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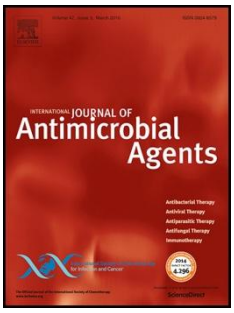

Title: Massive misuse of antibiotics by university students in all regions of china: implications for national policy

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Massive misuse of antibiotics by university students in all regions of China: implications for national policy

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Highlights

- Chinese young adults misused massive antibiotics for self-limiting illnesses.
- Poorer knowledge associated with more antibiotic misuse behaviors.
- Demand-side contributed over half of antibiotic misuse compared with supply-side.

Abstract

Antimicrobial resistance (AMR) is one of the greatest threats to population health this century. The primary cause of AMR is antibiotic misuse, especially the routine use of antibiotics for self-limiting illnesses. The major aim of this study was to explore behaviours in relation to antibiotic use in university students across China.

An electronic questionnaire was distributed at a major university in each of the six regions. A cluster random sampling method was adopted. Chi-square and logistic regression were used to assess the relationship between knowledge and behaviour.

11192 students completed the questionnaire. In the past month 3337(29.8%) students reported a self-limiting illness, 913(27.4%) saw a doctor, and 600(65.7%) of these were prescribed antibiotics, with 190(31.7%) by infusion; 136(22.7%) asked for and received antibiotics. Of the 1711(51.3%) who treated themselves, 507(29.6%) self-medicated with antibiotics. In the past year 23.0% of students had used antibiotics as prophylaxis, 63.0% kept a personal stock of antibiotics, 56.0% had bought antibiotics at a drugstore, two-thirds without a prescription. Students with lower knowledge scores about antibiotics were significantly more likely to see a doctor, to be prescribed with antibiotics, to self-medicate with antibiotics and use them prophylactically.

This massive misuse of antibiotics for self-limiting illnesses by well-educated young adults is a serious concern. A national campaign is needed urgently to address rational prescribing of antibiotics by doctors, enforcement of existing restrictions on the over-the-counter sale of antibiotics, and education of the general public about antibiotics and the management of self-limiting illness.

Keywords: antimicrobial resistance, antibiotic use behaviors, university students

1. Introduction

Antimicrobial resistance (AMR) is one of the greatest threats to global population health this century and a major contributor to rising healthcare costs worldwide [1-3]. The 2014 Review on Antimicrobial Resistance estimated that current annual mortality attributable to AMR is 700,000, rising to 10 million by 2050, if action is not taken to reduce our use of antibiotics [1]. Resistance results from mutations in microbes and selection pressure from antibiotic use, in humans, agriculture, and aquaculture, providing a competitive advantage for mutated strains. The single most important cause of AMR is the routine inappropriate use of antibiotics for self-limiting illnesses [2-4].

In China over prescribing of antibiotics is highly pervasive [5,6]. This has led to very high and increasing rates of AMR in both hospital and community-acquired infections [7-9]. With one-fifth of the world's population living in China, this is a serious global concern. Spread of resistance is facilitated by high population mobility with massive rural-urban migration and increasing foreign travel [2]. On average in China, around two-thirds of in-patients and 60% of all outpatients are prescribed antibiotics [10], with rates as high as 80% in some settings [11]. This high level of prescribing is often blamed on the reliance on drug sales for health provider income [5]. In 2009 the Chinese government launched the health reforms aimed at removing profits on drug sales in most primary care settings. However, they have had small effects on antibiotic use in both urban and rural health facilities [12,13]. The government has implemented policies aimed at reducing antibiotic misuse, and these focus mainly on the supply-side, especially rational prescribing. However, the impacts of these have also been small especially in primary care [14]. Demand side pressures have received much less attention. While self-medication with antibiotics is thought to be a common phenomenon [15], much less attention has been paid to healthcare seeking behaviour involving unnecessary and frequent attendance at health facilities, which may lead to high misuse of antibiotics.

