General population's knowledge and attitudes about antibiotics: a systematic review and meta-analysis.

Title

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Running head

Knowledge and attitudes about antibiotics.

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Keywords

Antibiotic, resistance, knowledge, attitude, meta-analysis

"Take home" messages

- A better knowledge about the correct antibiotic use could reduce the problem of antibiotic resistance.
- A lack of knowledge and wrong attitudes relating to antibiotic consumption among the general population were highlighted.
- It would be advisable to strengthen public health strategies to control inappropriate demand for antibiotics.
- It would desirable to push physicians to extensively inform their patients in order to increase the awareness of the importance of a correct antibiotic consumption.

Conflict of interest statement

Maria Rosaria Gualano, Renata Gili, Giacomo Scaioli, Fabrizio Bert, Roberta Siliquini declare they have no conflict of interests.

Word count

2574 words.

Prior posting or presentations

To date this study has not been presented before in any conference.

Abstract

Purpose: development of antibiotic resistance represents, nowadays, one of the most important issues of the global public health. The incorrect use of antimicrobial drugs is recognized as one of the leading causes of antibiotic resistance. Therefore, a better understanding of the existing evidences pertaining knowledge and attitudes about antibiotic and antibiotic resistance in the general population worldwide is advisable.

Methods: a systematic review and meta-analyses were performed through Pubmed and Scopus scientific databases. Cross-sectional studies published from January 2000 to November 2013 and investigating knowledge about antibiotics use and antibiotic resistance were included.

Results: overall, 26 studies have been selected for the systematic review and 24 of these were included in the meta-analyses. A lack of knowledge about antibiotic was detected. In particular, 33.7% (C.I. 95% 25.2-42.8) of the sample did not know that antibiotics can treat bacterial infections and 53.9% (C.I. 95% 41.6-66.0) of them did not know that antibiotics are not useful against viruses. Besides, although 59.4% (C.I. 95% 45.7-72.4) of the sample was aware of antibiotic resistance, 26.9% (C.I. 95% 16.6-38.7) of them did not know that misuse of antibiotics can lead to this problem. Finally, 47.1% (C.I. 95% 36.1-58.2) of the subjects stop taking antibiotic when they start feeling better.

Conclusions: it would be advisable to strengthen educational initiatives in the community and to push physicians to correctly inform their patients with the aim of making them aware of the importance of a correct behavior concerning antibiotic consumption.

Introduction

Development of antibiotic resistance represents, nowadays, one of the most important issues of the global public health. The World Health Organization estimated that, in the European hospitals, the problem of antibiotic resistance leads to an excess mortality of 25,000 people every year, with a cost of about 1,5 billions of Euro each year.[1] Recently, the US Centers for Disease Control and Prevention (CDC) estimated that each year in the United States, at least 2 million people are affected by antibiotic resistant pathology and at least 23,000 people die each year as a direct result of these infections.[2]

The incorrect use of antimicrobial drugs represents one of the main cause of antibiotic resistance.[1] Indeed bacteria, if exposed to antibiotics, develop some DNA mutations that makes them resistant to the antimicrobial action. Moreover, the prolonged administration of these medicines, leads to a natural selection process allowing the growth of resistant bacteria and the death of the sensible ones.[3] The indiscriminate consumption of antimicrobial drugs could be in part connected to the lack of knowledge about the correct antibiotic use of both, general practitioners and patients.

