

# Socio-demographic determinants of antibiotic misuse in children

## *A survey from the central region of Saudi Arabia*

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### ABSTRACT

**الأهداف:** دراسة المعرفة، والمعتقدات، والممارسات لدى الوالدين المرتبطة بسوء استخدام المضادات الحيوية.

**الطريقة:** تم مشاركة والدي الأطفال الذين لا تتجاوز أعمارهم 12 سنة في المسح الذي تم إجرائه في أربع مرافق تجارية في أغسطس من عام 2010. تم تعريف الصرف الذاتي للمضادات الحيوية للطفل خلال العام الماضي بالاستخدام السيئ للمضادات الحيوية من قبل الوالدين.

**النتائج:** من 610 من الوالدين (60.5% آباء، 39.5% أمهات)، (95% CI: 91%, 14.2%)، أقروا بالصرف الذاتي للمضادات الحيوية. اختلفت إجابات الوالدين حسب العمر، التعليم، المهنة وعدد الأطفال. إجمالاً: ذكر الوالدين أن الطفل يتطلب مضادات حيوية في حالات سيلان الأنف، السعال، التهاب الحلق أو الحمى (50%)، وأن المضادات الحيوية تقلل من شدة ومدة الأعراض (57.7%)، وأنها فعالة ضد الفيروسات (68.6%)، وأنه يمكن إيقافها عند تحسن الطفل (28.7%)، وأن التي استخدمت من قبل أحد أفراد الأسرة يمكن استخدامها (20.1%). كانت محدودات استخدام المضادات الحيوية باستخدام نموذج متعدد المتغيرات: الدخل المادي، عدد الأطفال، نوع الالتهاب المعالج، المعرفة بالأمراض التي تتطلب المضادات الحيوية، أو عدم التأكد، استخدام المضادات الحيوية التي استخدمت من قبل أحد أفراد الأسرة، وعدم التأكد من هذا الاستخدام.

**خاتمة:** الوالدين ذو الدخل المنخفض، والذين يملكون أكثر من طفلين، الافتقار إلى المعرفة، والمعتقدات والممارسات غير الملائمة هي عوامل تساهم في سوء استخدام المضادات الحيوية عند الأطفال.

**Objectives:** To investigate knowledge, beliefs, and practices associated with parental antibiotic misuse.

**Methods:** This cross-sectional study included parents visiting 4 malls in Riyadh, Saudi Arabia. The study took place at the College of Medicine, King Saud University, Riyadh, Kingdom of Saudi Arabia between June and

December 2010. Self-prescription of antibiotic for a child in the past year was defined as antibiotic misuse.

**Results:** From 610 parents (60.5% mothers and 39.5% fathers), 11.6% reported self-prescription. Responding parents differed by age, education, number of children, and profession. Overall, parents responded that antibiotics are required in children with runny nose or cough or sore throat or fever (50%); to reduce symptom severity and duration (57.7%), are effective against viruses (68.6%), can be stopped on clinical improvement (28.7%), and it used by another family member can be used in children (20.1%). Determinants of misuse in a multivariable model were income, number of children, type of infection treated last year, knowledge of illness requiring antibiotic or being unsure, using antibiotics used by an other family member in children, unsure of such use, and adjusting for the type of responding parent.

**Conclusion:** Parents with low income, more than 2 children, lack of knowledge, inappropriate beliefs and practices are vulnerable for misusing antibiotics in children.