We conducted this study among university students at top Chinese universities. They represent the educational elite and future opinion leaders, and are also the next generation of parents of young children who are known as very high users of antibiotics [16]. So the knowledge and behaviours of these young people are crucial to the future trajectory of antibiotic use in China.

Recent studies have highlighted poor knowledge of antibiotics, as well as high antibiotic use rates among Chinese university students [17-20]. However, these studies have had geographical, sample size, and content limitations. For example, two focused on self-medication [19,20]. No studies have taken a comprehensive view, from the starting point of health care seeking behavior for minor illness, and including antibiotic prescribing by doctors, the role of demand from patients, and the

contribution of self-medication. The relative contributions of these elements to the overall use of antibiotics also has not been examined.

The aim of this study therefore was to: 1) explore knowledge and antibiotic use behaviours of university students from across China, 2) determine the association between this knowledge and healthcare seeking behaviours in relation to antibiotic use, and 3) examine the contributions of these behaviours to the overall use of antibiotics.

2. Methods

2.1 Participants

The study was a cross-sectional survey of antibiotic-related knowledge and behaviours of university students. Geographically, China is divided into six regions (north, east, northeast, northwest, south and southwest). In each region one province was purposely selected. In each province a high-ranking multi-disciplinary university was selected: Nankai, Zhejiang, Jilin, Lanzhou Wuhan and Guizhou Universities. The survey was conducted from September to November 2015.

2.2 Questionnaire

The questionnaire comprised three sections: 1) socio-demographic information, 2) antibiotic knowledge, and 3) health care-seeking behavior. The questions on antibiotic knowledge and healthcare seeking behavior were adapted for the Chinese setting from previous studies [17,18]. The 13 knowledge questions focused on indications for antibiotic use and awareness of dangers of overuse. Healthcare seeking behaviour questions focused on self-limiting illness and the use of antibiotics both in the past month and in the past year. Students were asked to state the chemical or brand names of antibiotics they had used.

2.3 Data collection

We used the electronic questionnaire tool, Wen Juan Xing (Chinese Survey Monkey), to conduct the survey. A cluster random sampling method was adopted. Permission was initially obtained from each of the university authorities to conduct the survey. The aim was to achieve a sample size per university of around 1800 students across a range of disciplines to include science, social science/the humanities and medicine. At each university the class timetable on the main campus was obtained before the day of the survey. The classes were randomly selected. All university students attending

these classes were included. At each university three investigators approached teachers, explained the aim of our survey and asked for permission to speak to students before the class began. No teacher refused. The investigator then explained the aim of the survey to the students, disseminated the printed QR code of the electronic questionnaires, and explained to students how to complete the electronic questionnaire. The first section of the questionnaire consisted of an information sheet and consent form which was signed-off by all participants. It was explained clearly that participation was not compulsory and that the questionnaire would take around five minutes to complete. Over 95% of the students in the selected classes completed the questionnaire. A gratuity of 3RMB (0.5$) was paid via smartphone to all students who completed the questionnaire.

2.4 Statistical analysis

A score for antibiotic-related knowledge was created by simply adding the number of correct answers. A score of 0-4 was categorized as a low level of knowledge, 5 to 9 medium and 10 to 13 high. We used χ^2 test to examine associations between the antibiotic-related knowledge score and behaviors. We used multivariable logistic regression to control for the social-demographic variables. Analyses were done with SPSS software (version 20.0).

3. Results

3.1 Social-demographic characteristics (Table 1)

A total of 11,192 students across the six universities completed all key items of the questionnaire; 267 (2.3%) questionnaires were discarded because of non-completion of key variables. Males and females were equally represented, the mean age of the participants was 20.8 (SD 2.7), and 44% stated that their home was in a rural area. Both undergraduate and graduate students were included. The students came from a range of disciplinary backgrounds, 44% from social science and the humanities, 40% from science, and 16% were medical students.

