Knowledge, Attitude and Practice (KAP) survey regarding antibiotic use among pilgrims attending the 2015 Hajj mass gathering

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Abstract

Background

The overuse and misuse of antibiotics have been reported in the Hajj mass gathering. However, little is known about Knowledge, Attitude and Practice (KAP) of Hajj pilgrims themselves in relation to these agents.

Method

We conducted a cross-sectional study among adult pilgrims attending the Hajj pilgrimage in 2015. Pilgrims from seven countries were interviewed using a structured questionnaire designed to collect KAP information and participants' demographics. A scoring system was developed to generate overall KAP scores and investigate association between these scores and demographic variables.

Results

KAP information was collected from 1,476 pilgrims. A number of misconceptions regarding antibiotics were identified including that antibiotics: cure all diseases (24.6%); cure common cold and flu (63.0%); are used to stop fever (47.3%); have no side effects (43.2%). Some negative attitudes were also identified including prophylactic use of antibiotics (50%), self-medication (43.2%), non-compliance with antibiotic therapy (63.5%) and storage of left-over antibiotics for future use (54.1%). In practice, 87.3% of pilgrims admitted to using non-prescribed antibiotics, only 19.3% use antibiotic as directed by their doctor and 54% do not usually check the expiry date of antibiotics before use. More than 60% brought antibiotics from their home country to KSA and 39.2% acquired antibiotics in KSA without a doctor's prescription. There was a weak positive correlation between the overall knowledge and attitude scores and the overall practice scores. KAP scores were higher among the younger age group (≤43 years old) and among those with healthcare-related work or education and increased with increasing levels of education.

Conclusions

These findings call for a multifaceted and multidisciplinary approach, both in KSA and pilgrims countries of origin, to improve pilgrims knowledge, attitude and behavior regarding antibiotics, to better healthcare professionals' knowledge and prescribing practices and to implement and/or enforce legislations to stop the sell of non-prescription antibiotics.

Keywords: Antibiotics; Hajj; antimicrobial resistance; self-medication; health knowledge, attitude and practice; mass gathering

Introduction

The emergence and spread of bacterial resistance to antibiotics is a growing problem worldwide and a significant threat to public health globally.[1] Antibiotics resistance endangers their therapeutic effectiveness and increases treatment failures, leading to longer and more severe illness with higher economic and social costs and increased mortality rates.[1,2] Antimicrobial resistance is no longer a healthcare-related problem as about 80% of antibiotics are now used in the community.[3,4] Resistance in the community has steadily been increasing during the last decades, especially related to quinolones, carbapenems and third-generation cephalosporins and resistance has now reached alarming levels in many parts of the world.[2]

Resistance to antimicrobial agents has increased for many reasons including irrational or over-prescription of antibiotics by physicians (due to factors such as doctors' knowledge and experience, diagnostic uncertainty, patients' expectations and pharmaceutical marketing), noncompliance with prescribed treatments by patients, self-prescribing or over the counter access, and the recent extensive non-therapeutic use of antibiotics in agriculture and aquaculture.[1,5-9] Important factors for the inappropriate use of antibiotics in humans, estimated in 20-50% of all antibiotics used,[3] include patients' knowledge, beliefs and attitudes towards antibiotics and their usage and patients' expectations and experience with antibiotics.[10-12]

International travel promotes bacterial spread and countries such as Saudi Arabia which annually hosts millions of pilgrims during the Hajj and Umrah seasons can act as a hub for the collection and spread of resistance mechanisms.[13] Antibiotics overuse and misuse during Hajj are common. According to a study conducted at a hospital in Mecca during the 2003 Hajj, antibiotics accounted for 43.3% of all medication dispensed during the study period of 15 days.[14] Of 1,162 pilgrims investigated after the Hajj in 2013, 61.9% reported influenza-like illness, and 45.5% took antibiotics.[15] Among French pilgrims with cough, 69.4% took antibiotics.[16] A study during the 2009 Hajj in the Ear, Nose and Throat (ENT) clinic of a Hospital in Mecca found that, despite 42.1% of patients were being diagnosed with viral upper respiratory tract infections, more than 95% of them were treated with antibiotics.[17] Studies investigating the use of antibiotics in Saudi Arabia and during Hajj identified that citizens and Hajj pilgrims have misconceptions about antibiotics, have inappropriate access to antimicrobials in the Kingdom and in their own countries as well as poor practices such as the use of antibiotics for prophylaxis and treatment of non-bacterial infections.[17-21]

During Hajj, pilgrims from around 180 countries congregate in Mecca, Kingdom of Saudi Arabia (KSA), for the religious mass gathering. These pilgrims come from various ethnic, socioeconomic and cultural backgrounds with different levels of education and health education as well as divers practices and believes regarding healthcare, including the use of antibiotics. Hence, understanding pilgrims' knowledge attitude and practice (KAP) with regards to antibiotic use will aid in the development of appropriate and tailored strategies and intervention tools to address poor practices, improve knowledge and change attitudes. We

aimed to investigate pilgrims' KAP with regards to antibiotics and identify pilgrims' knowledge gaps and misconceptions about these agents as well as poor practices in relation to their use during the mass gathering in 2015.