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Misuse of antibiotic treatment potentially implies non-compliance with recommended and prescribed therapy. The concept of compliance involves practices including self prescription, failure to complete therapy, missing the doses, taking sub-optimal doses, and re-use of leftover antibiotics.<sup>1</sup> Antibiotic misuse is a worldwide problem and is important due to the rapid development of resistance to a large number of antibiotics resulting in high morbidity and mortality; with implications for increased health care costs, failure of treatments, hospitalization and clinic visits. A large systematic review evaluated heterogeneity in estimates from various regions and countries; reporting a mean compliance with antibiotic treatment of 62.2%, and use of leftover antibiotics of 28.6%.<sup>1</sup> Self-medication is considered as the use of drugs in treating self-diagnosed illnesses or symptoms, or the intermittent or continued use of prescription drugs to treat chronic or recurrent diseases or symptoms; and antibiotic storage at home predicts intentional self medication.<sup>2</sup> Antibiotics are the most important medications and their misuse is mainly for viral respiratory tract infections, to an extent that parents expect an antibiotic prescription from physicians with a belief for reduction in symptom severity.<sup>3</sup> Regional studies have found high prevalence rates of antibiotic misuse.<sup>2,4,5</sup> A study in Syria found that 57% of individuals followed the advice of someone other than a physician or used an old prescription, and 50% stopped using antibiotics after feeling better.<sup>4</sup> There was lack of knowledge attributed mainly to socioeconomic status, with only 10% of participants knowing that drug resistance is a consequence of antibiotic misuse, and 15% that antibiotic misuse is harmful.<sup>4</sup> In the United Arab Emirates, self administration of antibiotics was practiced by 34% of parents in children; major predictors of antibiotic misuse were storing antibiotics at home and ease of obtaining antibiotics from community pharmacies.<sup>2</sup> Another study from Jordan reports 39.5% of self medication for antibiotics; main reason being effective prior experience and such use was associated with socio-economic factors of age, income, and education.<sup>5</sup> Common misconceptions regarding antibiotic use include the ability to treat symptoms of influenza, sore throat, runny nose, fever, and any other common infection frequently of viral origin.<sup>2-5</sup> A recent survey of mothers (n=209) of children with respiratory tract infections (RTI) from Jeddah, Saudi Arabia reports 16.1% of mothers used non-prescribed antibiotics.<sup>6</sup> One of the previous studies in the Kingdom of Saudi Arabia has shown that RTIs are the most common infections requiring antibiotics in children.<sup>7</sup> There is insufficient data from Saudi Arabia assessing antibiotic

misuse and knowledge, beliefs, and practices related to it. One cross sectional study assessed awareness, attitudes, and practices related to precautionary measures for H1N1 influenza, in 2009 during the H1N1 pandemic; in spite of high level of concern in population there was a low compliance for precautionary measures, with low levels of knowledge and education were significant predictors of low compliance.<sup>8</sup> Similarly there is a need to explore common misconceptions and attitudes toward antibiotic use to help prevent unwanted sequelae associated with antibiotic misuse, but first, the misconceptions and attitudes need to be identified and quantified. Thus, our aim was to assess the extent and determinants of antibiotic misuse by parents by surveying them in public places such as malls located in Riyadh, central region of the Kingdom of Saudi Arabia.

**Methods.** The study was conducted at College of Medicine, King Saud University, Riyadh, Kingdom of Saudi Arabia and participants were enrolled in 4 popular major shopping malls of Riyadh, Saudi Arabia. These malls are located in different parts of the city and are visited by all social classes of the community. A cross sectional study design was used to perform this study. Study duration extended from June 2010 to December 2010. It was planned in June 2010 with protocol writing, formulation of tool after pilot testing in English and Arabic, the survey was conducted during the month of August 2010 between 6 and 10 pm, 4 days a week, including weekends. These times ensured the most access to potential study participants. Electronic databases such as MEDLINE and Google Scholar were searched to find related articles on antibiotic misuse using search words of self medication, antibiotic misuse, knowledge, beliefs and practices AND antibiotic misuse. Searches were supplemented with material on this subject found in the article's references as well.