3.2 Antibiotic use knowledge (Table 2)

A list of all responses is shown in the Table. Key findings were that the overwhelming majority were aware that overuse of antibiotics represented a current and future danger, 38.7% correctly stated that antibiotics do not work for viruses, 51.8% that antibiotics are not more effective if given by infusion. 45% thought that antibiotics can speed up recovery from flu, and 46.3% that antibiotics can relieve the symptoms of cold. Overall 135 (1.2%) answered all items correctly; 1600 (14.3%) scored 0-4, 6981 (62.4%) scored 5-9, and 2611 (23.3%) scored 10-13.

3.3 Health care seeking behavior and antibiotic use (Figure 1)

In the past month, 3337(29.8%) of students reported that they had experienced a self-limiting illness. Of these 67.5% had common cold, 36.4% sore throat, 18.8% diarrhea, 18.0% fever and 17.4% headache, with some obvious overlap between symptoms. Of these 913 (27.4%) went to see a doctor and 600 (65.7%) of these were prescribed antibiotics. Of those prescribed antibiotics, 190 (31.7%) were given antibiotics by infusion, 248 (60.5%) stopped taking them as soon as they felt better, 136 (22.7%) said they asked for them, because the doctor did not initially prescribe them, and in all cases the doctor did then prescribe antibiotics, Over half of the students 1711(51.3%) treated themselves for their symptoms. Of these 507 (29.6%) used antibiotics: 251(55.3%) used penicillin, 90(19.8%) cephalosporins, 54(11.9%) macrolides, 30(6.6%) quinolone, and 26(5.7%) used more than 2 antibiotics. Overall 9.9% (1107/11192) of students had used an antibiotic (prescribed or as self-medication) for a self-limiting illness in the previous month.

In the past year, 2230 (19.9%) of all respondents had asked a doctor for antibiotics, including by infusion, even when the doctor had not initially been willing to prescribe. Importantly 2572 (23.0%) had taken antibiotics for prophylaxis. In the past year 6269 (56.0%) of our respondents had bought antibiotics from a pharmacy. Of these 4133 (65.9%) had no prescription, and almost all of them 3946 (95.5%) were given antibiotics. A stock of antibiotics was kept at home or in the dormitory by 7057 (63.1%) of the students. Of these 1965 (27.8%) of the students stated that the source of the antibiotics was doctors prescribing more tablets than the recommended course (so tablets are left over) and 4893 (69.3%) were bought over the counter at a pharmacy.

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3.4 Determinants of antibiotic misuse (Table 3)

The proportion of students who claimed to have had an illness in the last month was remarkably consistent, at around 30.0%, across sex, region, education level, major and residence. However, differences emerge with health care seeking behaviour. Most marked differences were seen between regions. The proportion of students who chose to see a doctor for their illness ranged from 17.6% to 35.2%, the proportion prescribed an antibiotic for self-limiting illness ranged from 52.8% to 80.6%, and self-treatment with antibiotics for self-limiting illness ranged from 16.0% to 38.5%. Girls were slightly more likely to self-report illness 31.3%, compared with boys 28.3% ($p<0.0001$). Students from rural areas were more likely to go to a doctor 30.4% ($p=0.001$), be prescribed antibiotics 72.1%

