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Don't wear me out—the public's knowledge of and attitudes to antibiotic use

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Objectives: **To assess the public's knowledge and attitudes to antibiotics, their reported antibiotic use and the relationship between them.**

Patients and methods: **A questionnaire was included in the face-to-face Office for National Statistics Omnibus Household Survey in Britain in 2003. Of 10 981 randomly selected adults from England, Scotland and Wales, 7120 (65%) completed the questionnaire.**

Results: **Although 79% of respondents were aware that 'antibiotic resistance is a problem in British hospitals', 38% of respondents did not know that antibiotics do not work against most coughs or colds and 43% did not know that 'antibiotics can kill the bacteria that normally live on the skin and in the gut'. Respondents with lower educational qualifications were less knowledgeable about antibiotics. In a multivariable analysis, better knowledge of antibiotics was not associated with being less likely to be prescribed any in the last year, but was independently associated with being more likely to finish a course of antibiotic as prescribed. Knowledge was also associated with being more likely to take antibiotics without being told to do so. In women, better knowledge was associated with being more likely to give an antibiotic to someone else that was not prescribed for them.**

Conclusions: **We have shown that there is no simple relationship between increased knowledge and more prudent antibiotic use. Future national antibiotic campaigns should have a defined audience and aims in order to facilitate prudent antibiotic use by clinicians and public.**

Keywords: resistance, questionnaire, campaigns, education

Introduction

The public plays a key role in the emergence and spread of bacterial resistance to antibiotics.[1] In 2000, the WHO Report *Overcoming Antimicrobial Resistance* identified three key issues for public involvement: improving access to medical services, reducing unnecessary use of antimicrobial drugs and not sharing medication with other people or keeping part of the course for another occasion.[2] Several countries have undertaken campaigns to encourage the public to ask for less antibiotics. These campaigns advise the public that antibiotics do not work on coughs and colds.[3,4] To inform campaigns, it is essential to gather reliable information about patients' attitudes to antibiotic use and their use of these drugs. Pan-European telephone surveys of patients' attitudes to antibiotics and antibiotic use in respiratory tract infections indicated that the UK population was cautious with antibiotic use compared with the population of other European countries.[5] However, the sample selected from each country was not representative of the country's general population (200 working adults aged $\leq$55, 200 elderly adults aged $>$55 and 200 mothers of children aged $<$12) and so these surveys are of limited value when it comes to assessing the knowledge of and attitudes to antibiotic use in individual countries. Other antibiotic attitude surveys that have involved

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patients or their carers rather than the general public[6–8] have been too small to relate findings to respondent characteristics[9] or have been limited to small geographical areas.[10]

We used a large British (England, Wales and Scotland) household survey to study the public's knowledge, attitudes and behaviour with respect to antibiotic use. The study aimed to measure the extent to which antibiotics remain entirely or partially unused in households, assess the public's awareness of good antibiotic use and relate these to household and respondent characteristics. We have previously reported on retained antibiotics by household and its relationship to characteristics of the household.[11] In this article, we focus on the respondents' knowledge and attitudes to antibiotics, their reported behaviour about antibiotic use and the relationship between the two. In 1999, the Department of Health in the UK launched a campaign to raise public awareness about the problem of antibiotic resistance to increase people's understanding about the appropriate use of antibiotics and, in particular, to increase understanding about when antibiotics will not do any good.[3] The campaign was personalized by the creation of *Andybiotic*, a character symbolizing antibiotics in cartoon form, and expressing the words 'Don't wear me out' to introduce the topic of sensible use of antibiotics. The campaign included posters in general practice surgeries, nurseries, public places, the national press and magazines, and patient information leaflets to be given to patients instead of an antibiotic prescription. The campaign materials were distributed in 1999 and 2001 and targeted at all adults, but mainly those with young children and the elderly. We investigated what sort of person was more likely to be aware of the Andybiotic campaign.

Patients and Methods

The questionnaire [available as Supplementary data at JAC Online (http://jac.oxfordjournals.org/)] about antibiotics was included in the 2003 Office for National Statistics' (ONS) Omnibus Household Survey of homes in Britain.[12] The survey began in 1990 and has been carried out monthly since. The data for our study were collected in 2003, during the months of February and March, to follow peak antibiotic prescribing, and in June and July, to correspond with the months in which the previous household audit of medicines was undertaken[13] and antibiotic prescribing was lower.