Study participants included male and female parents of children aged between 1 and 12 years old whether native Saudis or Arab expatriates. We invited mall visitors to participate in the study informing on the inclusion criterion of having at least one child of less than 12 years of age. Consenting parents participated in the survey through convenient sampling in malls, like those who visited during the hours data collectors were available in malls. Although a non-probability sampling method was used due to the exploratory nature of study, to establish the existence of a problem. Surveys of knowledge beliefs, and practices in Saudi Arabia utilize settings such as shopping malls<sup>8</sup> as families from all cadres of society visit them. A platform was created for conducting the study by trained data

collectors who administered the survey after taking informed consent from the parents. While parents completed the forms, children were provided with coloring materials and other recreational activities to occupy them. Study participants filled out the forms; and in few cases they were assisted by data collection individuals at their request. Data collectors helped in clarifying any inquiries made by the parents while answering the survey questions. However, some of the parents preferred to be questioned by the data collectors instead of filling out the questionnaires themselves.

The questionnaire was developed from the validated questionnaires reviewed from literature<sup>5,9,10</sup> and the structure was modified after pilot testing in these local settings. The first part of the questionnaire included demographic characteristics of respondents, socioeconomic and educational status (Questions number 1-11), followed by questions that tested the knowledge (Questions number 12-16), beliefs (Questions number 17-23, and practices (Questions number 24- 35) related to antibiotic use.

Parents' gender, educational level, profession, monthly income, marital status, and nationality were inquired. Knowledge questions in terms of using antibiotics and their effectiveness against signs and symptoms were structured so that responses were on a 3-item points; 1= true, 2 = false, and 3 = I don't know. Beliefs and practices related to duration of use and reuse of antibiotic for various signs and symptoms were inquired. Structured questions for beliefs and practices were ascertained using 3 items: agree, disagree, and not sure.

Parental age groups were categorized in 5 groups (from <25 to ≥55 years) ), educational status had 6 categories, starting from none, primary school, secondary school, high school, academics must be bachelors degree, institute must be a diploma from an institute, and graduate must be post graduate studies such as MSc or PhD. Education was further categorized as 2 categories at the level of high school as ≤high school and >high school for parents. Respondents' relationship with child as father or mother was evaluated and considered as a potential confounder for studying association between socio-demographic characteristics and antibiotic misuse. Marital status and monthly income variables were also categorized as dichotomous variables (married versus other, such as widow/divorced) and monthly income as least income of <5000 SR versus other higher income groups. Multivariable analysis using multiple logistic regression modeling was performed to determine the socio-demographics including knowledge, beliefs and practice variables with antibiotic misuse or self

prescription of antibiotics for their children less than 12 years of age. Based on the reported studies prevalence of antibiotic misuse over a large range<sup>2,4-6</sup> sample size was calculated using the assumption of prevalence of 15% of antibiotic misuse (self-prescription) reported from Saudi Arabia<sup>6</sup> with 3% as desired level of precision. In addition for determinants of misuse, an odds ratio (OR) of ≥2 was assumed with 20% unawareness in prescribed users and ratio of 4:1 (aware: unaware) a sample size of 610 was adequate to capture antibiotic misuse and its determinants including 10% inflation for any errors or missing data. This sample size was estimated with the power of 80% and significance level set at alpha of 0.05.

For analyses, data were summarized for descriptive statistics. Proportions were calculated and subgroup analyses were based on respondent's information for prescribed or non-prescribed use of antibiotics for their child in the past year. Non-prescribed use of antibiotics was defined as antibiotics prescribed by oneself or by someone other than a physician. Variables for number of family members and number of children categories were created based on median or quartiles. Chi square was used as a statistical test of significance, with a  $p < 0.05$  considered significant for comparing determinants of non-prescribed use of antibiotic between prescribed users and self medicated users. Odds ratios and 95% confidence intervals were calculated to evaluate relationship between socio-demographic variables and antibiotic self prescription (misuse) as an outcome variable. Multiple logistic regression modeling was performed to determine the relationship of socio-demographics, knowledge, beliefs, and practices associated with the use of non-physician prescribed antibiotics, and adjusted odds ratios (AOR) were calculated. Determinants were adjusted for the differences respondents (mothers and fathers for age, education, and parental profession. Pearson Chi-square of goodness of fit test was carried out to assess the predictive accuracy of the model; using algorithmic approach. Data were entered and analyzed using Statistical Package for Social Sciences version 17 (SPSS Inc. Released 2008. SPSS Statistics for Windows, Chicago IL USA).