189 ($p<0.0001$), and self-treat with antibiotics 33.6% ($p=0.006$).
190
191 In terms of chronic use, prophylactic taking of antibiotics ranged from 15.9% in Zhejiang to 30.0% in
192 Guizhou. Medical students and urbanites were less likely to use antibiotics prophylactically. Girls
193 were more likely to keep a stock of antibiotics (67.9% vs. 58.0% for boys, ($p<0.0001$)) and students
194 from urban backgrounds more than those from rural backgrounds (70.3% vs. 53.8% from rural
195 backgrounds, ($p<0.0001$)). There were also differences by region, ranging from 55.9% in Guizhou to
196 69.0% in Tianjin.
197
198 **3.5 The relationship between knowledge and behaviour towards antibiotic use (Table 4)**
199 After adjusting for university, age, gender, education level, major and residence, students with higher
200 knowledge scores were less likely to use antibiotics in self-treatment, to go to see a doctor when they
201 were ill, to be prescribed with antibiotics, to ask for antibiotics, and to use antibiotics prophylactically
202 to prevent diseases. Unsurprisingly students who kept antibiotics at home are five times more likely
203 to self-treat with antibiotics (OR=5.05 95% CI 3.58-7.14).
204
205 We further analyzed the relative roles of the demand and supply sides in relation to antibiotic use. For
206 these self-limiting illnesses doctors prescribed for 600 (54.2%) students, of whom 136 (12.3%) asked
207 for and received antibiotics from a doctor who would not have prescribed. A further 507 (45.7%)
208 students self-medicated with antibiotics. So we estimate that the demand-side contributed 58.0%
209 (45.7% plus 12.3%) of antibiotic use, compared with 41.9% (54.2% minus 12.3%) on the
210 supply-side.
211
212 **4. Discussion**
213 To our knowledge this is the first nationwide survey to explore knowledge and behaviour in relation
214 to antibiotic use among university students in China. We found totally unnecessary use of large
215 quantities of antibiotics, for self-limiting illnesses, and even prophylaxis, in healthy students
216 attending top-ranked universities in all Chinese regions. As representatives of the educational elite
217 and future opinion leaders, this is of serious concern. This overuse of antibiotics by students is part of
218 a global phenomenon, especially serious in low and middle-income countries [18,21]. The
219 consequences for AMR, treatment failure and adverse reactions are self-evident.
220

But first through considering healthcare seeking behavior for minor illness as a starting point, we have produced a more comprehensive picture of the overall misuse of antibiotics, than is available from standard indicators, such as antibiotic prescription per visit. We showed that in the last month 29.8% of healthy young adults reported that they had been ill with classic self-limiting symptoms, mostly common cold, and that over one quarter of these attended a health facility. This is over double the attendance at health facilities by American college students [22]. This leads to overall high prescribing rates, as well as high self-medication. Extrapolating from our data we are able to make an estimate of the number of episodes of antibiotic use for self-limiting illness in a year in this population. Of the 11,192 students, 1107 had taken antibiotics in the past month. Using the most conservative estimate of one episode of antibiotic use in the month, this translates to 13,284 episodes of antibiotic use for self-limiting illness in a year, an average of 1.18 episodes per person per year. This excludes the prophylactic use of antibiotics in 23.0% of the students, the exact frequency of which is unclear. The current widely-used indicator, antibiotic prescribing per consultation, by definition, does not consider the numbers of consultations per individual or population over time, which is clearly very high. So our study emphasises the need for an indicator of antibiotic use (frequency, type) per capita over time. We also illustrate the sheer magnitude of the problem of antibiotic misuse. This is crucial because the frequency and quantity of antibiotics used are key determinants of AMR.

Our study not only highlights the need for a national campaign for reduction of antibiotic misuse, but also informs likely effective components of such a campaign.

First, while Chinese government strategy has focused on the supply side of antibiotic misuse, we show that addressing the demand side is just as important. High lifetime rates of self-medication (48.0%) among Chinese students have been reported in two small studies [17,19]. Our study showed that this self-medication contributes almost as much as doctors' prescribing. The need for increased awareness of appropriate use of antibiotics by users is obvious. This is emphasized by our finding that higher knowledge scores were associated, not only with reduced overall misuse, but also lower attendance at health facilities, less antibiotic prescription, and less self-medication. Other Chinese studies have shown that prior knowledge of antibiotics is associated with less self-medication [19,20]. However, we show that the effects of prior knowledge go beyond self-medication. Another study from China showed that doctors were much less likely to prescribe, if patients demonstrated their knowledge of appropriate antibiotic use at the consultation [23]. In terms of educating young people,

the delivery of an appropriate education programme in high school, before young people become independent health service users would thus be highly desirable.