Several studies investigate general practitioners' (GPs) attitudes regarding antimicrobial prescription to evaluate the unnecessary antibiotics administration.[4-6] For instance, Sharon et al. demonstrated that around 50% of antibiotic prescriptions in the primary care setting are potentially inappropriate.[7] Other studies observed, in particular, that common diseases (i.e. high respiratory tract infections) are responsible of 75% of the total antibiotic prescriptions. Therefore, these prescriptions have a higher risk of inappropriateness.[8,9]

Besides, it is widely demonstrated that also antibiotic overuse at population level is an important risk factor for the increase of antibiotic resistance.[10] Since patients are not aware about antibiotics and are confused on their role, they should be informed that most of the common infections do not require antibiotics and that such drugs may actually be harmful.[11]

There are several local, national and international projects that are trying to improve and promote the correct and appropriate use of antibiotics. These initiatives are based, on one hand, on the continuous updating of GPs and, on the other hand, on patients' education.[1] In particular, it has been highlighted how it is essential to increase the awareness of the importance of the proper use of antibiotics for common diseases (i.e. high respiratory tract infections, flu), both in health care workers and in the general population.[3,12,13]

To date, there are no systematic review on this topic. Furthermore, a better understanding of these issues could help clinicians to develop educational and public health strategies to reduce inappropriate demand for antibiotics. In order to gather data from all the available studies that evaluate knowledge, attitudes, practices and beliefs about antibiotics and antibiotic resistance in the general population, a systematic review of the current literature and a meta-analysis were conducted.

Methods

In order to summarize the existing evidences pertaining to this subject, a systematic review according to the PRISMA statements was performed.[14]

Eligibility criteria.

Cross-sectional studies investigating knowledge about antibiotics use and antibiotic resistance were considered. All the papers written in English, Italian, Spanish or French languages, published from January 2000 to November 2013, were included.

This review was limited to surveys which used structured questionnaire administered to general population assessing:

- Knowledge regarding antibiotic role and antibiotic use;
- Attitudes towards the use of antibiotics;
- Knowledge and awareness about the problem of antibiotic resistance.

Exclusion criteria were:

- Surveys focused only on a specific population group (e.g. patients, caregivers, parents);
- Studies concerning antibiotic use for a specific illness (e.g. upper respiratory tract infections);
- Surveys using open-answers only;
- Studies with undetectable data.

Data collection process.

Two researchers (GS and RG) independently performed systematic searches of scientific literature in order to identify publications from PubMed and Scopus scientific databases, using the following research string: antibiotic* AND survey AND (attitude OR knowledge).

Studies' selection.

Two authors (GS and RG) analyzed the search results individually to find potentially eligible studies. The publications were sorted by titles and abstracts and only eligible studies were selected for full text review. During this stage, all the irrelevant studies (lack of pertinence, data already found in other publications) and duplicates were excluded (Figure 1). Then they independently assessed each of the selected articles for inclusion in the study using the inclusion and exclusion criteria above mentioned.

Data extraction.

Data extraction was performed independently by the same two authors. Disagreement were resolved with a discussion and a second examination. Information on the year of the execution of the survey, the geographic location, the sample size, the way of administration of the questionnaire and data about knowledge and attitudes towards antibiotic role, antibiotic use and antibiotic resistance were retrieved. In particular, nine statements which grouped

questions that were common for the different studies were considered as outcomes for the meta-analyses:

1. Antibiotics can treat bacterial infections. (Percentage of inappropriate answers)
2. Antibiotics can treat viral infections. (Percentage of inappropriate answers)
3. Antibiotics are the same as anti-inflammatory agents. (Percentage of inappropriate answers)
4. Antibiotics are useful for cold and flu. (Percentage of inappropriate answers)
5. Are you aware of the problem of antibiotic resistance? (Percentage of Yes)
6. Misuse of antibiotics can lead to antibiotic resistance. (Percentage of inappropriate answers)
7. When I get a cold, I will take antibiotics to help me get better more quickly. (Percentage of inappropriate answers)
8. When I get a cold, I will take antibiotics to prevent my symptoms from getting worse. (Percentage of inappropriate answers)
9. I normally stop taking antibiotic when I start feeling better. (Percentage of inappropriate answers)

The first four statements assessed the knowledge concerning antibiotic role, the fifth and the sixth the knowledge about antibiotic resistance and the last three evaluated the attitudes towards antibiotic consumption. Since questions were not exactly the same in the different studies, the information suitable with our purpose were extracted.

Statistical analysis and quality assessment.