The study was planned according to ethical principles of autonomy, safeguarding participant interest, taking informed consent, and maintaining anonymity and privacy of study participants. The study was according to the principles of Helsinki's Declaration, and was approved by Institutional Review Board of King Saud University.

**Results.** A total of 631 parents participated in the study, 3.3 % (21/631) of parents reported that they did not use antibiotics in the past year for their children; hence 610 participants were included for the analyses. When asked about the last antibiotic used within the past year, 539 (88.4%) mentioned that it was prescribed by a physician, and 71 (11.6%; 95% CI: 9.1%, 14.2%) mentioned they self-prescribed. Among the respondents, the age ranged between <25 years (5.6%) to  $\geq 55$  years (3.3%) in age; 60.5% were mothers, 82.6% were Saudi nationals, 42% had more than 2 children of <12 years of age, 96% were married and others were either widowed or separated.

Table 1 shows distribution of responses by mothers and fathers that differed significantly by age groups, marital status, education, number of children <12 years of age, and profession. Income variable was borderline significant, with 15% of the respondents' reporting monthly income of less than 5,000SAR, and 17% reporting monthly income of and more than

15000SAR. Participant mothers tended to be younger, and less educated than responding fathers. Respondent parents did not differ from each other by number of family members, and location of the malls where they were surveyed. Overall, the knowledge of parents demonstrated that 57.7% parents were of the opinion that antibiotics; limit severity and symptom duration of common cold, 68.6% thought that antibiotics are effective against viruses, and 50% thought that any type of infection can be treated by antibiotics. Of the parents who used antibiotics in the past year for their child, 25% did not complete the required course of the antibiotic. Regarding beliefs, 50% of parents agreed that if a child has runny nose or cough or sore throat or fever, antibiotics should be given, 28.7% agreed to stop the course of antibiotic if symptoms start improving; 55% said that usually doctors give the same antibiotic upon consultation, but 66.2% were of the opinion that an antibiotic will not be effective in a community setting if it is overused. As regards to practices, 25% did

**Table 1** - Demographics distribution of responses by mothers and fathers that differed significantly by age groups, marital status, education, number of children <12 years of age, and profession.

Variable	Total	Father (n=241)	Mother (n=369)	P-value
<b>Age (years)</b>				
<25	34 (5.6)	6 (2.5)	28 (7.6)	<0.001
25 - <35	242 (39.7)	68 (28.2)	174 (47.2)	
35 - <45	215 (35.2)	97 (40.2)	118 (32.0)	
45 - <55	99 (16.2)	56 (23.2)	43 (11.7)	
$\geq 55$	21 (03.3)	14 (5.8)	6 (01.6)	
<b>Marital status</b>				
Married	585 (95.9)	238 (98.8)	347 (94.0)	0.003
Widowed/divorced	25 (4.1)	3 (1.2)	22 (06.0)	
<b>Family members</b>				0.87
<5	236 (38.7)	92 (38.2)	144 (39.0)	0.01
$\geq 5$	374 (61.3)	149 (61.8)	225 (61.0)	
<b>Number of children &lt;12 years</b>				
1-2 children	353 (57.9)	124 (51.5)	229 (62.1)	0.01
>2 children	257 (42.1)	117 (48.5)	140 (37.9)	
<b>Education</b>				<0.001
Non/primary education	39 (6.4)	10 (4.1)	29 (7.9)	0.054
Secondary education/High School	172 (28.2)	60 (24.9)	112 (30.4)	
Academic/Institute	352 (57.7)	133 (55.2)	219 (59.3)	
Graduate	47 (7.7)	38 (15.8)	9 (2.4)	
<b>Income (Saudi Riyals)</b>				
<5000	91 (14.9)	28 (11.6)	63 (17.1)	0.01
5,000 - <9,999	247 (40.5)	91 (37.8)	156 (42.3)	
10,000 - 14,999	168 (27.5)	72 (29.9)	96 (26.0)	
$\geq 15,000$	104 (17.0)	50 (20.7)	54 (14.6)	
<b>Profession</b>				
Health care related	48 (7.9)	28 (11.6)	20 (5.4)	0.01
Not health care related	562 (92.1)	213 (88.4)	349 (94.6)	
<b>Malls location</b>				0.57
Mall 1	106 (17.4)	39 (16.2)	67 (18.2)	0.57
Mall 2	93 (15.2)	37 (15.4)	56 (15.2)	
Mall 3	339 (55.6)	133 (55.2)	206 (55.8)	
Mall 4	71 (11.8)	32 (13.3)	40 (10.8)	