Second, education for doctors must be improved. This needs to go beyond the obvious training in rational prescribing. Adherence to rational prescribing guidelines is patchy at best [13], and the continued routine use of antibiotic infusion (usually requiring 3-4 attendances) shows that there is still much to be done in this area. We also showed that even when doctors were initially unwilling to prescribe antibiotics they readily acquiesced on demand. This points partly to the tensions in the doctor-patient relationship in China, which have been well-described elsewhere [24,25] and which may lead doctors to comply with demands of patients more willingly to avoid confrontation. But if standard protocols contained guidelines for educating patients about, not only the dangers of antibiotics, but also appropriate self-treatment of symptoms, doctors would be able to resist patients' demands more easily. Auditing of doctors' performance against good practice guidelines is now easily achieved using the Health Information System (HIS) [5].

Finally, the ease of access to antibiotics clearly demonstrated in this study, must be addressed urgently. Two-thirds of university students kept stocks of antibiotics and they were five times more likely to use antibiotics for self-treatment than those who did not. The sources of these antibiotics were non-completion of prescribed courses of antibiotics, (60.0% stopped antibiotics when symptoms improved) simple over-prescribing by doctors, that is, more tablets given than the patient's treatment course needs [5], and of course over-the-counter purchase. Although as early as 2004 the Ministry of Health introduced measures to prevent over-the-counter purchase, we show that enforcement is very weak and the fines are in any case not very punitive, only 1000 RMB (US$130) in much of the country [26]. Loopholes have also been created whereby, pharmacies employ a doctor (often retired) whose only job is to prescribe drugs that patients demand. So measures must be taken to enforce the ban on the over-the-counter sales of antibiotics.

This study has some limitations. Wen Juan Xing is relatively new as a questionnaire tool in China. Correct guessing may have over-estimated the knowledge scores. The validity of self-reporting of behaviours, is often questionable in surveys. However, given that knowledge of appropriate antibiotic use was reasonable such self-reporting would if anything tends towards an underestimate of antibiotic misuse,. The 13-item antibiotic use knowledge questions have not been validated in previous studies. We also did not ask about frequency of prophylactic use, which may have led to an

underestimate of overall episodes of antibiotic use. But combining the on-line survey with the classroom presence of researchers ensured that the response rate was very high compared to recent online surveys among students [27,28]. So we believe that our survey is reasonably representative of the student population of high-level universities.

5. Conclusions

The massive misuse of antibiotics by well-educated young adults is a serious concern. A national campaign focusing on reduction of antibiotic misuse is needed urgently and must address both demand and supply sides. This must include education and monitoring of rational prescribing in doctors, enforcement of existing restrictions on over-the-counter sale of antibiotics, and education of the general public about the management of self-limiting illness.

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Declarations

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Competing interests: We declare no competing interests.

Ethics approval: The study was reviewed and approved by the School of Public Health Zhejiang University (number ZGL20160922).

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Table 1. The social-demographic characteristics of university students (n=11192)

	N (%)
University (Province)	
Nankai University (Tianjin)	1752(15.7%)
Zhejiang University (Zhejiang)	1775(15.9%)
Jilin University (Jilin)	1961(17.5%)
Wuhan University (Hubei)	1816(16.2%)
Lanzhou University (Gansu)	1858(16.6%)
Guizhou University (Guizhou)	2030(18.1%)
Gender	
Male	5515(49.3%)
Female	5677(50.7%)
Age, Mean (SD)	20.8(2.7)
Education level	
Undergraduate	8892(79.4%)
Graduate	2300(20.6%)
Major	
Social science & humanities	4908(43.9%)
Science	4465(39.9%)
Medicine	1819(16.3%)
Hometown	
Urban	6271(56.0%)
Rural	4921(44.0%)
Average household income (RMB, monthly)	
<=3,000 ($461)	3417(30.5%)
3,001-10,000 ($462-$1538)	5823(52.0%)
10,001-20,000 ($1539-$3076)	1435(12.8%)
>20,000 ($3076)	517(4.6%)

