the heterogeneity test was significant, too. One of the variables that could have caused this heterogeneity was the continent variable. We reanalyzed heterogeneity between years of study by restriction on continent. Subsequently, European and African studies maintained an increasing trend in self-medication with years of study. It is noteworthy that heterogeneity within studies was significant in all comparisons.

We compared self-medication between genders by multiple Meta-regressions; females were more inclined toward self-medication compared to males. This outcome has been reported in various studies before [10]. Furthermore, people with higher education status had a higher odds ratio for self-medication in European and African studies. Some studies have affirmed that self-medication is highly common among the well-educated population [6, 9, 60, 78, 89, 101, 102]. We obtained this result with adjusted regression analysis. In several studies, poor economic status was the main reason for self-medication [13, 91]. In our study, employment status was not associated with self-medication. The number of studies in which prevalence of self-medication with OTC and POM drugs were individually specified were very limited, therefore conducting a Meta-regression analysis was not possible.

4. Conclusion

The prevalence of self-medication for POM drugs is worrisome. Asian countries ranked the second in storage of drugs at home and first in the self-medication rate. It is alarming that their most prevalent information source was previous experience. African countries had the highest prevalence of self-medication, especially in taking POM drugs and antibiotics, the most common source of information on drugs between Africans was information provided by pharmacists or drug dealers, followed by previous experience. Some studies conducted in America were fewer than in other continents. An increasing trend in self-medication among European countries should be considered. Accordingly, continuous training for pharmacists must be performed. Increasing drug awareness is essential, especially for women.

Conflict of interest

The authors declare to have no conflict of interest.

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Table S1: pooled prevalence of storage drug at home based on therapeutic groups in various continents

therapeutic groups	Africa			America			Asia			Europe		
	Prev* (CI95%)	I^2 (sig)**	n	Prev (CI95%)	I^2 (sig)	n	Prev (CI95%)	I^2 (sig)	n	Prev (CI95%)	I^2 (sig)	n
Cold-medicine	-	-	0	-	-	0	58.0 (51-65)	-	1	-	-	0
Hormone-medication	3.0 (2-6)	-	1	-	-	0	2 .0 (1-4)		1	-	-	0
Vitamin _mineral	6.0 (4 -16)	-	1	-	-	0	21.0 (17-25)	-	3	40.0 (38-42)	-	2
analgesics	40.0 (16-64)	98.24 (<0.001)	4	-	-	0	54.0 (52-56)	-	2	53.0 (-2-100)	-	3
sedative	-	-	-	-	-	0	70.0 (65-75)		1	21.0 (19-24)		1
NSAID	-	-	0	-	-	0	37.0 (12-62)	-	3	98.0 (97-99)	-	1
Anti _Allergy	7.0 (4-10)	-	1	-	-	0	16.0 (6-26)		3	20.0 (18-22)	-	2
Anti-acid	13.0 (10-17)	-	1	-	-	0	54.0 (50-58)		2	38.0 (35-40)	-	2
gastrointestinal	12.0 (8-18)		1	-	-	0	18.0 (10-27)	97.35 (<0.001)	4	23.0 (21-25)	-	2
cough medicine	-	-	0	-	-	0	37.0 (17-58)	-	3	72.0 (70-75)	-	1
cardiovascular	17.0 (13-21)	-	1	-	-	0	94.0 (93-95)	-	2	1.0 (0-3)	-	1
antibiotics	27.0 (12-41)	95.67 (<0.001)	4	-	-	0	28.0 (22-34)	-	3	30.0 (25-34)	-	1
Anti-parasite	13.0 (4-21)	94.09 (<0.001)	4	-	-	0	18.0 (7-30)	--	3	44.0 (38-49)	-	1
Herbal therapy	-	-	0	-	-	0	39.0 (32-45)	-	1	41.0 (38-44)	-	1
topical medication	-	-	0	-	-	0	27.0 (21-33)		1	11.0 (9-15)	-	1
Steroids(hormones	3.0 (2-6)	-	1	-	-	0	2.0 (1-4)	-	1	-	-	0

* Prev= prevalence
**sig= P-Value

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Table S2$_{A\ B\ C\ D}$: multiple Meta regression of self-medication odds ratio in females with adjusted some cofactors restricted by continents (Asia: A; n=21 Europe: B; n=21 Africa: C; n=21 America: D; n=9)

A

Variables	Cofactors	OR	SE(OR)	CI 95%	P-Value
Sample size	n>1000	1.27	0.17	0.95-1.70	0.099
Setting of population	Urban & Rural	0.87	0.18	0.56-1.34	0.493
Source of information	pharmacy	0.67	0.11	0.48-0.948	0.024
Mean Age		1.01	0.01	0.99-1.04	0.355
Education status	Primary school or lower	0.53	0.16	0.27-1.02	0.058