Meta-analyses were performed in all the studies yielding comparable outcomes, using the software StatsDirect 2.8.0. The Cochran Q and the I^2 were used to evaluate heterogeneity of studies. In order to tackle potential sources of heterogeneity between studies, the random

effects model was used to combine studies if heterogeneity was shown (Cochran Q $p < 0.10$ and $I^2 > 50\%$).[15]

The methodological quality of the studies was assessed according to the STROBE scale.[16]

Results

A total of 2,890 articles were retrieved from the two scientific databases analyzed (PubMed and Scopus). These papers were screened on the basis of title and abstract and 2,840 were excluded because irrelevant or duplicates. Fifty studies were eligible for the full text review. Twenty-four of these were subsequently excluded because they did not respect the inclusion criteria (Figure 1). Finally, 26 studies[17-42] were selected for the systematic review and twenty-four of these were included in the meta-analysis.[17-25,27-29,31-42]

Insert Figure 1 here.

Characteristics of eligible studies.

All the 26 studies included in the systematic review were cross-sectional surveys conducted in the general population, published between January 2000 and November 2013. Nine studies were conducted in Europe,[19,26-28,30,32,34,35,40] ten were conducted in Asia,[17,18,20-24,29,33,39] four in North America[36-38,42] and two in Oceania.[25,31] One survey was a multicentre study, conducted in eleven different countries worldwide.[41] The sample size of the studies ranged from 25[36] to 10,780[37] subjects interviewed.

Sixteen surveys were conducted by face-to-face interviews,[17-19,21-25,27,29-31,35,36,39,40] while seven were telephone surveys[20,28,33,37,38,41,42] and only three were administered by e-mail.[26,32,34]

Twenty-three studies assessed knowledge about antibiotic use, antibiotic role and antibiotic resistance and thirteen studies evaluated attitudes towards antibiotic consumption. Table 1 outlines the main studies' characteristics.

Insert Table 1 here.

All the studies selected followed the most important requirements of the STROBE scale.[16] However, the majority of the papers did not cover all the statements. Since the principal statements were generally included, all the 26 papers met the quality criteria and were selected for this systematic review.

Study results and meta-analyses.

Two studies were excluded from the meta-analysis and included in the systematic review only[26,30] because data of prevalence were not available. Both were conducted to assess general public's knowledge and attitudes in order to guide further educational interventions, such as public campaigns on the importance of the correct use of antibiotics and the consequences of their inappropriate consumption. One of these studies[26] reported that, in German general population, 10.5% of respondents expected a prescription of antibiotics for a common cold; this expectation was associated with a lack of knowledge about antibiotic use and antibiotic resistance. The second one[30] assessed knowledge and attitudes towards antimicrobial drugs in different European countries and found that the highest knowledge on taking antibiotic was in Slovenia while the lowest was observed in Former Yugoslav Republic of Macedonia (FYROM).

The other twenty-four studies were included in the meta-analysis process. A combined prevalence was found for each outcome chosen.

- *Knowledge concerning antibiotic role*

For each statement regarding knowledge about antibiotic role the number of inappropriate responses was considered. Overall, a lack of knowledge on this topic was detected: 33.7% (C.I. 95% 25.2-42.8) of the sample gave an incorrect answer for the statement "Antibiotics can treat bacterial infections" and 53.9% (C.I. 95% 41.6-66.0) did not know that antibiotics can not treat viral infections. Besides, 50.9% (C.I. 95% 31.1-70.6) of the sample erroneously thought that "Antibiotics are the same of anti-inflammatory agent" and 49.7% (C.I. 95% 39.6-59.8) did not know that antimicrobial drugs are not useful for cold and flu (Figure 2).

Insert Figure 2 here.

– *Knowledge concerning antibiotic resistance*

Two statements assessed the knowledge regarding the problem of antibiotic resistance. Although 59.4% (C.I. 95% 45.7-72.4) of the sample declared to be aware of this problem, 26.9% (C.I. 95% 16.6-38.7) of them did not know that misuse of antibiotics can lead to antibiotic resistance (Figure 3).

