HEALTH PROMOTION

Assessing Knowledge, Attitudes, and Practices of Adults Aged 21-62 Regarding Antibiotic Use for Treatment of Upper Respiratory Tract Infections in Children: A multi-country Cross-Sectional Study

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Keywords

Upper respiratory tract infections • Parental knowledge • Antibiotic misuse • Antimicrobial resistance • Self-medication

Summary

Objectives. *Antibiotic resistance is a growing global concern, often driven by inappropriate antibiotic use for viral upper respiratory tract infections (URTIs) in children. This study assessed parental knowledge, attitudes, and practices (KAP) toward antibiotic use and identified influencing factors.*
Study Design. *Multi-country, cross-sectional, web-based study.*
Methods. *From July 2023 to June 2024, adults aged 21-62 years from 9 Arab countries completed a validated online questionnaire. Data were analyzed using descriptive statistics and logistic regression.*
Results. *Of 2,172 participants from 9 Arab-speaking countries, most were highly educated with healthcare backgrounds. While physicians were the main information source, misconceptions persisted-especially regarding antibiotic use for fever and earaches. Higher income and medical training were protective factors. Self-medication was common despite good knowledge.*
Conclusion. *Parental misconceptions regarding antibiotics in pediatric URTIs remain prevalent. Educational interventions and regulatory strategies are essential to improve antibiotic stewardship in Arab countries..*

Introduction

Upper respiratory tract infections (URTIs) are prevalent in children and a major cause of pediatric clinic visits [1, 2]. Children in Germany, for instance, experience an average of 3.4 episodes of the common cold annually during infancy, 2.3 in preschoolers, and 1.1 in school-aged children [3]. URTIs are primarily viral [4-6], making antibiotic treatment ineffective [4, 7]. Antibiotics do not reduce URTI complications significantly [8]. Despite this, unnecessary antibiotic use remains high due to both overprescription and self-medication by parents [9-12].

Antimicrobial resistance (AMR) occurs when microorganisms evolve to resist antibiotics, reducing their efficacy [13, 14]. Antibiotics have been vital in treating bacterial infections since the 20th century, but bacterial resistance emerged in the late 20th century, particularly in intensive care units, where it contributes to numerous deaths annually [15]. Misuse and overuse of antibiotics are significant contributors to the rise of AMR [16-18]. AMR is now one of the top ten global health threats [19]. In 2019, AMR-related deaths totaled 4.95 million, with 1.27 million directly attributed to bacterial resistance [20, 21]. It also imposes a substantial economic burden, raising healthcare costs, affecting international trade, and reducing productivity. Without intervention, AMR could cost the global economy 100 trillion USD by 2050 [21]. The WHO has urged researchers to prioritize AMR in their work [22]. Although new antibiotics offer hope, their effectiveness will be limited without curbing antibiotic misuse [23]. Strict guidelines are essential to prevent misuse and the spread of resistance in healthcare and community settings [14].

Parents often misunderstand the indications for and proper use of antibiotics [24-26]. These misconceptions contribute to the spread of antibiotic resistance [16-18]. Parental knowledge and attitudes significantly impact antibiotic prescribing, as physician decisions are often influenced by the desire for parental satisfaction [27]. If parents expect antibiotics to improve their child's condition, they may pressure doctors for prescriptions, leading to overuse [28]. While numerous studies have assessed the knowledge, attitudes, and practices (KAP) regarding antibiotic use in treating URTIs in children, there remains a gap in qualitative research,

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particularly in some countries [29]. High-quality studies are needed to identify the issues parents face in managing URTIs.
This study aims to assess the KAP of adults aged 21-62 years regarding antibiotic use for URTIs in children and identify factors contributing to antibiotic overuse. It also explores the common misconceptions and beliefs surrounding antibiotic use and examines how socioeconomic and cultural factors influence overuse.

Methods

Study Design and Setting

This multi-country cross-sectional study was conducted across all 22 Arab-speaking countries (including Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, the United Arab Emirates, and Yemen) between 23 July 2023 and 05 June 2024. The questionnaire was distributed electronically across the Middle East and North Africa (MENA) region to ensure a broad representation of the Arab population.
The aim was to estimate public knowledge, attitudes, and practices (KAP) regarding the use of antibiotics in children with upper respiratory tract infections (URTIs). Given the online nature of the study, participants were recruited using a convenience and snowball sampling strategy. The questionnaire was developed using Google Forms and distributed via social media platforms (such as WhatsApp, Facebook, and LinkedIn) and professional networks. The invitation included a brief cover letter explaining the study's objectives, the voluntary nature of participation, and a statement ensuring anonymity and data confidentiality. To ensure a wider reach across most of Arab countries, collaborators in different regions helped disseminate the link within their respective local communities and networks.

Clinical Trial Registration

As this was a non-interventional, observational study, clinical trial registration was not applicable.

Study Population

The study population consisted of adults in Arab speaking countries aged 21 to 62 years who were admitted on a random basis. Estimating the target population of adults aged 21 to 62 years across Arabic-speaking countries is a complex endeavor, necessitating a rigorous approach to derive a reliable estimate. According to recent demographic estimates, the total population of the Arab-speaking countries in 2022 is approximately 464 million individuals [30]. Based on the age distribution data, it is projected that adults within the 21 to 62-year age range constitute roughly 45% of this total population [46]. This leads to an estimated population of approximately 208 million adults within this specific age group.