B

Variables	Cofactors	OR	SE	CI95%	P-Value
Sample size	n>1000	1.17	0.17	0.85-1.60	0.308
Setting of population	Urban & Rural	0.99	0.21	0.64-1.55	0.969
Source of information	pharmacy	0.81	0.16	0.53-1.26	0.327
Mean Age		0.99	0.01	0.98-1.02	0.757
Education status	Primary school or lower	0.41	0.12	0.22-0.77	0.009

C

Variables	Cofactors	OR	SE	CI	p
Sample size	N>1000	1.12	0.22	0.75-1.74	0.506
Setting of population	Urban & Rural	1.08	0.28	0.62-1.88	0.774
Source of information	pharmacy	0.79	0.23	0.42-1.49	0.438
Mean Age		0.99	0.01	0.96-1.02	0.527
Education status	Primary school or lower	0.36	0.14	0.16-0.81	0.018

D

Variables	Cofactors	OR	SE	CI	p
Sample Size	N>1000	1.32	0.77	0.21-8.39	0.668
Setting of population	Urban & Rural	0.76	0.16	0.39-1.48	0.276
Source of Information	Pharmacy	1.32	0.24	0.73-2.37	0.229
Mean Age		0.98	0.01	0.94-1.01	0.135
Education status	Primary school or lower	0.99	0.0003	0.99-1.00	0.368

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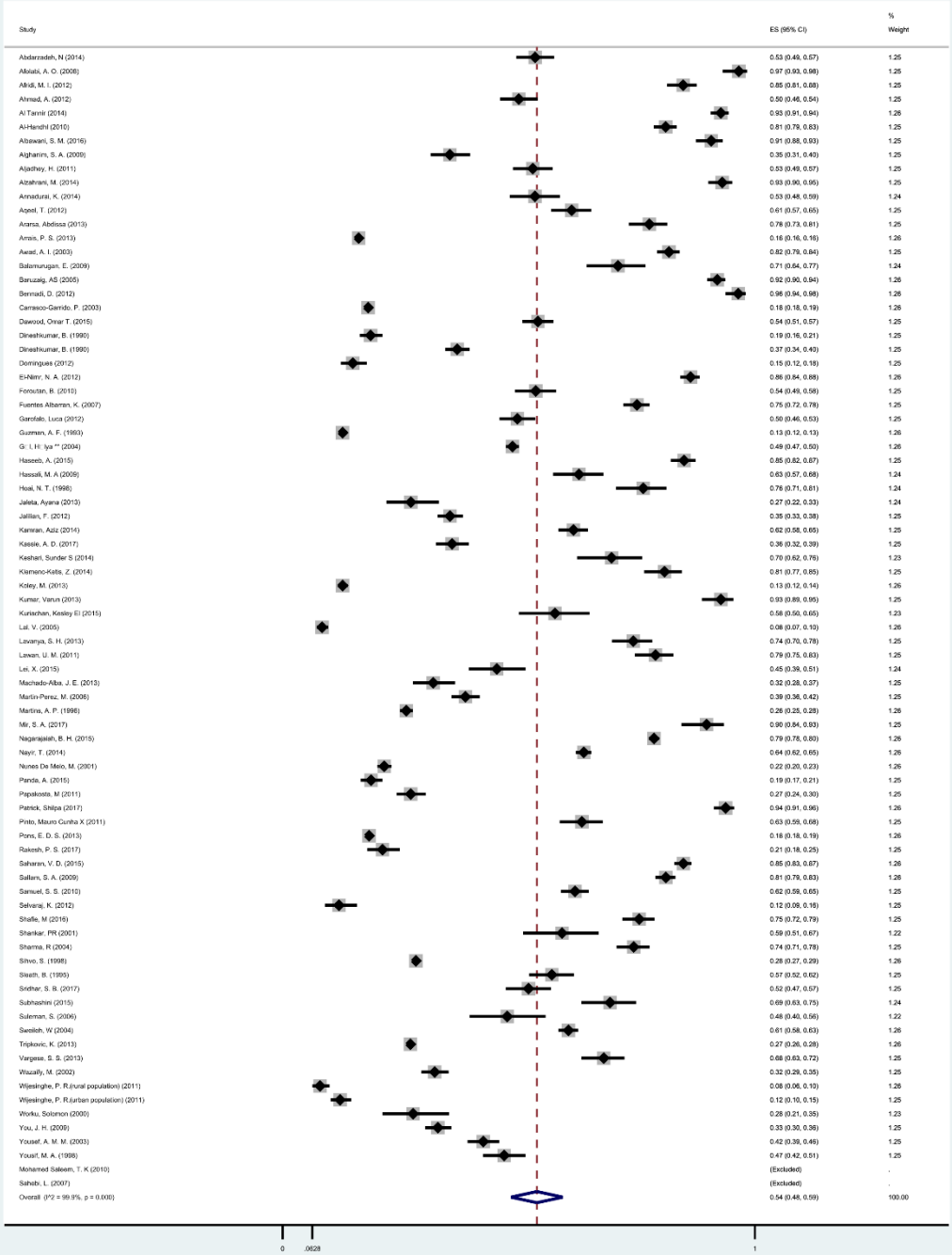