Insert Figure 3 here.

– *Attitudes towards antibiotic consumption*

Attitudes towards antimicrobial use were assessed with three statements: 52.1% (C.I. 95% 40.6-63.4) of the sample declared that they assume antibiotics for a cold to get better more quickly and 57.4% (C.I. 95% 34.1-79.1) that they take antibiotics for a cold to prevent their symptoms from getting worse. Finally, 47.1% (C.I. 95% 36.1-58.2) of the sample stated that they normally stop taking antibiotic as soon as they start feeling better (Figure 4).

Insert Figure 4 here.

Discussion

This systematic review aimed to gather different studies published from January 2000 to November 2013 that assessed knowledge and attitudes towards antibiotic role and consumption and antibiotic resistance. To our knowledge this is the first systematic review on this issue. Previous reviews were focused on self-medication with antimicrobial drugs,[43] physician prescribing behavior[44] or misuse of antibiotic therapies in the community.[45]

The strengthen of this paper consisted in the execution of nine meta-analyses, which permitted to gather and strengthen the results of the single studies and to obtain a combined prevalence which gave stronger evidences about knowledge and attitudes regarding antibiotic in the general population.

The analyses conducted on nine different outcomes showed interesting results. Around 50% of the sample did not know that antimicrobial drugs are not useful for viral infections (such as the common cold and flu), pain and inflammation. Besides, although 59% of the sample was aware of the problem of antibiotic resistance, around 27% did not know that misuse of antimicrobial drugs can lead to antibiotic resistance. Finally, the results of meta-analyses highlighted the incorrect attitudes of the general population towards antibiotic use. Indeed more than 50% of the sample demonstrated an incorrect behavior concerning antimicrobial consumption.

The findings of this review pointed out a lack of knowledge in the general population on this topic, which results in a misuse of antibiotics. Data about incorrect behavior were higher than the results showed in a previous review, where was highlighted as more than one-third of patients did not comply with antibiotic therapy, and one-quarter retained leftover antibiotics for future use.[45]

The general population's lack of knowledge regarding the correct use of antibiotics could lead to an over-request of these drugs to the GP for illness in which antibiotics are not useful, like

flu or common cold. Given that there are evidences that the patient could influence the physician in antibiotic prescribing,[5,6,46-50] an over-request could mean an over-prescription. Hence, the GPs play a pivotal role: they have to correctly inform the patients on the risk of antimicrobial drugs misuse, and at the same time they should not be overwhelmed by patients' requests. Indeed, the doctor-patient relationship may influence GPs choices, as often doctors prescribe antibiotics even when not necessary to meet the patient's satisfaction.[5] In particular, Teixeira Rodriguez et al., describing principal factors which could influence doctors' prescribing behavior, identified the link between patients' express desire for a quick healing and misuse of antibiotic and they stated that this could be associated with complacency.[44]

Besides, it is clearly demonstrated that part of the general population take antibiotics without medical prescription.[43] This practice makes difficult to address every kind of control from the GPs, contributing to the widespread of antibiotic resistance. It is therefore necessary to implement educational campaigns, aimed to improve general population's knowledge on this topic. For example, the European Antibiotic Awareness Day[51] organized by the European Centre of Disease Prevention and Control (ECDC) every year from 2008, emphasizes the need for both GPs and European citizens to use antimicrobial drugs responsibly. Nevertheless in 2008 a UK survey conducted by the Department of Health in order to determine the impact of the above mentioned initiative in UK, demonstrated only a little evidence of its effectiveness.[27] This highlighted the need of including communication interventions such as higher profile radio or television spots to have more impact on public attitudes or knowledge. For example, other antibiotic campaigns conducted in Belgium, England and France[8,52-54] which used high impact tools such as television and which were repeated for several years, resulted in an improving of antibiotic use and attitudes.