Study population

About 1800 adults are interviewed in the Omnibus Household Survey every month. Adults are selected to be representative of all adults in the general population and are selected by multistage stratified random sampling, with one adult selected from each household.[12] The survey covers Great Britain (England, Wales and Scotland), and data are released at standard regional level. The sampling frame was the postcode address file of 'small users' (residential addresses) and the primary sampling unit was a postal sector. Each month, a stratified sample of 100 postal sectors was taken, with strata defined by region, the proportion of households renting from local authorities and the proportion of households for which the household reference person is in socio-economic groups 1–5 or 13 (i.e. a professional, employer or manager). Within each stratum, postal sectors were sampled with probability proportionate to the number of addresses within it (i.e. sampling with probability proportional to size); and within each postal sector, 30 addresses were randomly selected. If an address contained more than one family, one was randomly selected. If a household contained more than one person aged $\geq$16, one was randomly selected to participate in the survey.

Ethics

This study formed part of an ongoing Omnibus survey undertaken by the ONS. Ethical approval was not required for this survey. Households were approached by letter, which gave a brief account of the survey. Respondents were able to refuse participation when they received the letter, when the interviewer visited the household or in any part of the questionnaire.

Questioning of respondent

Respondents were first requested to show the interviewer all medicines in the household, which had been prescribed for infections and asked whether it was currently in use for the episode of infection for which it was prescribed, left over or for standby use in the future. These data were reported separately.[11] Respondents were then asked whether they had been prescribed any kind of antibiotic in the past year and, if yes, whether they finished their last course of antibiotics as prescribed.

We also asked respondents whether they had 'ever taken an antibiotic without being told to do so by a doctor, dentist or nurse (self-medication)'; whether they had 'ever given someone else an antibiotic that was not prescribed for them' and whether they had 'ever obtained an antibiotic in another country without a prescription'. The interviewer then showed the respondent a series of 11 cards on each of which was printed a statement about antibiotics that was either true or false. Also on the card were printed four possible responses: strongly agree, agree, disagree and strongly disagree. A fifth possible response of 'Don't know/No opinion' was not shown on the card but could be recorded if given spontaneously. The 11 statements were based on issues covered in antibiotic public information campaigns in England, Australia, Canada, Belgium and the USA (Table 1).[4] In order that respondents were more likely to be truthful in their replies, they were asked whether they agreed or disagreed with general statements about antibiotics, rather than their own use of antibiotics. For example, patients were asked whether they agreed with the statement 'antibiotics work on most coughs and colds' rather than 'I would ask my doctor for an antibiotic for a cough or cold'. Statements included knowledge of activity of antibiotics against coughs and colds, viruses, bacteria and our normal flora; attitudes about the problem of antibiotic resistance in their family, local hospital and nationally; attitude to always completing a course of antibiotic (Table 1). Finally respondents were shown the Andybiotic Campaign leaflet and asked, 'May I check, have you seen this leaflet before or have you seen or heard anything about the Andybiotic campaign?' The Andybiotic campaign was not fully implemented in Scotland; campaign materials were sent to Health Boards but no resources were provided for distribution, whereas in England and Wales, the Department of Health distributed materials via shops and printed media in addition to community pharmacies and General Practices.

We also collected other details from the survey about the respondents and their household, including age, sex, ethnic

Table 1. Respondents were asked how strongly they agreed or disagreed with the following statements about antibiotic action, use and resistance and normal flora

Statements about antibiotics and resistance	Correct response
Antibiotic action	
antibiotics work on most coughs and colds	disagree
antibiotics can kill bacteria	agree
antibiotics can kill viruses	disagree
Normal flora/good bacteria	
antibiotics can kill the bacteria that normally live on the skin and in the gut	agree
bacteria that normally live on the skin and in the gut are good for your health	agree
Antibiotic use	
a course of antibiotics should always be completed	agree
antibiotics should not be taken unnecessarily	agree
if taken too often antibiotics are less likely to work in the future	agree
Antibiotic resistance	
bacteria are becoming resistant to antibiotics	agree
resistance to antibiotics is a problem in British hospitals	agree
antibiotic resistant bacteria could infect me or my family	agree

origin, occupation, level of education, region and Carstairs' deprivation quintile.[14] Carstairs' scores are a combination of four census variables: unemployment, overcrowding, car ownership and low social class.