not complete the course of antibiotics when last given to their child. Common infections in their children reported by parents in descending order were: tonsils, ears, influenza, pneumonia, diarrhea, urinary tract, and other complaints related to toothache, wound infection, poisoning, acne, and burns.

Table 2 displays the subgroups of study participants by physician or self prescribed groups. Variables with  $p < 0.25$  are shown in Table 2, as these were considered in model building. Overall, the socio-demographic characteristics did not differ significantly between the 2 groups except that parents with more than 2 children less than 12 years of age, tended to self prescribe antibiotics compared to those with one to 2 children (Table 2). This

analysis significantly differed by knowledge based on the antibiotic use for bacterial versus other infections, infections associated with fever, use of the specific antibiotic if it was used by a family member in the past for a similar illness in children, and type of infection that was reported to be treated (Table 2). Those who reportedly suffered bronchitis or pneumonia tended to use physician-prescribed antibiotics.

The logistic regression model displayed in Table 3 shows that those who incorrectly had knowledge that any type of infection with fever needs to be treated by antibiotics had twice the odds of misusing antibiotic (AOR: 2.17, 95% CI: 1.19-3.96), or who did not know (AOR 1.15, 95%CI:0.35-3.78) compared to parents

**Table 2 -** Knowledge, beliefs, practices and socio-demographic characteristics by antibiotic self prescription in study participants.

Questions	Characteristics	Self-prescribed (n=71) %	Physician prescribed (n =539) %	P-value
1	<i>Relationship with child</i>			
	Father	46.5	38.6	0.24
	Mother	53.5	61.4	
2	<i>Number of family members</i>			
	Less than 5	30.0	39.7	0.19
	More than or equal to 5	69.0	60.3	
3	<i>Number of children</i>			
	One to two	46.5	59.4	0.04
	More than 2	53.5	40.6	
4	<i>Marital Status</i>			
	Married	93.0	96.3	0.19
	Widow/Divorced	7.0	3.7	
5	<i>Monthly Income (Saudi Riyals)</i>			
	Low income <5000	23.9	13.7	0.03
	Higher income $\geq$ 5000	76.1	86.3	
6	<i>Education</i>			
	Less than or equal to High School	40.8	13.6	0.24
	Greater than High School	59.2	86.4	
7	<i>Any infection with fever need to be treated by antibiotics</i>			
	Incorrect response	69.0	48.1	0.004
	Correct response	25.4	43.8	
	Don't Know	5.6	8.1	
8	<i>Antibiotics are effective against viruses</i>			
	Incorrect response	64.8	69.1	0.14
	Correct response	21.1	23.7	
	Don't Know	14.1	7.2	
9	<i>Antibiotic used by other family members for similar illness can be given to a child</i>			
	Incorrect response	40.8	18.5	<0.001
	Correct response	52.1	78.3	
	Don't Know	7.1	3.2	
10	<i>Did you complete the full course of antibiotics when used last time</i>			
	Yes	70.0	78.2	0.16
	No	24.3	19.4	
	Do not remember	5.7	2.4	