This study had some limits that should be acknowledged. First of all, there was a big heterogeneity among the populations analyzed in the included papers, with a consequent lack

of homogeneity of the answers. However, to tackle this problem the random effects model was used. The heterogeneity could be due to the cultural, demographic and socio-economic differences among the countries in which the studies were conducted. Moreover, it should be addressed that there are differences about the ways of questionnaire administration and sampling selection. In particular, each method used to administer the interviews could lead to a selection bias. The telephone and e-mail surveys excluded persons without a phone or an e-mail address who presumably belong to a lower socio-economic level (people without a telephone) or to an older age class (people without an e-mail address).[42,55-59] Even the face-to-face interviews could present some limits due to the method of sampling selection. For instance, to interview people attending health care facilities (patients and their relatives or caregivers) could over-represent frequent care seekers.[25]

Conclusion

In conclusion, considering that antibiotics are among the most commonly used medications worldwide and given the importance of the world-spreading problem of antibiotic resistance, these results lets to understand how it is still a long way towards a complete awareness of the correct use of these drugs by the general population. In this framework it would be advisable, on one hand, to strengthen initiatives in the community, such as educational campaigns, in order to improve knowledge on this topic. On the other hand, it is mandatory to push physicians to correctly and extensively inform their patients with the aim of making them aware of the importance of a correct behavior concerning antibiotic consumption.

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Table 1. Characteristics of the studies included (26 studies, N = 40,767)

Author	Year	Country	Sample size	Questionnaire administration	Outcome
Bosevska et al.	2012	Macedonia	239	Face-to-face interviews	Knowledge about antibiotics; attitudes towards antibiotic use
Chan et al.	2012	China	465	Face-to-face interviews	Knowledge about antibiotics and antibiotic resistance; attitudes towards antibiotic use
Lim et al.	2012	Malaysia	401	Face-to-face interviews	Knowledge about antibiotics and antibiotic resistance; attitudes towards antibiotic use
Shehadeh et al.	2012	Jordan	1141	Face-to-face interviews	Knowledge about antibiotics and antibiotic resistance
Widayati et al.	2012	Indonesia	559	Face-to-face interviews	Knowledge about antibiotics and antibiotic resistance
Wun et al.	2012	China	2471	Telephone survey	Knowledge about antibiotic resistance; attitudes towards antibiotic use
Kim et al.	2011	South Korea	1177	Face-to-face interviews	Knowledge about antibiotics and antibiotic resistance; attitudes towards antibiotic use
Norris et al.	2011	Samoa and New Zeland	232	Face-to-face interviews	Knowledge about antibiotics; attitudes towards antibiotic use
Oh et al.	2011	Malaysia	408	Face-to-face interviews	Knowledge about antibiotics and antibiotic resistance; attitudes towards antibiotic use
André et al.	2010	Sweden	747	Telephone survey	Knowledge about antibiotics and antibiotic resistance; attitudes towards antibiotic use

Faber et al.	2010	Germany	1076	Internet-based survey	Knowledge about antibiotics and antibiotic resistance; attitudes towards antibiotic use
McNulty et al.	2010	England and Scotland	1830	Face-to-face interviews	Knowledge about antibiotics and antibiotic resistance; attitudes towards antibiotic use.
Norris et al.	2010	New Zealand	300	Face-to-face interviews	Knowledge about antibiotics amongst immigrant ethnic groups.
Barah et al.	2009	Syria	812	Face-to-face interviews	Knowledge about antibiotics and antibiotic resistance; attitudes towards antibiotic use
Radosevic et al.	2009	Croatia, Former Yugoslav, Republic of Macedonia, Greece, Hungary, Slovenia, Serbia	838	Face-to-face interviews	Knowledge about antibiotics and attitudes towards antibiotic use.
You et al.	2008	China	1002	Telephone survey	Knowledge about antibiotics and antibiotic resistance; attitudes towards antibiotic use
Cals et al.	2007	The Netherlands	935	Internet-based survey	Knowledge about antibiotics and antibiotic resistance
Grigoryan et al.	2007	Austria, The Netherlands, Sweden, UK, Belgium, Italy, Malta, Israel, Czech Republic, Lithuania, Croatia	1101	Internet-based survey	Knowledge about antibiotics and antibiotic resistance; attitudes towards antibiotic use
McNulty et al.	2007	Great Britain	7120	Face-to-face interviews	Knowledge about antibiotics and antibiotic resistance; attitudes towards antibiotic use
Pechere et al.	2007	Italy, The Netherlands,	4514	Telephone survey	