Methods

Study design, setting and population

This cross-sectional study was carried out in Mecca, Saudi Arabia, among adult pilgrims (>18 years of age) attending the Hajj pilgrimage from 21st-28th September 2015 (8th to 15th Dul Hijjah, 1436 H). Pilgrims were enrolled from 7 countries: South Africa, Nigeria, Bangladesh, Pakistan, Egypt, Iraq and Morocco. During the data collection phase, cohorts of pilgrims residing in their camps or hotels were approached serially and invited to participate by trained study investigators who provide information about the study and answered any queries from participants.

The sample size was calculated using a margin of error of 2.5%, a confidence interval of 95%, an approximate pilgrims population from the target countries of 600,000 as well as expected response proportion of 50% to most of the main questions. The minimum sample size estimated for the study was 1,533. By the end of the study, we enrolled a larger sample size of 1,615 pilgrims. Pilgrims were first asked a general question on whether or not they knew what "antibiotics" were so that to exclude those who were unaware of what the subject matter of the survey was. For those who answered that they did not know what antibiotics were, and to avoid eliminating participants who were just not familiar with the word "antibiotics", they were given an example of widely known antibiotic, "penicillin". Those who still did not recognize the subject matter of the survey after these two steps were not interviewed further to avoid collecting misleading information.

Survey design and scoring system

Data was collected using an anonymous structured questionnaire developed in both English and Arabic languages. The questionnaire was administered through trained investigators and was designed to collect KAP information concerning antimicrobial knowledge and use and also collected participants' demographics including age, gender, level of education, occupation and place of residence. The questionnaire was developed by reviewing available questionnaires in the literature,[18,22-24] but tailored for the Hajj population, which includes many elderly pilgrims with expected little or no health education.

The overall scores for the KAP questions were calculated as follows: For the knowledge questions, incorrect or uncertain (don't know) responses were given a 0 score, while 1 point was given for choosing the correct answer; a correct response being that based on current literature. The expected maximum total knowledge score was 12. For the attitude and practice sections, a score of 1 was given for choosing the answer

reflecting positive attitude or good practice and 0 was given for choosing the answer reflecting negative attitude or poor practice. The expected maximum total attitude and practice scores were 4 and 3 respectively.

Statistical analysis

Characteristics of the study population were summarized as frequencies and percentages for qualitative variables and as mean and standard deviation (SD), range and percentiles for quantitative variables. The association between demographic variables and respondents' knowledge, attitude or practice was evaluated by t-test, one way analysis of variance or chi2 tests as appropriate. Multiple regression analyses, using a backward stepwise elimination procedure, were performed to examine the potential impact of the variables that were identified as being significant with $p < 0.1$ in the univariate analyses. Correlation between KAP scores were assessed by calculating the Pearson's correlation coefficient "r". All of the tests for significance were two-sided and p values < 0.05 were considered statistically significant. All analyses were done using SPSS 22.0 (SPSS Inc., Chicago, USA) software program.

Ethics

All study participants were briefed about the study and gave verbal consent before enrolment. The questionnaire was anonymous. The study was approved by the King Fahad Medical City Ethics Committee and the Institutional Review Board and was conducted in accordance with the Ethics Committee's guidelines.

Results

Demographics and other characteristics of the study population

The study enrolled 1,615 pilgrims originating from 7 countries from Central and South Africa, the Middle East and North Africa (MENA), and South Asia. The characteristics of the study population are summarized in Table 1. Pilgrims from Bangladesh and Nigeria were most represented accounting for 27.4% and 19.8% of the respondents respectively. The mean age of the participants was 50.9 years (range= 19-84 years) with a male:female ratio of 2.1:1. Nearly 26% of pilgrims declared not having had any type of formal education and 11% either worked in the healthcare sector or had healthcare-related education.

Pilgrims' knowledge regarding antibiotics

Pilgrims were asked if they knew what antibiotics were and to identify antibiotics from a list of 4 medications, 2 of which were not antibiotics but well known and commonly used medications (Table 2). The majority of respondents (1,402, 86.8%) claimed to know what antibiotics were. Among the 213 pilgrims who declared not to know what antibiotics were, 74 recognized the antibiotic penicillin and were also included in the study. Hence, KAP information was obtained from a total of 1,476 pilgrims. Over quarter of respondents (25.2%)

declared that they did not know which of the 4 medications was an antibiotic. Only 35.6% of respondents correctly identify Flagyl and Amoxicillin as the 2 antibiotics in the list, with a further 26.9% and 1.2% respectively identifying either Amoxicillin or Flagyl as the only antibiotic in the list. Amoxicillin was the most recognized antibiotic with nearly 70% of the respondent identifying it as an antibiotic solely or in combination with other medications. Importantly, many pilgrims identified Paracetamol and/or Aspirin as antibiotics (Table 2).