Eligibility Criteria

Inclusion criteria:

- Adults aged 21 to 62 years residing in Arabic-speaking countries.
- Able to read and understand Arabic.
- Provided e-informed consent by agreeing to a mandatory consent statement at the beginning of the online questionnaire.
- From either medical or non-medical educational/professional backgrounds.

Exclusion criteria:

- Individuals younger than 21 or older than 62 years (to ensure a working-age adult sample and minimize age-related bias).
- Participants residing outside the targeted Arab countries.
- Individuals who did not provide informed consent.
- Incomplete survey submissions.

Participant Selection and Screening

To maintain scientific rigor in a virtual environment, the online questionnaire employed an automated screening mechanism using survey skip logic. This "digital gatekeeping" ensured that the inclusion and exclusion criteria were strictly enforced from the outset; participants were required to complete mandatory fields regarding their age, country of residence, and informed consent. Any individual falling outside the specified age range of 21-62 years, residing outside the Arab countries, or declining to provide informed consent was immediately redirected, and their session was terminated. This systematic filtering process, which also automatically excluded incomplete submissions, ensured that all analyzed responses met the predefined study protocol without the need for person-to-person selection.

Sample Size Calculation

Hypothesis 1: Sample Size for a Defined Population

To determine the appropriate sample size for a known target population of approximately 208 million individuals, we used Cochran's formula with a finite population correction (FPC) [50]. A confidence level of 95% was selected, corresponding to a Z-score of 1.96, with a margin of error of ± 5% and an estimated response proportion (P) of 0.5, which maximizes variability. After applying the finite population correction to adjust for the large but finite population size, the resulting minimum required sample size was approximately 384 individuals.

Hypothesis 2: Sample Size for an Indeterminate (Infinite) Population

In scenarios where the population size is unknown or considered infinite, Cochran's standard sample size formula without the finite population correction is applied [50]. Using the same confidence level (95%), margin of error (± 5%), and estimated proportion (P = 0.5), the calculated minimum sample size was also approximately 384 individuals. This consistency supports the adequacy of the calculated sample size under both known and indeterminate population assumptions.

Minimizing Bias in Data Collection

Given the potential for bias in self-administered online surveys and the public health importance of antibiotic misuse, a standard confidence level of 95% was adopted in accordance with common practice in cross-sectional public health research. To further address potential response bias, incomplete questionnaires, and variability in response quality, the calculated minimum sample size was doubled, yielding a final target sample size of approximately 768 participants. Increasing the sample size beyond the minimum requirement was intended to enhance representativeness, improve statistical power, and increase the precision of estimates within a large and heterogeneous population across multiple countries.

Study Procedures

Participants were recruited through a public online campaign using Google Forms. The survey link was disseminated via social media platforms (Facebook, WhatsApp, and Twitter), parenting groups, university networks, and healthcare-related online communities across the Arab countries. No financial incentives were offered. To reduce selection bias, the link remained open for 5 months and was shared periodically across diverse community groups.

The questionnaire used in this study was adapted from a previously validated tool developed by Panagakou et al. (2011) for a similar cross-sectional study conducted in Greece [31]. The adapted version was translated into Arabic and subsequently validated by Zyoud et al. (2015) in a Palestinian population to ensure linguistic and contextual appropriateness [33]. It consisted of structured items covering sociodemographic, knowledge, attitudes, and practices related to antibiotic use and resistance in pediatric URTIs. Participants were asked if they had a child who had previously suffered from upper respiratory tract infections (URTIs) to assess their prior experience and subsequent behavior regarding antibiotic use. This variable refers to the history of infection rather than a diagnosis at the time of participation.

Data Analysis

Data were entered using Microsoft® Excel and analyzed with Stata 14.2 (Stata Corp LP, College Station, TX, USA). Descriptive statistics were reported as means ± standard deviations for continuous variables and frequencies (percentages) for categorical variables. Chi-square tests assessed associations between categorical variables. Stepwise logistic regression analysis was conducted to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for predictors of incorrect responses to questions such as "Are antibiotics the first-line treatment for URTIs in children?" Independent variables included age, sex, urban/rural residence, education, income, health insurance status, medical field affiliation, parenthood, and healthcare access. A *p-value* < 0.05 was considered statistically significant. All independent variables, including socio-demographic data (such as age, gender, educational level, and income) and professional background, were self-reported by the participants using the structured online questionnaire.

Although stepwise models have limitations such as potential overfitting, its use was appropriate in this hypothesis-generating context and allowed identification of the strongest predictors. The results are interpreted cautiously, and future studies should validate these findings using theory-driven models.

Given the heterogeneity of the participating Arab countries in terms of culture, healthcare access, and insurance systems, we examined country-level differences by introducing country dummy variables during preliminary regression testing. However, these variables did not materially change the effect sizes or significance of the main predictors and were therefore excluded from the final parsimonious model. Nonetheless, country-level distributions are reported, and interpretation acknowledges contextual variability.