Table 2. The antibiotic use related knowledge of university students (n=11192)

Questions	Answer N(%)		
	Yes	No	Don't know
1. Antibiotics are effective for viral infections.	4236 (37.8%)	4335 (38.7%)	2621 (23.4%)
2. Antibiotics have the same effects as anti-inflammatory drugs.	2005(17.9%)	7310 (65.3%)	1877(16.8%)
3. If one needs to use antibiotics, it is best to give them by infusion.	2385 (21.3%)	5801(51.8%)	3006(26.9%)
4. Once the symptoms are relieved, one should immediately stop using antibiotics.	5359(47.9%)	3735(33.4%)	2098(18.7%)
5. We will have few antibiotics to use in the future if we don't use antibiotics properly.	9281(82.9%)	801 (7.2%)	1110(9.9%)
6. The more frequently people use antibiotics; the more difficult it will be to treat bacterial infections.	8978(80.2%)	976(8.7%)	1238(11.1%)
7. Antibiotics are effective for treating common cold (cough, runny nose).	2275(20.3%)	7974 (71.2%)	943(8.4%)
8. Antibiotics can speed up recovery from flu.	4590(41.0%)	4504(40.2%)	2098(18.7%)
9. Antibiotics can relieve the symptoms of cold.	5187(46.3%)	3805(34.0%)	2200(19.7%)
10. Antibiotics are effective for sore throat.	3222 (28.8%)	6968(62.3%)	1002(9.0%)
11. One needs to take antibiotics for a cold with green mucus.	2068(18.5%)	7381(65.4%)	1806(16.1%)
12. Antibiotics are effective at treating common diarrhea.	2194 (19.6%)	7793(69.6%)	1205(10.8%)
13. Newer antibiotics are more effective than older ones.	3051(27.3%)	5457 (48.8%)	2684(24.0%)

Table 3. Association between social-demographic characteristics and antibiotic use behaviors (in the past month)

	Got illness (n=11192)*	p value	Went to see a doctor (n=3337)*	p value	Prescribed with antibiotics (n=913)*	p value	Self-treated with antibiotics (n=1711)*	p value
University (Province)		0.008		<0.0001		<0.0001		<0.0001
NKU (Tianjin)	510(29.1%)		90 (17.6%)		53 (58.9%)		95(32.5%)	
ZJU (Zhejiang)	532(30.0%)		147(27.6%)		83(56.5%)		39(16.0%)	
JLU (Jilin)	527(26.9%)		122(23.1%)		83(68.0%)		117(38.5%)	
WHU (Hubei)	576(31.7%)		180(31.3%)		95(52.8%)		58(21.6%)	
LZU (Gansu)	593(31.9%)		163(27.5%)		116(71.2%)		112(33.7%)	
GZU (Guizhou)	599(29.5%)		211(35.2%)		170(80.6%)		86(31.6%)	
Gender		<0.0001		0.865		0.333		0.945
Male	1560(28.3%)		429(27.5%)		275(64.1%)		237(29.6%)	
Female	1777(31.3%)		484(27.2%)		325(67.1%)		270(29.7%)	
Education level		0.094		0.580		0.404		0.066
Undergraduate	2684(30.2%)		740(27.6%)		491(66.4%)		393(28.6%)	
Graduate	653(28.4%)		173(26.5%)		109(63.0%)		114(33.7%)	
Major		0.090		0.002		0.071		0.208
Social science	1516(30.9%)		433(28.6%)		298(68.8%)		248(31.7%)	
Science	1292(28.9%)		369(28.6%)		238(64.5%)		182(28.3%)	
Medicine	529(29.1%)		111(21.0%)		64(57.7%)		77(27.0%)	
Hometown		0.005		0.001		<0.0001		0.006
Urban	1937(30.9%)		487(25.1%)		293(60.2%)		294(27.3%)	
Rural	1400(28.4%)		426(30.4%)		307(72.1%)		213(33.6%)	
Score				<0.0001		<0.0001		<0.0001
0-4	-		181(35.1%)		139(76.8%)		112(43.9%)	
5-9	-		580(27.6%)		377(65.0%)		318(29.3%)	
10-13	-		152(21.1%)		84(55.3%)		77(20.8%)	

Table 3. Association between social-demographic characteristics and antibiotic use behaviors (in the past year) (cont.)