Over half (56.8%) of respondents knew that antibiotics are used to treat bacterial infection (Figure 1). However, 4% and 10.7% thought that antibiotics were used to treat viral infections or both bacterial and viral infections respectively. A further 28.5% did not know what antibiotics were used for. Nearly a quarter of respondents (24.6%) thought antibiotics cure all diseases, 63% believed that antibiotics cure common cold and flu and 47.3% thought antibiotics are used to stop fever. Just over half of the pilgrims (56.8%) correctly answered that antibiotics may have side effects. A majority of participants (73.8%, and 78.5% respectively) recognized that antibiotics are less likely to work if they take them often, and that antibiotics are less likely to work if the full course of the medication was not completed.

Pilgrims' attitude toward antibiotics

Half of the participants believed it was ok to use antibiotics for prophylaxis, 43.2% thought they should self-medicate when they are sick to get better, 63.5% would stop taking antibiotics treatment once they start feeling better and 54.1% would store antibiotics after treatment for future use (Figure 2).

Pilgrims' antibiotics practice

Results regarding access to antibiotics revealed that over 87% of participants use non-prescribed antibiotics and 79.2% use multiple sources to access antibiotics. Nearly 10% of respondents used antibiotics prescribed by doctors for their families or friends, 26.5% used antibiotics prescribed to them by a doctor for a previous illness and 66.6% accessed antibiotics without prescription through a pharmacists. Only 12.7% of respondents reported that when they are sick they would visit a clinic and only take the antibiotics prescribed to them by a doctor. The use of non-prescribed antibiotics was reported more frequently by individuals with higher education (primary or no formal education vs secondary or higher education, $p < 0.0001$), and by older age groups (<43 years old vs >43 years old, $p < 0.0001$).

When it comes to how antibiotics were used by participants, only 19.3% indicated good practice by using antibiotics only as directed by their doctor (Table 3). A further 66.4% reported that they use antibiotic as directed by their doctor but were also found to have incorrect practices at the same time, such as stopping antibiotics when the tablets/bottle finished or when they felt better. In relation to the latter, 54.7% of pilgrims indicated that they stop taking antibiotics when they feel better. Results also showed that only 46% of pilgrims do usually check the expiry date of antibiotics before use.

Access to antibiotics among pilgrims

At the time of the survey, a quarter (25.8%, 363/1403) of participants declared that they were in possession of antibiotics. Of these, 61% brought some or all their antibiotics from their home country and 39.2% acquired antibiotics in KSA without a doctor's prescription. Only 21.5% declared that the antibiotics they were in possession of were acquired in KSA via a doctor's prescription only.

Correlation between KAP scores

Based on the above results the total mean KAP scores were calculated as 7.23 out of a possible 12 for the knowledge section, 1.89 out of a possible 4 for the attitude section and 0.74 out of 3 for the practice section (Table 4). There was a weak positive correlation between the overall practice scores and the overall knowledge scores ($r= 0.168$; $R^2= 0.028$) as well as the overall practice scores and the overall attitude scores ($r= 0.211$; $R^2= 0.045$). This suggests that only 2.8% and 4.5% of the variations in antibiotics practices could be explained by knowledge or attitude respectively.

Factors associated with overall KAP scores

The results of the univariate analysis of the KAP scores and association with various demographic variables are presented in Table 5. Males had significantly more knowledge about antibiotics than females. They also had higher mean attitude and practice scores; however, the difference was not statistically significant. There was a significant variation in KAP scores according to age. Respondents in the higher age group (>60 years old) had the lowest mean scores. These scores increased with decreasing age groups.

Country of residence also showed a statistically significant relation with KAP scores. Participants from Morocco had the highest mean knowledge and attitude scores. While having the lowest mean knowledge score, pilgrims from Iraq had the highest mean practice score. Pilgrims from Nigeria and Bangladesh had the lowest mean attitude and mean practice scores respectively.

Level of education was statistically significant associated with knowledge, attitude as well as practice in relation to antibiotics. Pilgrims with no formal education had the lowest KAP scores. These scores increased as the level of education of participants increased. Similarly, participants who had healthcare-related occupation or educations had significantly higher KAP scores than those who did not.

The joint effect of the demographic variables on knowledge and attitude scores were investigated using multiple regression analysis. Results indicate that the significant variables that predicted the knowledge level of participants were gender, age, country of residence and level of education. Significant variables that predicted the attitude level of participants were age, country of residence, level of education and healthcare-related work or education.

Discussion

While antibiotics overuse and misuse during Hajj have been widely reported,[14-17] only one study investigated KAP among Hajj pilgrims.[18] However, this study was conducted among a small cohort of pilgrims from a developed country. Hence, its findings may not be representative of that of the much larger and diverse Hajj population. We conducted a study among a large cohort of pilgrims from different countries, most of which are on the top list of countries with the largest number of Hajj pilgrims each year.