Data Handling

All data were entered as recorded, without alteration. Each entry was double-checked against the original questionnaire to resolve discrepancies. The original unedited data were preserved to ensure integrity. Coding, entry, and analysis were performed by the research team to ensure data fidelity and reproducibility. Ethical approval was obtained prior to data collection.

Results

Demographic Characteristics

A total of 2,172 adults from Egypt, Jordan, Yemen, Iraq, Saudi Arabia, Kuwait, Morocco, Palestine, and Sudan completed the survey. The mean age was 31 ± 9 years (range: 21-62). Most participants resided in urban areas (78.91%), held university-level education (79.97%), and reported moderate family income (77.90%). More than half (53.18%) had a background in healthcare. Approximately 35.05% lacked health insurance, 14.96% reported poor access to healthcare, and 41.90% had children (Tab. I). Although the required sample size was 768, the actual collected data reached 2,172 thereby substantially increasing the statistical power of the study.

Participants were classified into six groups (Tab. II) based on combined family income and healthcare-related education or employment: (Group 0) Low family income level and no working or studying in a medical field, (Group 1) Low family income level and working or studying in a medical field, (Group 2) Moderate family income level and no working or studying in a medical field, (Group 3) Moderate family income level and working or studying in a medical field, (Group 4) High family income level and no working or studying in a medical field, (Group 5) High family income level and working or studying in a medical field.

General Knowledge

The primary source of antibiotic-related information was physicians (67.68%), followed by pharmacists (17.36%), with similar patterns across groups (Tab. III).

Tab. I. Demographic profile (n = 2,172).

Characteristics	%	N
Female	79.93%	1,736
Age		
Mean ± s.d. range (min-max)	30.97 ± 8.88 21-62	
Habitants of Town	78.91%	1,714
Country		
Jordan Yemen Egypt Iraq Sudan Palestine Kuwait Morocco Saudi Arabia	23.11% 20.86% 18.37% 17.82% 13.77% 2.49% 1.7% 0.97% 0.92%	502 453 399 387 299 54 37 21 20
Educational status		
Postgraduate education High school University stage	13.90% 6.12% 79.97%	302 133 1,737
Family income level		
High Moderate Low	9.35% 77.90% 12.75%	203 1,692 277
Insured (Government health insurance or Private health insurance)	64.96%	1,411
Access to health care system (medium-very good)	85.04%	1,847
Work or study in medical field	53.18%	1,155
Children	41.90%	910
Having a child that suffered from URTIs (i.e. colds, ear, asthma, etc.)	6.72%	146

Tab. II. Distribution of subjects interviewed in the six groups.

Groups	N	%
Group 0	116	5.34
Group 1	161	7.41
Group 2	821	37.80
Group 3	871	40.10
Group 4	80	3.68
Group 5	123	5.66

When asked whether antibiotics are the first-line treatment for pediatric upper respiratory tract infections (URTIs), 66.62% answered correctly (*i.e.* disagreed). Group-level differences were statistically significant ($p<0.001$), with the highest accuracy in participants with both high income and medical knowledge (Group 4: 92.50%; Group 5: 92.68%) and the lowest in Group 0 (51.72%). Respondents with medical backgrounds more accurately identified antibiotics from a drug list ($p<0.001$). Misidentification was more common among participants without medical training (Fig. 1).

A large majority (87.06%) acknowledged the potential side effects of antibiotics. Additionally, 69.61% disagreed with initiating antibiotics solely due to high fever, with significant differences across groups ($p=0.010$) (Tab. IV).

The most commonly cited risks were antibiotic resistance (75.37%) and weakened immunity (74.49%). Group 5 showed the highest awareness of resistance risk (92.68%). About 74.35% recognized that most respiratory infections are viral in origin and do not require antibiotics (Tab. V).

Logistic regression identified high income (OR=0.15, 95% CI: 0.09-0.25), university education (OR=0.66, 95% CI: 0.53-0.83), and medical training (OR=0.72, 95% CI: 0.60-0.87) as protective factors against the misconception that antibiotics are the first treatment for URTIs (Tab. VI). Age, sex, and parenthood were not significant predictors ($p>0.06$).

Similarly, predictors of awareness about antibiotic resistance included high income (OR = 0.44, 95% CI: 0.29-0.67) and medical background (OR = 0.68, 95% CI: 0.56-0.83). Other variables were not statistically significant and were excluded from the final model (Tab. VII).

Attitudes

Regarding symptoms, 39.81% of respondents reported fever and 34.07% reported earache in children as reasons to use antibiotics, often exceeding 70% usage in these cases (Tab. VIII).