Data analysis

Sampling weights were applied to the data, allowing for any over or under sampling of individuals by region, Carstairs' deprivation quintile, age group and sex. Weights were based on the 2001 census data for Britain. All data management and analyses were performed using Stata 8.2.

Antibiotic statements. Responses were coded as either correct or incorrect, ignoring the difference between responses of 'Strongly agree' and 'Agree' and 'Strongly disagree' and 'Disagree'. We decided that not knowing whether you agreed or disagreed with the statement was equivalent to giving the incorrect response; therefore, a response of 'Don't know/No opinion' was always treated as an incorrect response. We determined the number with incorrect responses to each statement and the percentage of incorrect responses given by each respondent.

For the quantitative outcome 'percentage of questions about antibiotics answered incorrectly' (Figure 1 and Table 2), mean values were calculated for each group to be compared and 95% confidence intervals for the true mean values were estimated. A variation on the usual linear regression method was used to estimate differences between mean values, and the test for any difference between mean values was a variation on the usual *F*-test. The variations were to allow for the sampling weights and the clustering of the sample within postal sectors. A variation of multivariable linear regression was used to identify those variables independently associated with knowledge about antibiotic activity, use and resistance. The multivariable analysis allowed for the clustering of the sample, but ignored sampling weights.

For the outcome 'respondent was or was not aware of the Andybiotic campaign' (Figure 2), percentages were calculated for each group and 95% confidence intervals for the true percentages were estimated. The test for any difference between percentages was a variation on the usual Pearson χ^2 test. Again, these methods were corrected to allow for the sampling weights and the clustering of the sample.

For the outcomes 'respondent has or has not ... in the past year/at any time in the past' (Figure 3 and Table 3), percentages were calculated for each group to be compared and 95% confidence intervals for the true percentages were estimated. The test for any significant difference between percentages was a variation on logistic regression and the test for any difference between percentages was a Wald test. Again, these methods were corrected to allow for the sampling weights and the clustering of the sample. A variation of multivariable logistic regression was used to identify those variables independently associated with reported antibiotic use. The multivariable analysis allowed for the clustering of the sample but ignored sampling weights.

Results

Of 10 981 households selected, 2768 (25%) refused to participate and 1093 (10%) addresses were not contactable. In 7120 (65%) households, a participant completed the questionnaire survey. Owing to the Data Protection Act, we have no information on the characteristics of non-respondents. However, regular audits undertaken by the ONS have shown that respondents are representative of the whole population.

Knowledge about antibiotics and attitudes to use

There was a significant lack of knowledge about both the effectiveness and harmful effects of antibiotics (Figure 4a). In particular, 38% of respondents did not know that antibiotics do not work on most coughs and colds and 43% did not know that antibiotics can kill bacteria that normally live on the skin and in the gut (Figure 4a).

In contrast <10% of respondents incorrectly answered the three questions about attitudes to antibiotic use (Figure 4b). Knowledge about antibiotic resistance was also high (Figure 4c): 79% of respondents knew that antibiotic resistance is a problem in British hospitals.

Respondent characteristics and responses to antibiotic statements

Younger and older respondents were less knowledgeable about antibiotics (Figure 1a). Males gave more incorrect responses than females (Figure 1b), and Asian or black Caribbean respondents gave more incorrect responses than white British respondents (Figure 1c). There were increasing incorrect responses