In our study nearly 15% of pilgrims questioned thought that antibiotics were effective against viruses which is lower than what has been reported from various studies around the world,[25-28] including among Australian Hajj pilgrims (55.8%).[18] However, a further 28.4% of our sample did not know if antibiotics were effective against bacteria, which is in agreement with figures reported from other settings among the general public (23.3%-42.8%).[25-27] This lack of knowledge has been attributed by some to the common use of the term "germ" during counselling or provision of medical advice to the public/patients instead of using the microbiological term "bacteria" or "virus".[25] Interestingly, while a relatively small proportion of our sample thought antibiotics are effective against viruses, much high proportion (63%) thought they are effective against common cold and flu. Reports from around the world indicate that large proportions of the public believe antibiotics are effective against colds and flu (24.5%-60%),[26,29] including among Hajj pilgrims (53.6%),[18] and that antibiotics can treat colds and coughs (52%-70%).[22,30,31]

Misuse of antibiotics, including overuse and not completing the full course of treatment, is an important factor in the development of antibiotic resistance. Over 70% of the pilgrims questioned recognized that misuse of antibiotics can reduce their effectiveness. This is similar to a report among Australian Hajj pilgrims which found that 76% of pilgrims thought that overuse of antibiotics can cause them to lose their effectinvess.[18] Globally, 35-93% of the general population is reported to recognize that antibiotic misuse can reduce their effectinvess,[29,32] and 27-92% are aware that such misuse can lead to the phenomenon of antibiotic resistance.[26,29,33]

Nearly half of the pilgrims we questioned thought antibiotics are used to stop fever, which is a similar proportion to that found among the general public in Malaysia (46.6%).[25] These results are probably linked to the bigger issues of the general lack of knowledge about, and confusion regarding, the actual purpose of antibiotics and mixing antibiotics with other commonly used medications with different indications. For instance, in our study nearly a quarter of respondents thought that antibiotics can cure all diseases, which is similar to the 25.5% proportion of people who thought that antibiotics could cure all infections reported from Malaysia.[25]

Also, antibiotics are commonly thought of as medications to relieve pain, fever or inflammation. A meta-analysis of 24 studies on general populations' knowledge and attitudes about antibiotics reported that 50.9% (95%CI 31.1–70.6) of the sample erroneously thought that antibiotics were the same as anti-inflammatory agents.[26] Ling Oh and colleagues[25] reported that 51% of the people they surveyed wrongly thought that antibiotics are indicated to relieve pain/inflammation and 18.1% were unsure if this statement was true or not. Also, that 20.6% and 13.7% thought that Aspirin and Paracetamol respectively were antibiotics with a further 45.3% and 29.4% respectively being unsure if these medications were antibiotics. We found that 11.2% of Hajj pilgrims surveyed thought Aspirin, Paracetamol, or both were antibiotics. A study among Australian pilgrims reported that 24.6% responded that antibiotics were the same as medications used to relieve pain and fever such as Aspirin and Paracetamol.[18]

Ling Oh et al.[25] listed a number of factors that could have contributed to why respondents generally lacked knowledge to differentiate between antibiotics and other commonly used medicines in their study. These included the possibility that the respondents had never heard about or used these medicines, seldom took note of the names of medicines they were taking or did not get enough information from health-care providers. Also, that the public in general are more familiar with trade names instead of generic names. Mitsi et al.[34] found that when the public in Greece were asked to name an antibiotic 85.2% answered correctly by giving the generic or market name. The most common was amoxicillin (36.7%). Similarly, we found that the majority (nearly 70%) of pilgrims questioned correctly identified amoxyl/amoxicillin as an antibiotic.

We found some poor attitudes among pilgrims towards antibiotics use. Over half of the pilgrims believed in taking antibiotics for prophylaxis and 43.2% believed in self-medication with antibiotics when they are sick to get better. Such attitudes are not uncommon. A recent systematic review and meta-analysis found that 52.1% (95% CI 45.7-72.4) of the sample declared that they take antibiotics for a cold to get better more quickly and 57.4% (95% CI 34.1-79.1) that they take antibiotics for a cold to prevent their symptoms from getting worse.[26] Over 40% of Australian Hajj pilgrims questioned believed that using antibiotics would hasten recovery from respiratory illnesses such as the common cold.[18]

Other common negative attitudes among our respondents were stopping antibiotic treatment once they start feeling better and storing antibiotics leftovers for future use, reported in respectively 63.5% and 54.1% of the pilgrims. These proportions are much higher than those found among Australian pilgrims where only around 24% had such attitudes.[18] However, studies among general populations globally found wide variations. From 22%-59% believed in stopping antibiotics treatment when they feel better[25-27,30,34,35] and 25%-54.6% admit to storing antibiotics for future use or using antibiotic leftovers without doctor's instructions.[22,30,34] Our results are clearly within the upper end of these ranges.