**Table 3** - Determinants of antibiotic misuse by parents: Logistic regression model.

Variables in model	Beta (SE)	Wald statistics	P-value	AOR	95% Confidence interval
<i>Any infection with fever is to be treated by antibiotics</i>					
Incorrect response	0.77 (0.31)	6.34	0.012	2.17	1.19-3.96
Correct response (Reference)		6.87	0.032	1.00	
Did not know	0.14 (0.60)	0.06	0.813	1.15	0.35-3.78
<i>Antibiotic used by other family members for similar illness can be given to a child</i>					
Incorrect response	1.13 (0.28)	15.75	<0.001	3.01	1.77-5.37
Correct response (Reference)		17.16	<0.001	1.00	
Did not know	1.01 (0.56)	3.83	0.050	3.00	1.00-9.01
<i>Infection type perceived to be treated with antibiotics in a child in past year</i>					
Other infections	0.79 (0.34)	5.30	0.021	2.21	1.13- 4.34
Pneumonia/Bronchitis (Reference)	-			1.00	
<i>Number of children</i>					
Parents with >2 children of <12 years	0.52 (0.27)	3.67	0.055	1.68	0.99-2.85
Parents with ≤2 children of <12 years	-			1.00	
<i>Monthly income (Saudi Riyals)</i>					
Low <5000	0.70 (0.33)	4.43	0.035	2.00	1.05-3.83
High ≥5000	-			1.00	
<i>Relationship of respondent with child</i>					
Father	-0.30 (0.27)	1.22	0.269	0.74	0.44-1.26
Mother	-			1.00	
Constant	-4.69(0.91)	26.42	0.000		
Pearson Chi square goodness of fit test (87.87; df 80, with $p=0.256$ ); $R^2$ 13.9%, AOR - adjusted odds ratios					

with correct knowledge. Parents who believed that it was acceptable to administer the same antibiotics to their children that were used for a similar illness by any other family members in the past; had thrice the odds of using non-prescribed antibiotics compared to those who did not keep such a belief (AOR: 3.01, 95% CI: 1.77-5.37). Similarly, those who were not sure about the use of prior antibiotics by any other family member were also 3 times more likely to misuse antibiotics compared to those who would not treat the child with the same antibiotic used by any other family member with a similar illness (AOR: 3.00, 95% CI: 1.00-9.01). Parents' who reported that their children suffered with infections other than pneumonia/bronchitis misused antibiotics twice as much compared to those whose children had pneumonia and or bronchitis (AOR: 2.21, 95% CI: 1.13-4.34). Parents with more than 2 children of less than 12 years of age misuse antibiotics (AOR 1.68, 95%CI: 0.99-2.85) compared to those who had only one or 2 children. Parents reporting monthly income of less than SAR5,000 had twice the odds of misusing (self prescribing antibiotic) (AOR 2.00, 95% CI: 1.05-3.83) compared to those with monthly income of and more than SAR5,000. The model was

adjusted for demographic differences (age, education, and profession) between responding mothers and fathers (Table 3). The model likelihood ratio had Chi square=44.33, with df=8, and  $p < 0.001$  (Nagelkerke R-square=13.9%). Due to small number of covariates, fulfilling the asymptotic assumption criteria; the calculated Pearson Chi-square goodness of fit test was insignificant ( $p=0.256$ ).

**Discussion.** Antibiotic misuse is evidently associated with misconceptions on the use of antibiotics and their indications. In Saudi Arabia, antibiotics can be purchased from the pharmacy without a prescription, however, antibiotic use without prescription was only 11.6% (95% CI: 9.1%-14.2%) of the study participants. This rate is lower than reported from UAE (36%), Syria (57%), Jordan (39.5%), and Greece (22.7%),<sup>2,4,5,11</sup> but much closer to the studies from USA (12% in suburban areas),<sup>9</sup> Hong Kong (9%),<sup>10</sup> and UK (5%).<sup>12</sup> Possibility of an inherent bias cannot be ruled out as sample selection may have occurred from a distinguished section of the population who belonged to the group who did not misuse antibiotics. However, estimates were similar in the 4 selected diverse shopping

malls that differed by reported monthly income ( $p < 0.002$ ), and we feel confident that various strata of the population by socioeconomic status were captured in our sample. Moreover, survey of mothers of children with RTI, from Jeddah reported 16.1% of antibiotic misuse<sup>6</sup> that further supports our estimate.