Figure S1. Forest plot of global Meta prevalence of self-medication

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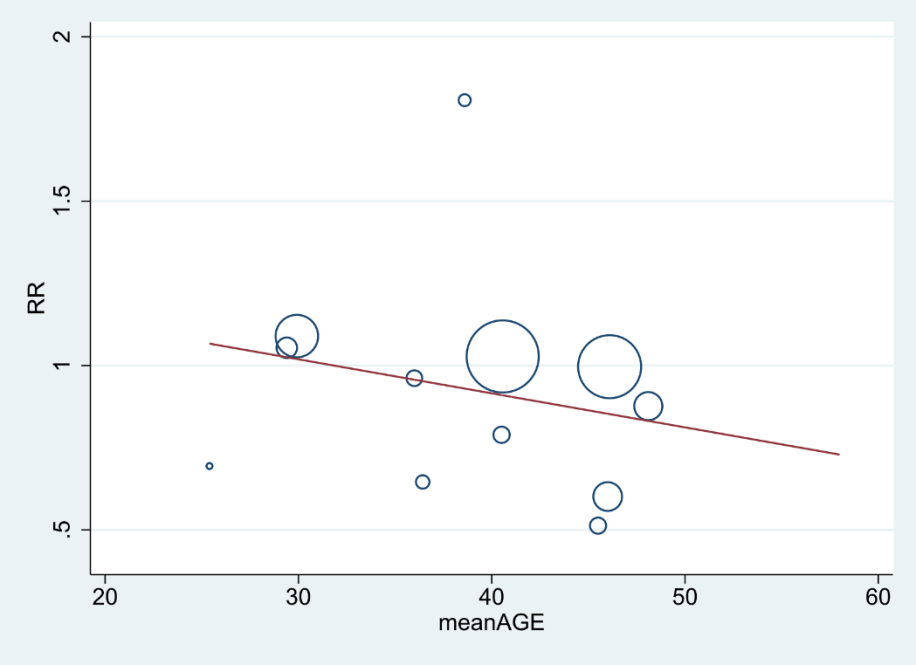

Figure S2. The bubble plot of Meta regression between self-medication and gender based on age

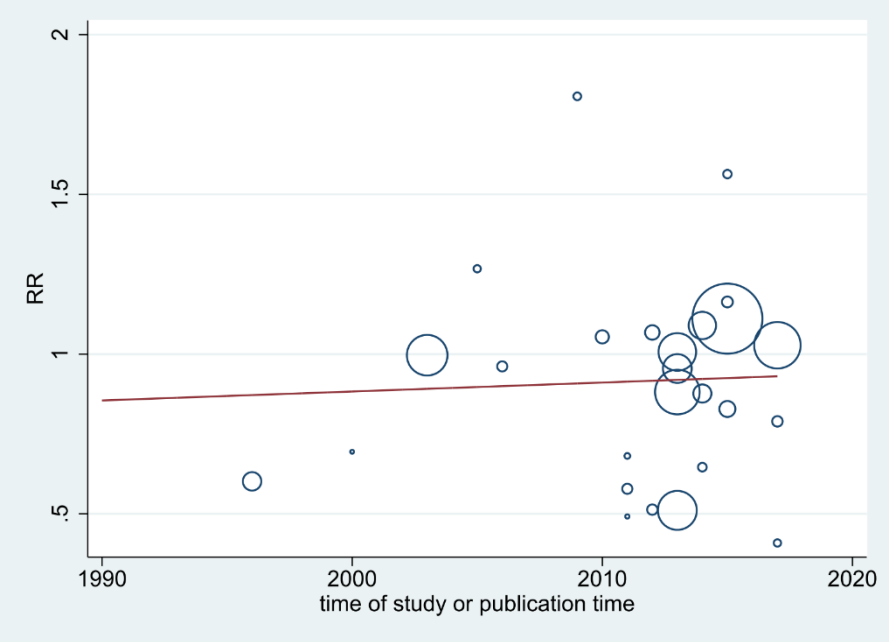

Figure S3. The bubble plot of Meta regression between self-medication and gender based on year of study