		Japan, Mexico, USA, China, Brazil, Turkey, The Philippines, South Africa, Russia			Determine factors that influence non-compliance with antibiotic therapy for acute community infections.
Larson et al.	2006	New York City	25	Face-to-face interviews	Knowledge about antibiotics and antibiotic resistance; attitudes towards antibiotic use
Chen et al.	2005	Taiwan	1024	Face-to-face interviews	Knowledge about antibiotics; attitudes towards antibiotic use
Corbett et al.	2005	Colorado	992	Telephone survey	Knowledge about antibiotic and antibiotic use.
Mitsi et al.	2005	Greece	173	Face-to-face interviews	Attitudes towards antibiotic use
Vanden Eng et al.	2003	Connecticut, Minnesota, Oregon, California, Georgia, Maryland and New York	10780	Telephone survey	Knowledge about antibiotics; attitudes towards antibiotic use
Belongia et al.	2002	Minnesota and Wisconsin	405	Telephone survey	Knowledge about antibiotics

Figure 1.

Flow of information through the different phases of the systematic review.

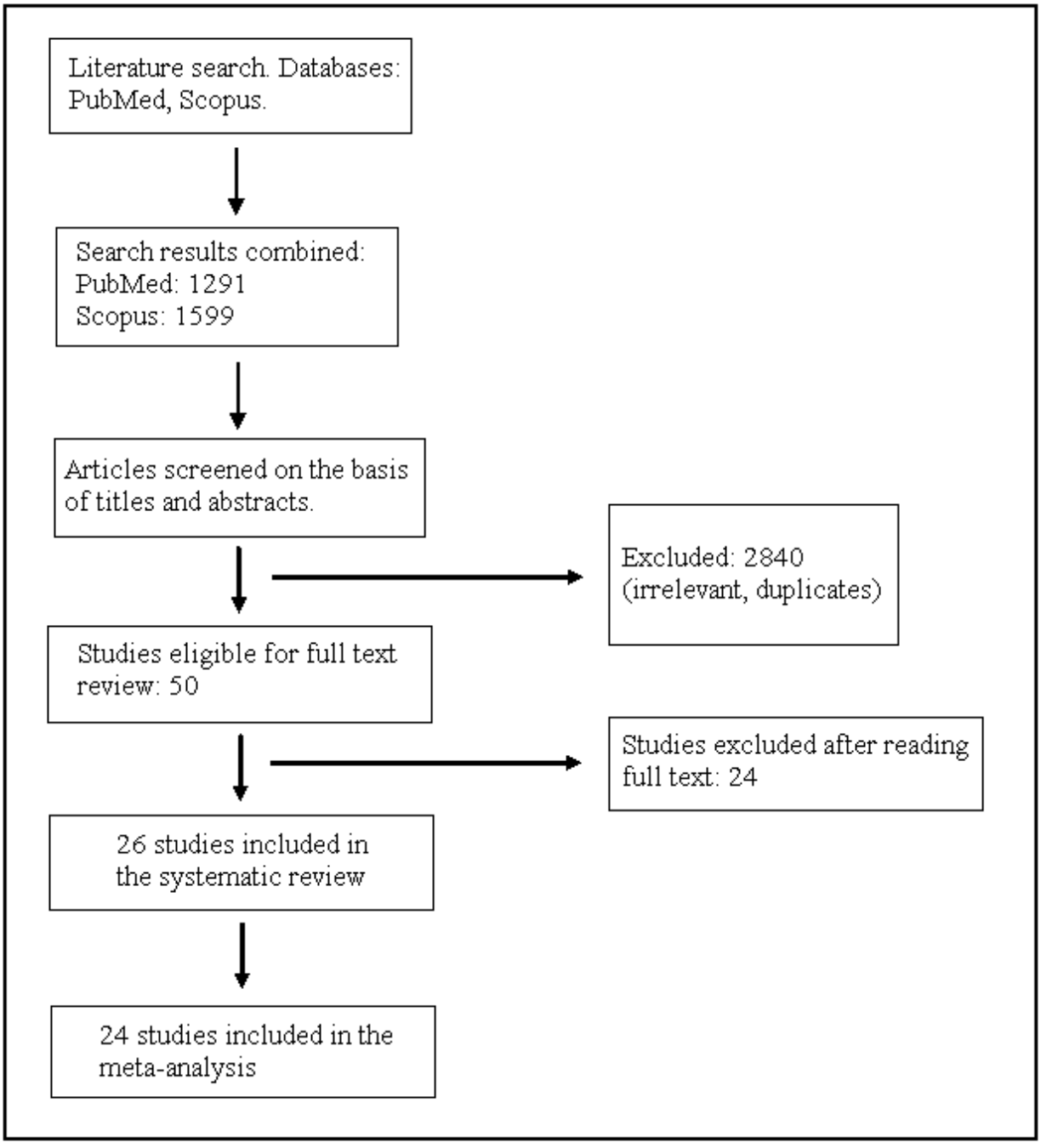

Figure 2.

Knowledge concerning antibiotic role.