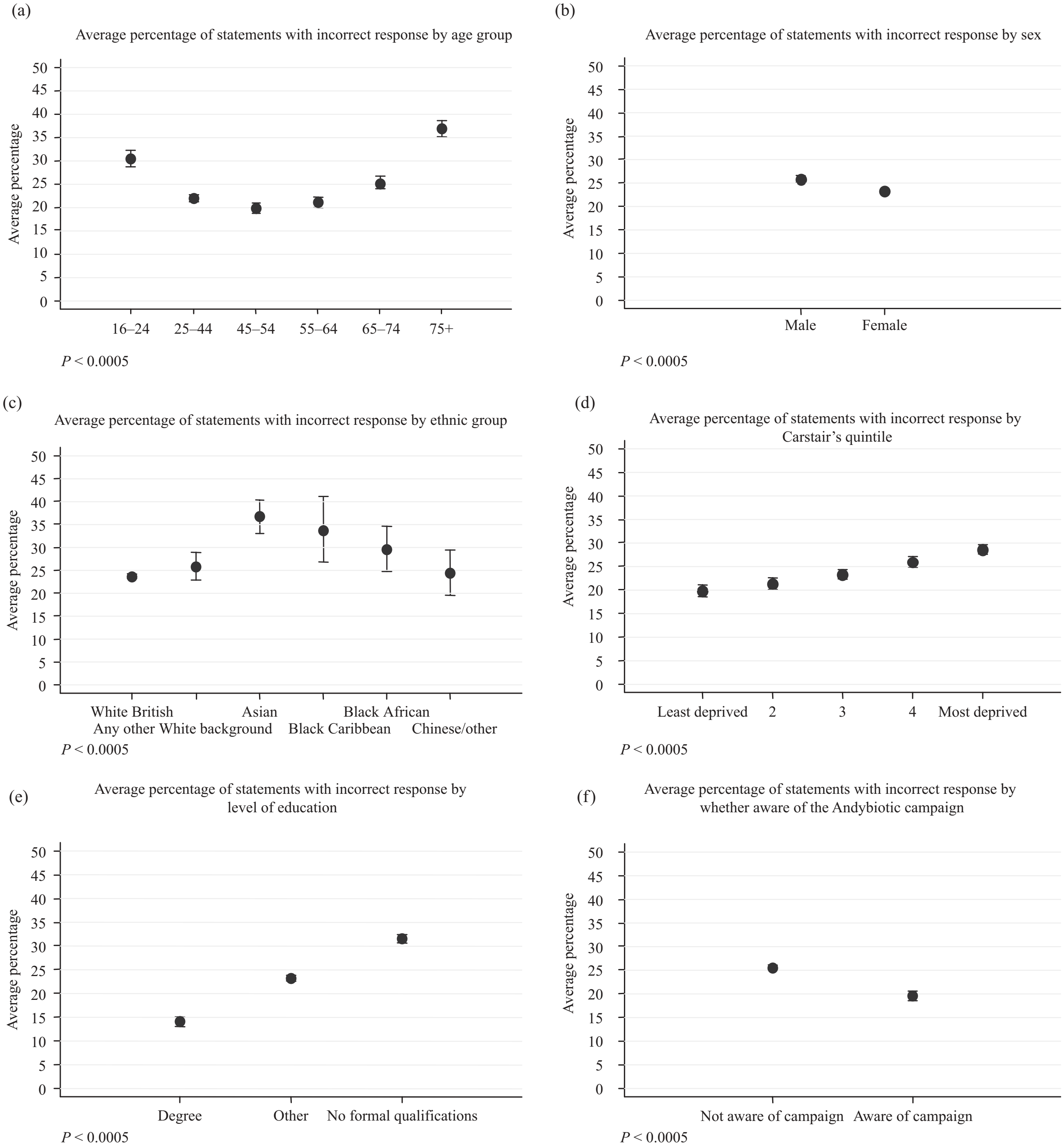

Figure 1. Average percentage (and 95% CI) of all statements about antibiotics with incorrect responses and respondents' characteristics.

with greater deprivation and lack of formal qualifications (Figure 1d and e). This relationship between level of education and knowledge of antibiotics was present across all question categories (Table 2).

Awareness of the Andybiotic campaign was associated with fewer incorrect answers (Figure 1f). In the multivariable analysis, there was a strong independent association between knowledge of or attitudes to antibiotics and age, sex, ethnic group, deprivation score, educational qualification and awareness of the Andybiotic campaign ($P < 0.0005$ for each variable). (Details of the multivariable analysis are given in Table 2.)

Who was aware of the Andybiotic campaign?

Respondents from Scotland were significantly less likely to be aware of the campaign than respondents from England and Wales (Figure 2a). Awareness of the campaign decreased with increasing age, so that 16–24 year olds were three times more

Table 2. Knowledge about antibiotic activity, use and resistance (summary of all 11 questions, 7109 respondents)