Our study identified a number of poor practices related to antibiotic use among Hajj pilgrims. The majority of pilgrims admitted to using non-prescribed antibiotics by taking antibiotics leftovers from previous illness, antibiotics shared from friends and family or via purchasing them directly from pharmacists without a prescription. These results are in accordance with other reports. For example, studies from KSA found 48%-82% prevalence of use of non-prescribed antibiotics.[21,36-38] Among the Greek urban adult population, 74.6% of respondents admitted to using non-prescribed antibiotics.[34] The main sources of these antibiotics were pharmacists (40.4%), leftovers (30.2%) and friends and family (22.3%). Lower proportions of use of antibiotics without prescription (<25%) were reported from Kosovo,[39] France,[29] USA,[40] and Hon Kong.[41] The differences may be related to not only the general public's knowledge and education regarding antibiotics but also the policies regulating antibiotics purchase in different countries. Use of non-prescribed antibiotics by pilgrims was more frequent in those who are older and those with higher education which is in accordance with other reports.[34,40]

We found that among pilgrims who were in possession of antibiotics at the time the survey was administered, 61% brought these antibiotics from their home country and 39.2% acquired them from Saudi Arabia without prescription. These results are in accordance with a previous study among Australian Hajj pilgrims which found that 77.5% of pilgrims who used antibiotics during their Hajj stay in Saudi Arabia obtained antibiotics inappropriately.[18] Most carried antibiotics from Australia (47.5%) or obtained them from a pharmacy in KSA without prescription (26.3%). The Kingdom has regulations that explicitly prohibits pharmacists from dispensing antibiotics without physician's prescription. However, the practice continues due to a number of factors including lack of governmental enforcement of the current legislations, financial incentives of the pharmacies as well as the public's perceptions regarding antibiotics and demand.[21] A study conducted in Riyadh, found that 77.6% of pharmacies recommended and sold antibiotics over the counter.[36] This phenomenon is by no means limited to Saudi Arabia. In one international survey it was noted that it was possible to get antibiotics directly from the pharmacist without prescription in the nine countries studied (United Kingdom, France, Belgium, Italy, Spain, Turkey, Thailand, Morocco, and Colombia), even where this practice was illegal.[32]

There was a significant relationship between various socio-demographic factors and KAP scores in our study. Being male was significantly associated with better knowledge score. One possible explanation for this observation is that our sample contained a significantly higher proportion of males with secondary or higher education compared to females (63.1% vs 52.3%, $p > 0.001$). A number of studies found no significant differences between males and females in their knowledge and practice related to antibiotics.[25,30] On the other hand, some reported differences.[21,22,34,35,42] For example, among African Americans with low-socioeconomic status, females exhibited better use of antibiotics and compliance with lower rate of inappropriate behaviour of sharing antibiotics compared to males.[42] Similarly, Jordanian and Saudi women were less likely to self-medicate than men.[21,22] However, women in Greece were more likely to use non-

prescribed antibiotics compared to men.[34] Some speculated that women's involvement in child raising and their disease management could alter their self-medication attitudes, leading to misuse of antibiotics.[34,35]

KAP scores differed based on the country from which the pilgrims originated. Given that pilgrims originated from countries with different cultures, languages, believes, educational and health systems as well as regulations and practices regarding antibiotic access, it is reasonable to assume that these factors would affect the pilgrims' KAP scores. Studies have shown that there are significant differences in the general population's knowledge and attitude to antibiotics from one country to another, impacted by country specific factors.[26,32] For instance, Pechere et al.[32] found that the percentage of admitted non-compliance with antibiotic therapy for acute community infections among 4,514 adults from 11 countries around the world varied widely between countries, with country being an independent variable associated with non-compliance.

Knowledge, attitude and practice scores were higher among pilgrims with higher education, those within the younger age group (≤ 43 years old) and those with healthcare-related occupation or education. Many studies found that older age was associated with better knowledge and use of antibiotics,[22,25,29,30,32,43] although some found the opposite[31,34] or no difference between the age groups.[28] Individuals with higher education and those with healthcare-related work or education are more likely to have better knowledge of antibiotics and a better understanding of the consequences of antibiotic misuse. Lim and Teh[44] found that highest education level and healthcare-related occupation contributed significantly to better knowledge and attitude towards antibiotics among the general public in Malaysia.

The association between higher level of education and better knowledge and attitude towards antibiotics is also consistent with reports from Hong Kong,[41] Malaysia,[25] South Korea,[31] Oman,[30] Greece,[34] and Lithuania.[28] Higher level of education has also been reported to be associated with better use of antibiotics in practice in some studies but not all. Mitis et al.[34] speculated that more educated individuals may believe they have a certain amount of "medical savvy" hence, may be more likely to feel comfortable making a diagnosis of their illness and their need for antibiotics.

We found that practice scores only weakly correlated with knowledge scores or attitude scores. This suggest that more knowledge or better attitude to antibiotics do not necessarily translate to better practice. Reports in the literature support the notion that there is no simple relationship between the level of knowledge and behaviours regarding antibiotics. Demore and colleagues[29] found that there was no association between antibiotics knowledge and behaviour among the general population in France. This echoes the results of the survey conducted by McNulty et al.[45] which showed, in particular, that a high level of knowledge about antibiotics was associated with more frequent self-medication. However, Lim and Teh[44] found a significant positive correlation between respondents' antibiotic knowledge score and their attitude

score among the general public in Malaysia. This was consistent with a study in Korea, where adequate knowledge of antibiotics was shown to be a predictor for appropriate attitudes toward antibiotics and their use.[31]