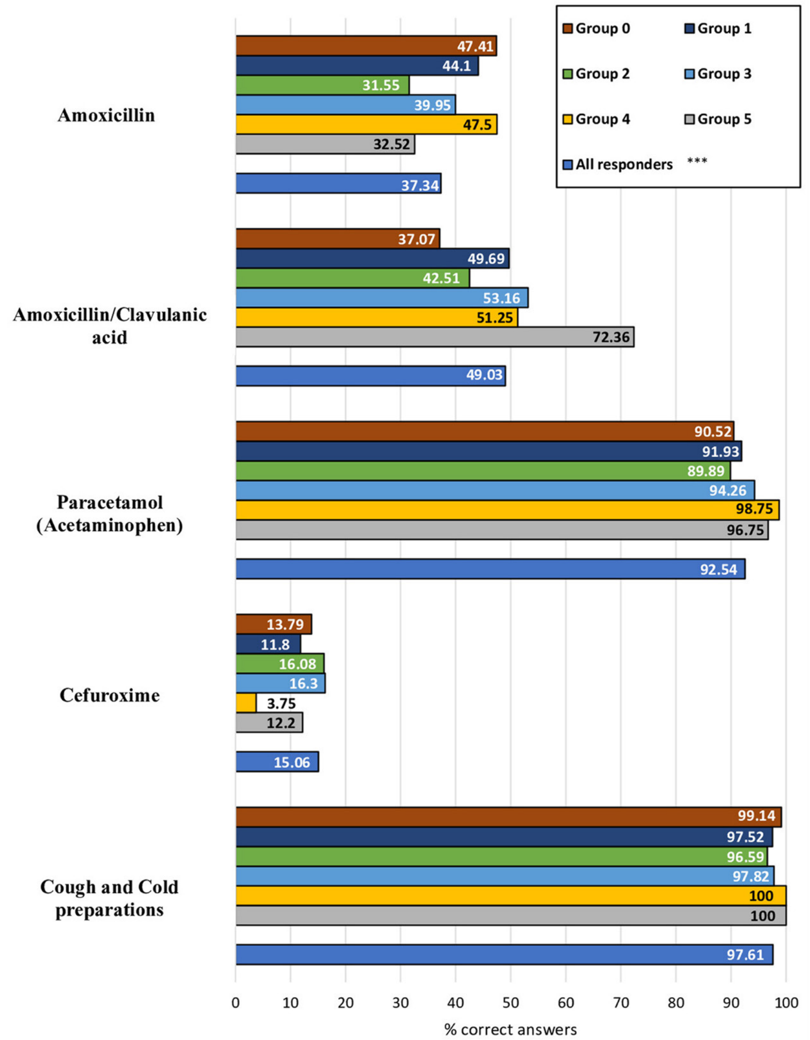
Pediatricians were consulted for fever (73.02%) and earache (68.28%). When asked what medications they expected for pediatric URTIs, 78.59% expected analgesics/antipyretics, 51.93% antitussives, and 49.82% antibiotics (Fig. 2).

Antibiotics were sometimes used by self-administration for reasons such as prior prescriptions (57.69%), pharmacist recommendations (33.66%), perceived mild illness (29.42%), time/cost barriers (27.39%), and non-

Tab. III. Percentage of respondents reporting their primary source of information on the appropriate use of antibiotics, overall and by group.

	Physician	Pharmacist	Radio, Television and internet	Scientific newspaper and magazine	Others	Relatives and friends
Group 0	62.07	16.38	10.34	2.59	2.59	6.03
Group 1	62.73	12.42	6.21	7.45	8.70	2.48
Group 2	62.36	23.02	5.72	3.29	1.71	3.90
Group 3	72.33	14.70	3.79	3.79	3.21	2.18
Group 4	73.75	13.75	7.50	0.00	5.00	0.00
Group 5	78.05	8.13	11.38	0.81	1.63	0.00
All	67.68	17.36	5.62	3.50	2.99	2.85

Fig. 1. Which of the following do you think is an antibiotic? Percentage of correct answer.



professional advice (7.32%) (Tab. IX).
A total of 84.53% agreed that antibiotics are often overused, with significant group differences ($p < 0.001$) (Tab. X).