Socio-demographic characteristics such as age<sup>2,5,11,12,13</sup> gender<sup>4,10,12</sup> education<sup>2,4,5,10,11,12</sup> income levels,<sup>4,5,10,13</sup> and geographical locations<sup>9</sup> have been associated with antibiotic misuse. Younger,<sup>4,12,13</sup> and middle<sup>5</sup> age groups have been associated with antibiotic misuse, males<sup>4,10</sup> have been invariably related with misuse practices where as younger females<sup>12</sup> have been associated with storing of antibiotics.<sup>12</sup> Both low,<sup>4</sup> and high,<sup>2,5,10,11,12</sup> education, low,<sup>4,13</sup> middle,<sup>4</sup> and high<sup>5,10</sup> income levels are reported to be associated with antibiotic misuse. Such reports reflect cultural variation, cohort effects, and sampling variation; for example, high education is associated with misuse in relatively developed settings such as UAE,<sup>2</sup> Jordan,<sup>5</sup> Hong Kong,<sup>10</sup> and Greece,<sup>11</sup> however, antibiotic misuse was least in Hong Kong (9%), mid level in Greece (22.7%) and highest in Jordan (39.5%), but low education levels were associated with misuse in Syria that reported highest levels of misuse (57%).<sup>4</sup> In our study, the participating mothers (58.7%) were younger and less educated than participating fathers; in a subgroup analyses less educated fathers had higher odds of antibiotic misuse than educated fathers (OR 2.68, 95% CI=1.19-6.05); such an association was not significant in mothers (OR 0.82, 95% CI 0.38-1.75); likewise, mothers from another study carried out in Saudi Arabia were reluctant to self medicate their children due to adverse affects on immunity.<sup>6</sup> More fathers were in health care related profession than mothers, and mothers were less likely to misuse antibiotics compared to fathers; however these results were not significant; though there are reports that parents in non-health care professions misused antibiotics more than parents in health related professions.<sup>13</sup> Parents with more children showed association with antibiotic misuse in Greece,<sup>11</sup> and our study showed somewhat similar association. Our study had higher percentages for inadequate knowledge, and beliefs compared to those reported from Hong Kong with whom our rate of misuse was closer than other studies;<sup>10,12</sup> nevertheless, practice of stopping antibiotics earlier (25%) when symptoms improved in our study were better than the reported estimate of 50% from Greece.<sup>11</sup>

Symptoms of RTI are known to be associated with self prescribed antibiotics, and parental pressure upon doctors to prescribe antibiotics.<sup>3,12</sup> Our results showed that parental misuse was more for infections other

than pneumonia or bronchitis, including common respiratory infections. Similarly history of successful treatment by antibiotics in a family member is vulnerable to increase misuse and storage of leftover antibiotics. In our study 34% disagreed that the repeated use of a specific antibiotic in the community may make it less effective in the future. This indicates a low awareness for the development of bacterial resistance. Such an issue is reported from a study that 28% were unaware of the dangers associated with antibiotic misuse.<sup>2</sup> Thus, education about the appropriate usage of antibiotics and the issue of bacterial resistance should be introduced to the public. Failure to complete therapy, ignoring and skipping doses, reusing leftover antibiotics, and self-medication can have detrimental effects both at the individual and community level with development of resistance, low potency, diagnostic errors, and therapeutic problems.<sup>1,3</sup>

A notable point is that our study participants (28%) did not know that an antibiotic should be used for a certain period of time. Another issue lies in the understanding of antibiotic function: only 38.5% understood that antibiotics are used to treat bacterial infection, while the remaining respondents had mixed answers and believed for its use in viral infections too. The correct use of antibiotics and discontinuation of treatment is of concern, as a good number of respondents did not have enough information to enable them to use antibiotics safely.