Our study has some limitations. Similar with other public surveys, the data collected in our study is based on self-reported information which depends on the honesty and recall ability of the respondents, as well as their understanding of the questionnaire. We ensured that the questions were simple and clear and that interviewers were trained to communicate with pilgrims from different cultural and language backgrounds to reduce possible bias. Also, while our sample size was large and originated from 7 different countries, this represent a small fraction of the Hajj population which reaches over 2 million pilgrims from around the world. Hence, our results may not be representative of all Hajj population. Finally, as noted by others, excluding all the respondents who had never heard about antibiotics might have resulted in missing important information regarding this category of people.[25]

Antibiotics are overused and misused during Hajj. Addressing this issue requires a multifaceted and multidisciplinary approach, especially given the geographic, ethnic and cultural diversity among pilgrims. Many of these interventions should start at the pilgrims' countries of origin. Public campaigns to improve knowledge and educate people to change their expectations, behavior and attitude about the rational use of antibiotics are needed. These campaigns should be designed to reach and educate the public, taking into account the cultural and social context in which the incorrect beliefs and practices have developed.[30] The heterogeneity of culture, health-care systems, consumption of antibiotics, and current legislations across countries involved may warrant different approaches for different countries.[46] The appropriate health messages should be utilized and delivered through various means such as television, radio, newspapers the internet as well as through education from healthcare professionals to effectively reach the targeted populations.[46-49] As the benefits of such public campaigns are apparent slowly over time, such strategies need to be continuously reinforced and repeated. Public campaigns including such community-integrated strategies were shown to have positive changes in consumer awareness, beliefs, attitudes and behavior to the appropriate use of antibiotics.[39,46,48,49]

Public campaigns have been shown to work best when aligned with interventions aimed at physicians themselves.[46-48,50] Hence, strategies targeting healthcare professionals at rationalizing antibiotic use, ameliorate their dispensing behavior and how to deal with patient expectations and pressure are also important. These are however subject to the presence of guidelines and policies for dispensing antibiotics within appropriate clinical scenarios which should be created if they do not already exist.[21,51] Engagement with pharmacists is also crucial as pharmacies are a major source of the antibiotics used inappropriately. In countries with already existing legislations against over the counter sell of antibiotics, these have to be enforced and pharmacists need to be liable for their adherence with these policies.[21]

Hajj pilgrims receive health promotion and education messages while they are in Saudi Arabia for Hajj but many also have such campaigns administered in their country of origin before the pilgrimage. Such campaigns should include education on the appropriate use of antibiotics and should address the common belief of the advantages of prophylaxis use of antibiotics during Hajj as well as the practice of carrying antibiotics with them from their country of origin to KSA. Engagement of healthcare professionals, pharmacist as well as pilgrims health missions and community and religious leaders in this endeavor is important. Within the Kingdom, rational use of antibiotics and the consequences of antibiotic overuse or misuse should be part of the health education programs for pilgrims. Education of healthcare professionals especially those in contact with pilgrims as well as enforcing the legislations prohibition over the counter sell of antibiotics are crucial given that many pilgrims in our study had acquired antibiotics from pharmacies in the Kingdom without prescription.

Summary

In summary, we conducted the first large scale study among Hajj pilgrims investigating their KAP regarding antibiotics. While some of the findings are encouraging, the mean knowledge score of the participants indicates that there is substantial room for improvement of pilgrims' knowledge of appropriate antibiotic use. We found that pilgrims had some negative attitudes and poor practices including procuring and using antibiotics without a prescription, sharing antibiotics and using antibiotic left overs as well as bringing antibiotics with them from their country of origin. These finding call for action from relevant health authorities, policy makers and stakeholders to improve pilgrims' knowledge, attitude and behavior regarding antibiotics, to better healthcare professionals' knowledge and prescribing practices and to implement and to strictly enforce legislations to stop the sell of non-prescription antibiotics. Such multifaceted interventions would improve rational use of antibiotics during Hajj, reduce antibiotic overuse and misused and help prevent development of resistance.

Declarations

Competing interests

The authors declare that they have no competing interests

Financial support

None to declare

Table 1. Characteristics of the study population

Variable	Number (n)	Percentage (%)
Pilgrims enrolled	**1615**	
Gender	**1611**	
Male	1095	68.0
Female	516	32.0
Age (years)	**1609**	
Mean; SD; (range)	**50.9; 10.8; (19-84)**	
≤43	429	26.6
>43-50	336	20.9
>50-60	492	30.6
>60	352	21.9
Country of residence	**1611**	
Bangladesh	442	27.4
Pakistan	273	16.9
Nigeria	318	19.8
South Africa	50	3.1
Egypt	266	16.5
Iraq	158	9.8
Morocco	104	6.5
Level of education	**1612**	
No formal education	416	25.8
Primary education	236	14.6
Secondary education	523	32.5
University-higher education	437	27.1
Occupation/education related to healthcare	**1587**	
Yes	176	11.1
No	1411	88.9

SD; standard deviation

Table 2. Recognition of antibiotics among pilgrims

The medication is an antibiotic	Total number	Yes	
		n	%
• Flagyl	1476	597	40.4
• Amoxyl/Amoxicillin	1476	1022	69.2
• Paracetamol	1476	141	9.6
• Aspirin	1476	38	2.6