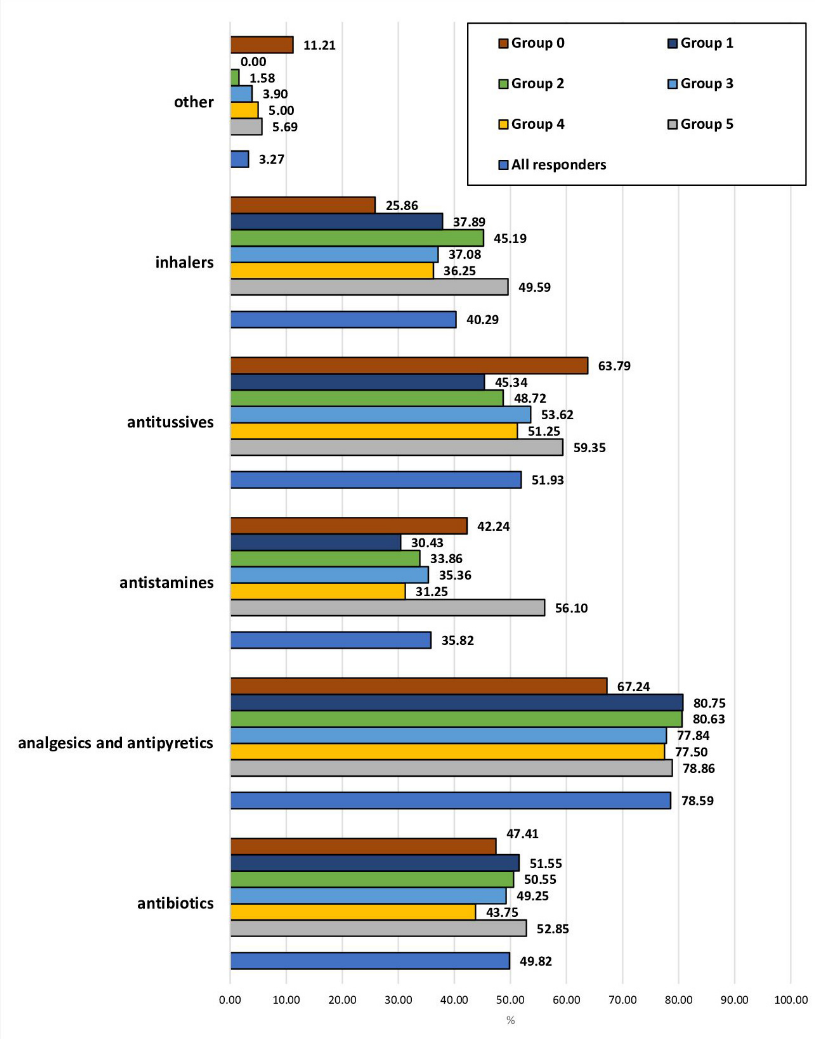
Practices

Approximately 42.03% of participants consistently asked pediatricians whether antibiotics were needed before administration. Only 21.69% expressed opposition to unnecessary prescriptions, with significant variation across groups ($p<0.001$). Over 50% reported consistent adherence to the pediatrician's instructions when administering antibiotics (Tab. XI).

Discussion

This study assessed adult knowledge regarding antibiotic use for pediatric URTIs across nine Arab countries (Jordan, Yemen, Egypt, Iraq, Sudan, Palestine, Kuwait, Morocco, Saudi Arabia). The predominantly female sample (79.93%) aligns with previous research [31-33]. Participants were grouped by socioeconomic and educational status to explore impacts on knowledge. Physicians were the main information source, consistent with earlier findings [31, 33-39, 42]. Two-thirds recognized that antibiotics are not the first-line treatment, with the highest awareness among those with higher income and medical backgrounds, similar to findings from studies conducted in Oman, Greece, Malaysia, Saudi Arabia, and Palestine [37]. Awareness of side effects was high; 69.61% opposed using antibiotics solely for fever, consistent with existing literature [31, 33, 35, 38, 40]. However, a Jordanian study found that over two-thirds believed fever warranted antibiotics [36], and 37% of Turkish parents thought viral infections could be treated with antibiotics [41]. Regarding risks, 75.37% identified antibiotic resistance as a major concern, aligned with international reports [31, 33, 35-40]. High education and reliance on healthcare professionals likely contribute to these positive outcomes.
Attitudes: Despite sound knowledge, many participants

Fig. 2. participants expectations for Pediatrician-Recommended Treatments for Upper Respiratory Infections: Affirmative Response Percentage.



believed antibiotics were necessary for fever (39.81%) and earache (34.07%), with over 70% seeking pediatric consultation for such symptoms–mirroring findings from Oman and Saudi Arabia [42, 43]. Expectations for medication during URTI episodes included analgesics/antipyretics (78.59%), antitussives (51.93%), and antibiotics (49.82%). Elbur et al. reported higher antibiotic expectations (>50%) but lower for analgesics (33%) and antitussives (25.8%) [43]. Self-medication was often influenced by prior prescriptions (57.69%), pharmacist recommendations (33.66%), and mild illness perception (29.42%), similar to findings from UAE and Saudi Arabia studies [33, 43-45]. Additional reasons included time and financial constraints, as well as non-professional advice. A majority believed antibiotics are overused, with significant group differences (G3: 95.93%; $p<0.001$), supporting prior findings [31, 35, 43]. Higher socioeconomic and educational status correlated with reduced self-medication [47-49].

Practices: Only 42.03% regularly questioned the necessity of antibiotics, comparable to 30% in Greece [31] but lower than in Cyprus and Jordan [35, 36]. Most participants reported adherence to pediatrician instructions, reflecting strong trust in healthcare providers, with similar adherence rates documented in Malaysia, Palestine, and Saudi Arabia [33, 37, 39].

Limitations: Despite the diverse participation from various Arab countries, several limitations must be acknowledged. First, the study relied on self-reported data, which may introduce social desirability bias. Additionally, the retrospective nature of questions regarding children's past infections may have led to recall bias, potentially affecting the accuracy of participants' responses.

Regarding the methodology, a significant limitation is the inability to determine a formal response rate; since the survey was distributed via social media using snowball sampling, the total number of individuals reached (the denominator) remains unknown. Furthermore, while the study covered nine countries, the uneven sample size distribution and the lack of a uniform denominator prevented us from performing reliable comparative

Tab. IV. Percentage of participants with knowledge regarding upper respiratory tract infections in children, overall and by group.