Our results are consistent for; parents with more than one child of <12 years of age and association with antibiotics misuse,<sup>11</sup> and for reported misuse in single parents,<sup>2</sup> but for latter association our results insignificantly showed the same relation as single, widowed, or separated individuals, but sparse data could have shown a chance relationship. The relationship between socio-demographic strata and antibiotic misuse cannot be overlooked anywhere, hence our results have important implications to educate all but especially vulnerable subgroups of population. Further using self reporting of antibiotic misuse and compliance has been criticized;<sup>1</sup> therefore, home visit approach is recommended to detect errors in medications for children.<sup>14</sup> In Europe, antibiotic misuse is considered as a major threat for development of resistance, hence national level awareness initiatives engaging political, media, and other stakeholders are targeting primary care providers.<sup>15</sup> Equally important is resistance against other medications such as anti-malarial medicines, that are being misused at high levels (44.3% for anti-malarial drugs, 48% for antibiotics).<sup>17</sup> Furthermore, a study from India reports that environmental factors,

such as climate, availability of health care systems due to poor environmental conditions are also responsible for misuse of antibiotics thus leading to development of resistance in antibacterial medicines.<sup>18</sup> It further recommends dissemination of information and education with enforcement of legislation for antibiotic dispensing.<sup>18</sup> Another interesting fact is the availability of health insurance that is reported to be associated with low antibiotic misuse with better knowledge, beliefs and practices.<sup>9,19</sup> In Saudi Arabia, health care is available with a better health care ensured for the population and where antibiotic misuse is lower as in developed settings; the knowledge beliefs and practices need to be enhanced. Our study had several strengths. First use of parents (mothers and fathers) as a target population to obtain direct information on knowledge, beliefs and practices. Second, a large sample size to capture various strata of target population including parents' gender, education and income level, and other unknown factors that could affect the knowledge, beliefs, and practices related to antibiotic use. Thirdly, utilization of referenced questions contributed to obtain meaningful data and reliable results.

The study faced some limitations; firstly participants were selected from those visiting various shopping malls; hence, representativeness of target population may have been affected by some select group visiting that particular mall leading to selection bias. It is possible that those with greater misuse of antibiotics knowledge and practices may not have visited the shopping mall or volunteered to participate in the study. It is unlikely that a highly select group of participants were included as when we evaluate the demographic and socio-economic characteristics of study population; a distribution not differing by malls, age groups or educational status seems to ensure that such selection bias may not have occurred, however, if those with more than 2 children, with low monthly income, and those with poor knowledge and beliefs, single or divorced parents who seem to be misusing antibiotics and other such potential groups may not have visited the malls on the days of data collection, we would be actually underestimating prevalence and determinants of antibiotic misuse. In addition, data were collected on weekdays as well as weekends at the time when most of families visit these malls. In Saudi Arabia, visiting shopping malls is a popular recreational activity; as only families are allowed on weekends and other times inside malls. Moreover, culturally it is not considered appropriate to visit homes and studies are usually conducted in shopping malls; by setting up a stall; and campaign related to health.

The fact that few non-Saudis visited malls could be due to the summer vacation months when many expatriates leave for their home towns; may also be the reason for low misuse of antibiotics; as study from UAE argued that the high percentage of misuse was due to the presence of expatriate population.<sup>2</sup> Secondly, a limitation could arise from the participants not understanding the question; and attempting to respond; further some questionnaires were administered with the help of data collectors. Looking at the educational level of participants; there were 1.7% (n=11) without any education and 4.6% with primary education only (n=29); hence it is assumed that assistance was mandatory for some of them. We did not keep a log of this information and had we carried out that, may have evaluated this through subgroup analyses.

This study determined a reasonable estimate of antibiotic misuse with identification of socio-demographic determinants of low income, and having more children was related to moderate knowledge deficits, inappropriate beliefs and practices in parents.

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