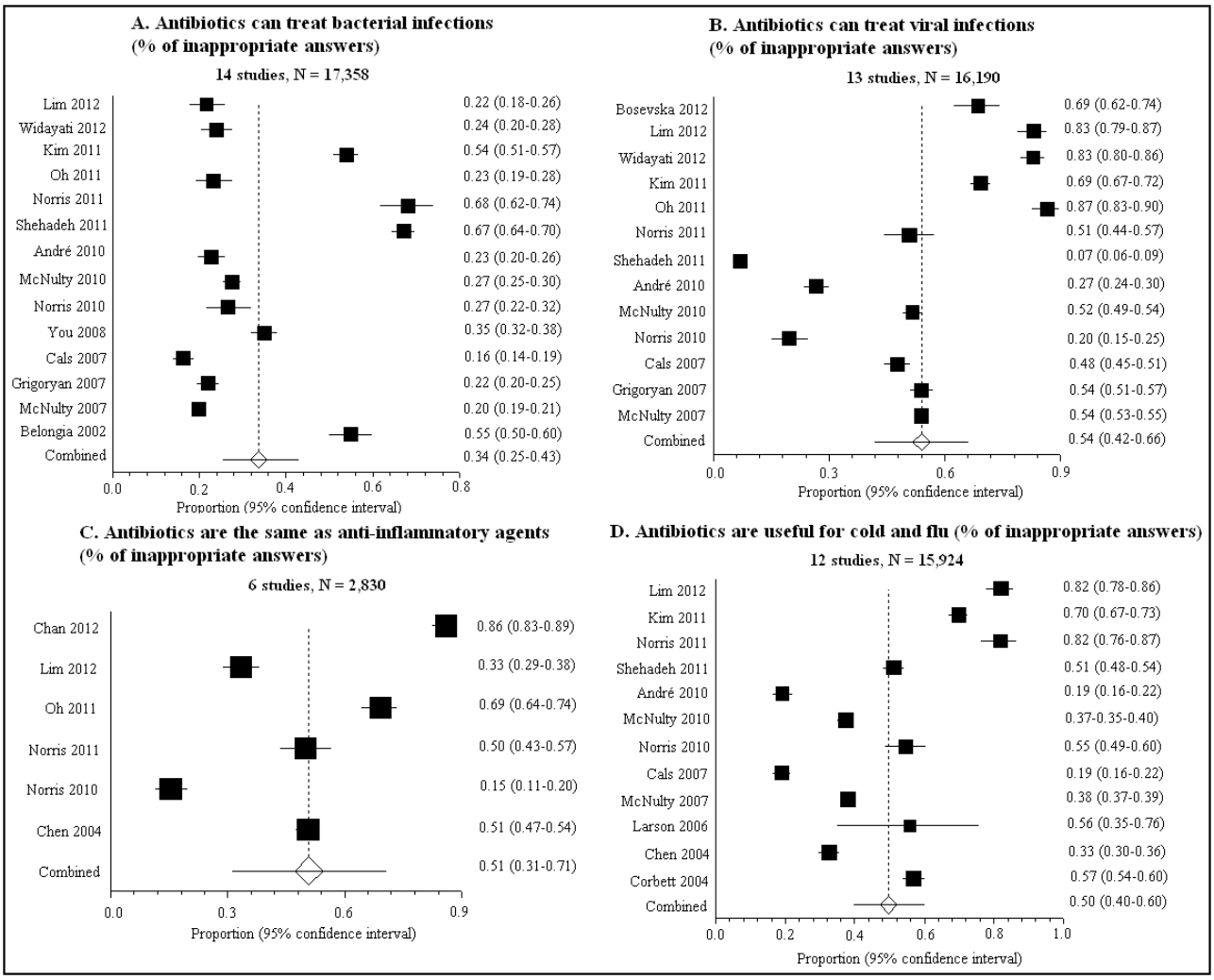

Figure 3.

Knowledge concerning antibiotic resistance.