	Strongly agree/agree	Uncertain	Disagree/strongly disagree
All children should be given antibiotics when they have a fever (high temperature)			
All	27.67	2.72	69.61
Group 0	31.03	0.86	68.11
Group 1	24.85	3.73	71.42
Group 2	29.1	3.78	67.12
Group 3	27.9	2.18	69.92
Group 4	28.75	0	71.25
Group 5	16.26	1.63	69.61
Children with flu symptoms get better faster when they are given antibiotics			
All	32.91	2.81	64.28
Group 0	38.79	4.31	56.9
Group 1	32.92	3.1	63.98
Group 2	40.32	2.68	57
Group 3	27.21	2.99	69.8
Group 4	31.25	3.75	65
Group 5	19.51	0	80.49
Respiratory infections re often caused by a virus and do not require antibiotics			
All	74.35	4.74	20.91
Group 0	77.59	0.86	21.55
Group 1	81.99	6.21	11.8
Group 2	74.06	4.99	20.95
Group 3	74.51	4.59	20.9
Group 4	65	0	35
Group 5	68.29	8.95	22.76
Antibiotics do not have side effects			
All	9.25	3.69	87.06
Group 0	16.38	2.59	81.03
Group 1	12.42	2.49	85.09
Group 2	8.52	3.78	87.7
Group 3	8.96	3.67	87.37
Group 4	7.5	6.25	86.25
Group 5	6.5	4.07	89.43
Excessive use of antibiotics reduces their effectiveness and leads to bacterial resistance			
All	77.72	2.76	19.52
Group 0	75	0	25
Group 1	85.72	0.62	13.66
Group 2	79.41	1.71	18.88
Group 3	76.58	3.9	19.52
Group 4	71.25	0	28.75
Group 5	70.73	8.94	20.33
Using antibiotics can prevent complications from upper respiratory infections			
All	65.83	6.08	28.09
Group 0	72.41	2.59	25
Group 1	76.4	4.35	19.25
Group 2	65.65	7.92	26.43
Group 3	64.06	4.94	31
Group 4	60	3.75	36.25
Group 5	63.41	8.94	27.64
Scientists will be able to produce antibiotics capable of treating the types of bacteria that are resistant to the antibiotics currently available			
All	66.58	13.95	19.47
Group 0	69.83	14.66	15.52
Group 1	68.33	18.01	13.66
Group 2	66.86	15.35	17.79
Group 3	65.45	11.6	22.96
Group 4	81.25	13.75	5
Group 5	57.72	15.45	26.83

Tab. V. Percentage of respondents reporting perceived risks associated with antibiotic use, overall and by study group.

	All	Group 0	Group 1	Group 2	Group 3	Group 4	Group 5
Harming the liver	43.00	48.28	49.69	45.19	39.38	48.75	36.59
Harming the kidney	48.80	46.55	49.07	49.70	49.60	48.75	39.02
Hurting the stomach	38.67	42.24	36.02	38.73	38.81	37.50	38.21
Increased resistance of bacteria to antibiotics	75.37	75.00	83.85	70.16	76.12	77.50	92.68
Allergies	31.49	30.17	33.54	27.77	33.52	38.75	35.77
Weakened immune system	74.49	80.17	73.29	75.03	73.94	63.75	78.05
It has no risk	0.51	0	0.00	0.24	0.46	6.25	0.00
Other	10.08	4.31	8.07	7.43	12.28	6.25	22.76

Tab. VI. Logistic Regression Analysis of Demographic Variables Predicting Antibiotic Preference for Child Upper Respiratory Infections.

	OR	St. error	*p*	IC 95%
Family income level	0.15	0.04	0.000	0.09-0.25
Work or study in medical field	0.72	0.07	0.001	0.60-0.87
Educational status	0.66	0.08	0.000	0.53-0.83
Health insurance	0.79	0.08	0.012	0.64-0.95
Original residence	0.79	0.09	0.037	0.63-0.99
Access to health services	0.78	0.10	0.058	0.61-1.01

Tab. VII. Logistic Regression Analysis of Demographic Variables Predicting Drug Resistance Risk: Negative Response.

	OR	St. error	*p*	IC 95%
Family income level	0.44	0.09	0.000	0.29-0.67
Work or study in medical field	0.68	0.07	0.001	0.56-0.83
Educational status	0.79	0.10	0.051	0.62-1.00

analyses between specific nations or regions.

It should also be noted that while preliminary models adjusted for country-level effects using dummy variables – showing no significant impact on the results – inherent differences in healthcare systems, national guidelines, and cultural prescribing norms across the Arab world may still influence KAP outcomes.

Finally, Future studies should aim to include more diverse socio-economic groups to ensure a more comprehensive understanding of antibiotic use across all segments of the population. Moreover, subsequent research should explore country-specific determinants in greater depth to identify unique cultural and regulatory influences on parental behaviors.

Conclusion

This cross-sectional study assessed adults' knowledge, attitudes, and practices regarding antibiotic use for pediatric URTIs across diverse Arab populations. While healthcare professionals are the primary information source and antibiotic overuse is recognized, misconceptions about antibiotic necessity for fever and earache persist, with some self-medication reported. Compliance with medical advice remains generally high. These findings highlight the crucial role of healthcare providers and the urgent need for targeted interventions to improve public understanding and behavior. Further qualitative and longitudinal research is recommended, including underrepresented Arab countries. Addressing antibiotic resistance requires coordinated efforts from healthcare stakeholders to curb irrational antibiotic use and safeguard their efficacy.

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Tab. VIII. Percentage distribution of participants according to reported frequency of antibiotic prescription (Never-Always) for selected child symptoms, overall and by group.