Table 3. Practice statements of pilgrims regarding antibiotics

Practice question	Total number	Good practice	
		n	%
• Acquire antibiotics by prescription from doctor	1401	178	12.7
• Take antibiotics as directed by the doctor	1401	271	19.3
• Check the expiry date of antibiotics before taking them	1405	647	46.0

Table 4. Overall knowledge attitude and practice scores for the study population

Parameter	Knowledge score (0-12)	Attitude score (0-4)	Practice score (0-3)
Mean	7.23	1.89	0.74
SD	2.36	1.34	0.73
Range	0-11	0-4	0-3
Percentiles			
25^{th}	5	1	0
50^{th}	8	2	1
75^{th}	9	3	1

SD; standard deviation

Table 5. Overall knowledge attitude and practice mean scores and demographic variables

	Knowledge score (0-12)				Attitude score (0-4)				Practice score (0-3)			
Variables	**n**	**Mean**	**SD**	**p-value**	**n**	**Mean**	**SD**	**p-value**	**n**	**Mean**	**SD**	**p-value**
Gender												
Female	451	6.72	2.40	.0001	422	1.79	1.35	.058	450	0.73	0.67	.897
Male	1028	7.46	2.32		977	1.94	1.33		1027	0.75	0.76	
Age group												
1 ≤43	425	7.95	2.33	.0001	405	2.31	1.29	.0001	426	0.91	0.73	.0001
2 >43-50	396	7.68	2.28		383	1.92	1.30		393	0.73	0.74	
3 >50 - 60	378	6.78	2.25		360	1.76	1.30		377	0.67	0.74	
4 >60	279	6.15	2.16		251	1.38	1.31		280	0.59	0.68	
Country of residence												
South Africa	50	7.36	1.65	.0001	50	1.76	1.10	<.0001	50	0.92	0.83	.0001
Nigeria	287	7.63	2.36		284	1.61	1.50		287	0.81	0.81	
Bangladesh	441	6.87	2.24		376	1.76	1.52		438	0.63	0.69	
Pakistan	233	7.58	2.42		233	1.79	1.40		233	0.73	0.66	
Egypt	266	7.20	2.52		258	1.98	0.81		266	0.70	0.77	
Iraq	110	5.83	1.92		106	2.34	0.69		111	0.98	0.62	
Morocco	92	8.57	2.08		92	2.88	1.12		92	0.79	0.73	
Education												
No education	318	5.27	2.28	.0001	260	1.18	1.14	<.0001	319	0.49	0.66	.0001
Primary	209	6.18	1.82		203	1.52	1.35		207	0.61	0.62	
Secondary	517	7.32	2.04		504	1.74	1.17		516	0.73	0.76	
University	437	9.08	1.37		435	2.66	1.25		437	0.99	0.72	

Healthcare work/education												
No	1282	7.03	2.39	.0001	1205	1.76	1.26	<.0001	1280	0.7	0.73	.0001
Yes	176	8.78	1.39		174	2.94	1.34		176	1.03	0.72	