	Asked for antibiotics (n=11192)*	p value	Took antibiotics prophylactically (n=11192)*	p value	Kept antibiotics at home/dorm (n=11192)*	p value
University (Province)		<0.0001		<0.0001		<0.0001
NKU(Tianjin)	276 (15.8%)		311 (17.8%)		1209 (69.0%)	
ZJU(Zhejiang)	281 (15.8%)		282 (15.9%)		1149 (64.7%)	
JLU(Jilin)	504 (25.7%)		553 (28.2%)		1281 (65.3%)	
WHU(Hubei)	296 (16.3%)		316 (17.4%)		1109 (61.1%)	
LZU(Gansu)	419 (22.6%)		502 (27.0%)		1175 (63.2%)	
GZU(Guizhou)	454 (22.4%)		608 (30.0%)		1134 (55.9%)	
Gender		0.018		0.293		<0.0001
Male	1049(19.0%)		1244(22.6%)		3200(58.0%)	
Female	1181(20.8%)		1328(23.4%)		3857(67.9%)	
Education level		0.005		0.032		0.314
Undergraduate	1724(19.4%)		2082(23.4%)		5586(62.8%)	
Graduate	506(22.0%)		490(21.3%)		1471(64.0%)	
Major		<0.0001		<0.0001		<0.0001
Social science	1162(23.7%)		1369(27.9%)		3213(65.5%)	
Science	795(17.8%)		924(20.7%)		2678(60.0%)	
Medical	273(15.0%)		279(15.3%)		1166(64.1%)	
Hometown		0.19		<0.0001		<0..0001
Urban	1222(19.5%)		1338(21.3%)		4410(70.3%)	
Rural	1008(20.5%)		1234(25.1%)		2647(53.8%)	
Score		<0.0001		<0.0001		<0.0001
0-4	449(28.1%)		565(35.3%)		928(58.0%)	
5-9	1419(20.3%)		1674(24.0%)		4489(64.3%)	
10-13	362(13.9%)		333(12.8%)		1640(62.8%)	

* 3337 of 11192 students got illness, 913 of 3337 students went to see a doctor, 600 of 913 students were prescribed with antibiotics, and 507 of 1711 students self-treated with antibiotics while they sick in the last month. 2230 students asked for antibiotics, 2572 took antibiotics prophylactically, and 7057 kept antibiotics at home/dorm in the last year.

Table 4. Logistic regression of health care seeking behavior and antibiotic use knowledge

	Self-treated with antibiotics		Went to see a doctor		Prescribed with antibiotics		Asked for antibiotics		Took antibiotics prophylactically		Kept antibiotics at home/dorm	
	OR (95%CI)	p	OR (95%CI)	p	OR (95%CI)	p	OR (95%CI)	p	OR (95%CI)	p	OR (95%CI)	p
Knowledge												
Score (0-4)	1		1		1		1		1		1	
Score (5-9)	0.53(0.39-0.72)	<0.0001	0.70 (0.57-0.87)	0.001	0.58 (0.39-0.87)	0.009	0.71 (0.62-0.80)	<0.0001	0.64 (0.57-0.72)	<0.0001	1.29 (1.15-1.45)	<0.0001
Score (10-13)	0.36(0.24-0.54)	<0.0001	0.55 (0.42-0.72)	<0.0001	0.46 (0.27-0.76)	0.003	0.50 (0.42-0.59)	<0.0001	0.35 (0.30-0.41)	<0.0001	1.12 (0.98-1.29)	0.10

Adjusted for university, age, gender, education level, major and residences urban/rural