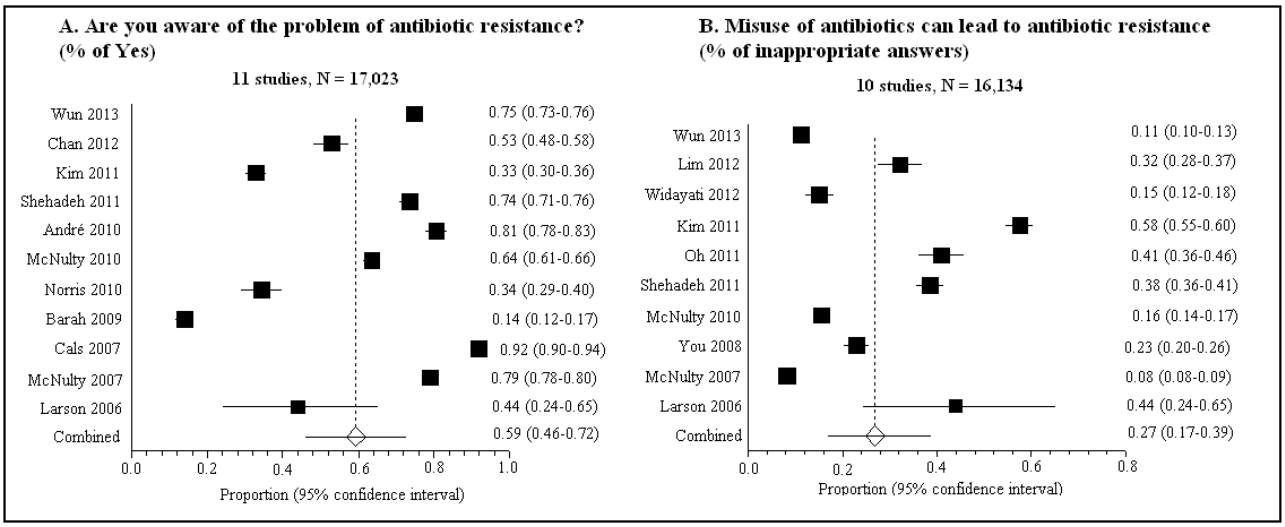

Figure 4.

Attitudes towards antibiotic consumption.