SD; standard deviation

Figure 1. Knowledge of pilgrims regarding antibiotic

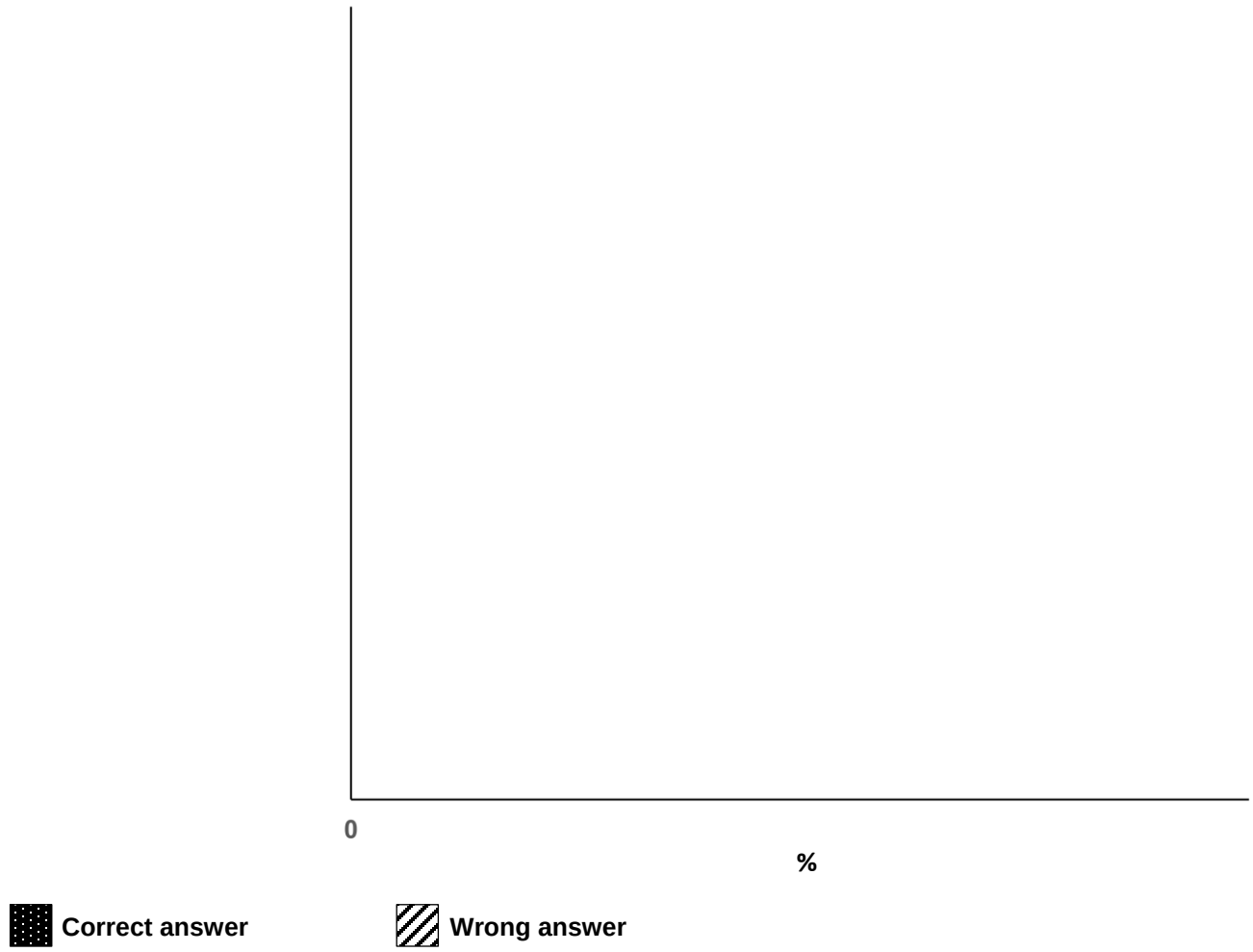
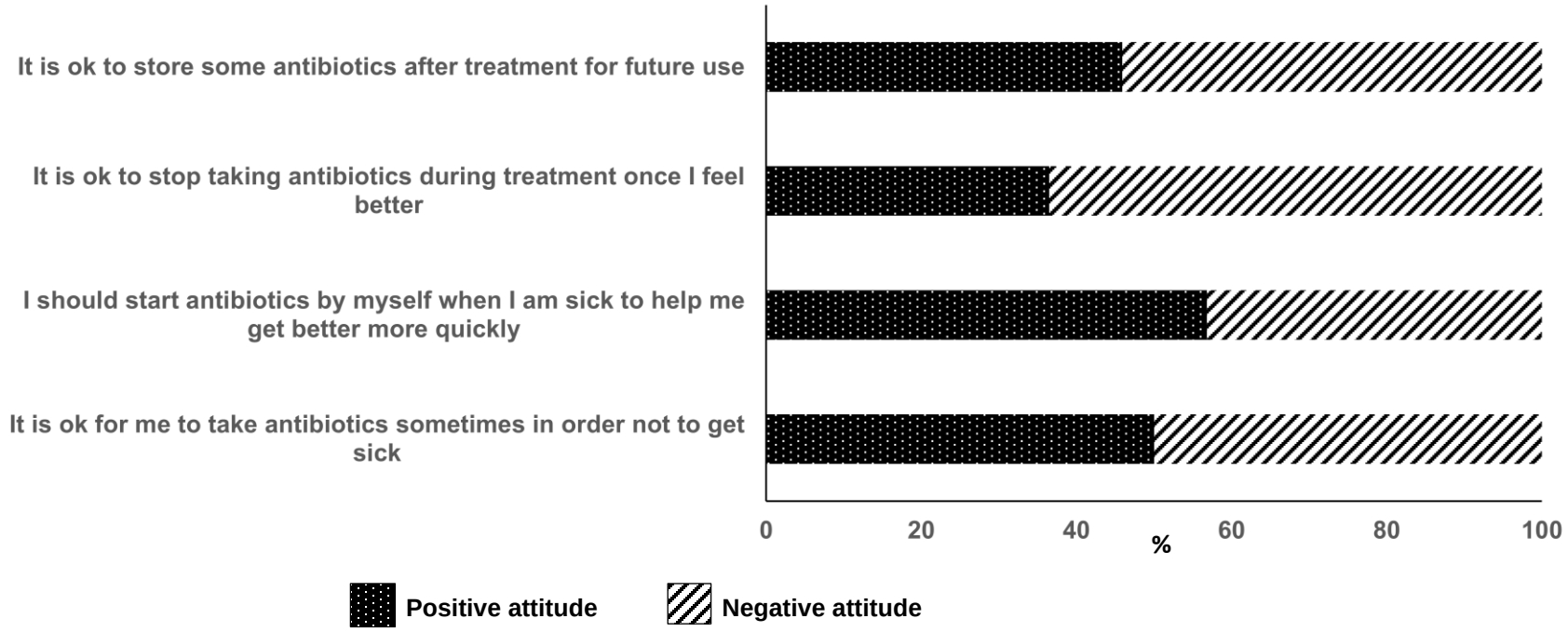


Figure 2. Attitudes of pilgrims towards antibiotics



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