	Never 0-5%	Sometimes 5-30%	Often 30-70%	Most of the times 70-95%	Always 95-100%
Colds					
All	37.85	30.70	16.62	8.84	5.99
Group 0	37.94	35.34	19.83	5.17	1.72
Group 1	32.30	42.24	13.04	9.94	2.48
Group 2	36.18	25.82	19.48	12.67	5.85
Group 3	39.49	30.31	16.19	6.89	7.12
Group 4	48.75	37.50	1.25	0.00	12.50
Group 5	37.40	42.28	12.20	4.87	3.25
Runny nose					
All	50.28	27.95	17.27	3.04	1.46
Group 0	47.41	33.62	11.21	5.17	2.59
Group 1	56.52	26.09	12.42	4.97	0.00
Group 2	42.39	32.76	20.46	2.44	1.95
Group 3	54.54	24.91	16.65	3.10	0.80
Group 4	56.25	26.25	7.50	2.50	7.50
Group 5	63.41	15.45	18.70	2.44	0.00
Dry throat					
All	37.25	32.50	18.51	9.76	1.98
Group 0	39.66	31.03	21.55	5.17	2.59
Group 1	42.85	20.50	32.30	3.11	1.24
Group 2	33.25	33.62	19.00	11.21	2.92
Group 3	38.69	33.41	16.88	9.64	1.38
Group 4	45.00	25.00	10.00	18.75	1.25
Group 5	39.02	40.65	11.38	8.13	0.82
Cough					
All	29.01	33.70	18.60	15.65	3.04
Group 0	25.86	27.59	25.00	18.97	2.58
Group 1	35.40	33.54	21.74	9.32	0.00
Group 2	23.38	32.16	20.83	19.61	4.02
Group 3	30.65	37.44	15.84	13.20	2.87
Group 4	50.00	21.25	15.00	12.50	1.25
Group 5	35.77	31.71	15.45	13.82	3.25
Vomiting					
All	38.26	27.76	16.80	12.20	4.98
Group 0	33.62	27.59	6.90	25.86	6.03
Group 1	43.48	20.50	13.66	18.63	3.73
Group 2	35.81	23.75	20.22	14.13	6.09
Group 3	39.15	32.49	14.36	9.18	4.82
Group 4	36.25	30.00	31.25	0.00	2.50
Group 5	47.15	29.27	15.45	7.32	0.81
Fever					
All	12.57	26.29	25.83	21.50	13.81
Group 0	9.48	23.28	23.28	32.76	11.20
Group 1	6.83	13.66	28.57	36.02	14.92
Group 2	10.72	23.02	24.24	24.60	17.42
Group 3	13.55	30.54	27.44	15.27	13.20
Group 4	26.25	33.75	18.75	21.25	0.00
Group 5	19.51	32.51	28.46	15.45	4.07
Pain in the ear					
All	6.58	26.71	32.64	21.22	12.85
Group 0	3.45	22.42	26.72	20.69	26.72
Group 1	3.11	16.15	42.24	21.11	17.39
Group 2	5.36	27.41	30.33	23.01	13.89
Group 3	7.58	26.75	34.56	21.13	9.98
Group 4	22.50	27.50	31.25	12.50	6.25
Group 5	4.88	39.02	28.46	16.26	11.38

Tab. IX. Percentage of participants reporting factors leading to self-administration of antibiotics for their child, overall and by study group.

All	Group 0	Group 1	Group 2	Group 3	Group 4	Group 5
Because the pediatrician previously prescribed the same medicine for your child and for the same current symptoms						
57.69	63.79	59.01	56.15	56.95	56.25	66.67
Because the pharmacist recommended a specific antibiotic						
33.66	31.03	41.61	24.71	32.26	28.75	31.71
Because you thought your child's condition was not serious						
29.42	23.28	24.22	29.6	31.11	25	31.71
Because you do not have enough time to visit the doctor, or not having enough money						
27.39	22.41	39.75	27.89	27.1	30	13.01
Because a relatives or neighbors recommended giving a specific antibiotic						
7.32	11.21	7.45	5.72	8.61	2.5	8.13

Tab. X. Percentage distribution of parents' attitudes and behaviors regarding antibiotic use, overall and by study group.

	Strongly agree/agree	Uncertain	Disagree/strongly disagree
Do you think antibiotics are used too much and unnecessarily?			
All	84.53	2.72	12.75
Group 0	86.21	3.45	10.34
Group 1	72.67	0.00	27.33
Group 2	81.73	3.90	14.37
Group 3	86.80	2.18	11.02
Group 4	92.50	0.00	7.50
Group 5	95.93	3.25	0.82
Did you change your pediatrician because he didn't prescribe the antibiotics for your child as you wanted?			
All	15.66	19.98	64.37
Group 0	6.03	30.17	63.80
Group 1	11.18	21.74	67.08
Group 2	20.22	18.88	60.90
Group 3	14.81	20.55	64.64
Group 4	10.00	1.25	88.75
Group 5	9.76	23.58	66.66
Have you changed your pediatrician because at every visit he prescribes antibiotics?			
All	50.86	21.55	27.58
Group 0	54.66	8.70	36.65
Group 1	57.00	11.94	31.06
Group 2	58.78	12.28	28.94
Group 3	75.00	2.50	22.50
Group 4	49.59	21.95	28.46
Group 5	50.86	21.55	27.58
Do you give your child leftovers from the previous antibiotic when he has the same previous symptoms?			
All	22.6	13.77	63.63
Group 0	25.00	25.00	50.00
Group 1	27.95	14.29	57.76
Group 2	23.26	14.86	61.87
Group 3	21.59	12.51	65.90
Group 4	30.00	1.25	68.75
Group 5	11.39	12.20	76.42
Do you think that most upper respiratory infections can be resolved without the use of antibiotics because they go away on their own?			
All	72.75	5.11	22.14
Group 0	73.27	6.90	19.82
Group 1	63.35	3.73	32.92
Group 2	72.84	5.85	21.31
Group 3	73.36	4.94	21.70
Group 4	87.50	1.25	11.25
Group 5	69.91	4.07	26.02

Tab. X. (*follows*).

	Strongly agree/agree	Uncertain	Disagree/strongly disagree
Do you think parents and pediatricians should be informed about using antibiotics wisely?			
All	94.66	0.64	4.7
Group 0	97.41	0.00	2.59
Group 1	86.34	0.62	13.04
Group 2	95.00	1.46	3.53
Group 3	94.83	0.11	5.05
Group 4	100.00	0.00	0.00
Group 5	95.93	0.00	4.07

Tab. XI. Percentage distribution of parental practices and behaviors regarding antibiotic prescription for children, overall and by study group.

	Never 0-5%	Sometimes 5-30%	Often 30-70%	Most of the times 70-95%	Always 95-100%
Do you ask the doctor whether or not it is necessary to prescribe antibiotics for your child?					
All	5.61	12.29	18.09	21.96	42.03
Group 0	8.62	19.83	18.97	12.93	39.66
Group 1	9.94	12.42	19.25	17.39	40.99
Group 2	3.65	10.48	16.81	22.41	46.65
Group 3	4.71	12.86	17.45	25.37	39.61
Group 4	20.00	12.50	21.25	20.00	26.25
Group 5	7.32	13.01	26.83	10.57	42.28
Would you like the doctor not to prescribe antibiotics for your child?					
All	2.67	14.92	26.75	33.98	21.69
Group 0	0.00	24.14	25.86	22.41	27.59
Group 1	1.24	13.66	29.19	34.78	21.12
Group 2	4.02	13.89	30.21	34.10	17.78
Group 3	2.64	13.89	24.23	38.00	21.24
Group 4	0.00	22.50	25.00	16.25	36.25
Group 5	0.00	17.07	20.33	26.02	36.59
Do you directly ask the doctor to prescribe antibiotics for your child?					
All	39.00	34.02	14.41	7.27	5.29
Group 0	32.76	43.97	5.17	12.93	5.17
Group 1	35.40	32.92	16.15	11.18	4.35
Group 2	39.34	30.21	17.17	8.65	4.63
Group 3	39.15	36.51	14.01	5.05	5.28
Group 4	48.75	25.00	5.00	7.50	13.75
Group 5	39.84	39.84	11.38	3.25	5.69
Do you fully follow all your pediatrician's instructions and advice when using the antibiotic?					
All	0.86	1.72	8.62	33.62	55.17
Group 0	0.62	4.35	4.35	34.78	55.90
Group 1	0.73	4.26	10.60	28.50	55.91
Group 2	0.57	2.53	16.65	27.55	52.70
Group 3	0.00	2.50	8.75	20.00	68.75
Group 4	0.00	4.07	11.38	19.51	65.04
Group 5	0.86	1.72	8.62	33.62	55.17
Do you think your pediatrician is prescribing an antibiotic for your child just because you asked for it?					
All	39.96	30.06	16.85	7.37	5.76
Group 0	40.52	30.17	14.66	10.34	4.31
Group 1	42.86	34.78	9.32	6.83	6.21
Group 2	41.66	25.94	19.61	7.67	5.12
Group 3	38.46	32.72	16.76	6.77	5.28
Group 4	38.75	22.50	20.00	7.50	11.25
Group 5	35.77	37.40	8.94	7.32	10.57

Ethics approval and consent to participate:

At the beginning of the questionnaire, participants were presented with a detailed consent form outlining the study's aims, procedures, risks, benefits, and data privacy measures. Only participants who agreed to the consent statement were able to proceed with the survey. informed consent was obtained from all participants. Ethical approval for this study was obtained from the Ethics Committee of Tanta University (approval code: 36264PR105/2/23).

Competing interests statement

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

Authors' contributions

MK: made all over the study, preparing the proposal, receiving ethical approval, completing the questionnaire preparation and revision, collecting the data, handling the data, performing the statistical analysis, writing, revising, and reviewing the final manuscript.
EM, AK, AN, RG: participated in the literature review, writing the protocol, collecting the data, preparing and revising the questionnaire, and writing the manuscript. All authors participated in performing the statistical analysis and writing and revising the Results section of the manuscript. MS: participate in Perform statistical analysis, writing and revising results section, and revising discussion section of the manuscript.
MA, EN: Participation in the literature review and writing of the manuscript.
AF, NM, SR: Participated in the literature review, collected the data, and revised the manuscript. SS: Supervised the whole process of the research and revised the manuscript.
All authors read and approved the final manuscript.

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