	Average (%) (95% CI)	Crude average difference (95% CI)	P	Adjusted average difference[a] (95% CI)	P
Outcome = percentage of 11 knowledge/attitude questions about antibiotics, with incorrect responses by each respondent.					
Age group					
16–24	30.5 (28.7, 32.2)	0	<0.0005	0	<0.0005
25–44	22.0 (21.3, 22.8)	−8.4 (−10.3, −6.6)		−7.6 (−9.1, −6.0)	
45–54	19.8 (18.6, 21.0)	−10.7 (−12.8, −8.6)		−11.4 (−13.1, −9.6)	
55–64	21.0 (20.0, 22.1)	−9.4 (−11.5, −7.4)		−11.8 (−13.6, −10.0)	
65–74	25.3 (24.0, 26.6)	−5.2 (−7.4, −3.0)		−9.1 (−11.0, −7.3)	
75+	36.9 (35.2, 38.7)	6.5 (4.0, 8.9)		1.3 (−0.7, 3.2)	
Sex					
male	25.7 (25.0, 26.5)	0		0	
female	23.2 (22.6, 23.9)	−2.5 (−3.5, −1.5)	<0.0005	−3.1 (−3.9, −2.3)	<0.0005
Ethnic Group					
white British	23.7 (23.2, 24.2)	0	<0.0005	0	<0.0005
other white background	25.9 (22.8, 29.0)	2.2 (−0.9, 5.3)		2.3 (0.3, 4.3)	
Asian	36.6 (33.0, 40.2)	12.9 (9.2, 16.5)		15.1 (12.7, 17.6)	
black Caribbean	33.9 (26.8, 41.0)	10.2 (3.0, 17.3)		6.1 (1.9, 10.4)	
black African	29.6 (24.6, 34.7)	5.9 (0.9, 11.0)		12.4 (7.7, 17.1)	
Chinese/other	24.6 (19.6, 29.5)	0.8 (−4.1, 5.8)		5.0 (0.6, 9.4)	
Prescribed an antibiotic in the last year					
no	24.6 (24.0, 25.3)	0	0.32	0	0.02
yes	24.1 (23.3, 24.9)	−0.5 (−1.5, 0.5)		−1.0 (−1.9, −0.2)	
Carstairs' deprivation score					
first quintile (least deprived)	19.9 (18.7, 21.0)	0	<0.0005	0	<0.0005
second quintile	21.3 (20.2, 22.5)	1.5 (−0.2, 3.1)		0.4 (−1.1, 1.8)	
third quintile	23.3 (22.3, 24.4)	3.5 (1.9, 5.1)		2.0 (0.6, 3.4)	
fourth quintile	26.0 (24.9, 27.0)	6.1 (4.5, 7.7)		3.5 (2.1, 4.9)	
fifth quintile (most deprived)	28.5 (27.5, 29.6)	8.7 (7.1, 10.2)		4.9 (3.5, 6.3)	
Educational qualifications					
degree	14.1 (13.1, 15.1)	0	<0.0005	0	<0.0005
other	23.2 (22.6, 23.8)	9.1 (7.9, 10.3)		8.8 (7.5, 10.0)	
no formal qualifications	31.6 (30.6, 32.5)	17.4 (16.1, 18.8)		16.6 (15.2, 18.0)	
Aware of Andybiotic campaign					
no	25.6 (25.0, 26.2)	0	<0.0005	0	<0.0005
yes	19.5 (18.5, 20.6)	−6.1 (−7.3, −4.9)		−5.4 (−6.4, −4.3)	

[a]The differences for each factor are determined after adjusting for the other covariates.

likely to have heard of the campaign than those over 75 years (Figure 2b). Awareness of the Andybiotic campaign was greater in respondents who were female (Figure 2c) and lived in the most deprived areas (Figure 2e). There was no evidence of a relationship between ethnicity and awareness of the Andybiotic campaign (Figure 2d). There was no simple relationship between awareness of the campaign and educational qualifications. Respondents with other formal education qualifications were more likely to be aware of the campaign (22%) than respondents with a degree (18%) or no formal qualifications (15%). Respondents who were prescribed an antibiotic in the past year were more likely to be aware of the campaign ($P < 0.0005$) (Figure 2f).

In a multivariable analysis including age group, sex, region, whether or not prescribed an antibiotic in the last year, deprivation of area of residence and level of education the strongest association was with younger age (for age groups 16–24, 25–44, 45–54, 55–64 and 65–74 ORs with those 75 or more were 3.4, 3.2, 2.8, 2.0 and 1.3, respectively). Strong associations were also found with being a woman (OR 1.5) and being prescribed an antibiotic in the past year (OR 1.6; Table 2).

Was awareness of the Andybiotic campaign associated with increased knowledge?

Respondents aware of the Andybiotic education campaign were less likely to give incorrect responses to the antibiotic statements. The greatest difference was for 'antibiotics work on most coughs and colds' (24% incorrect responses if aware of the campaign versus 42% if not aware, $P < 0.0005$) and 'antibiotics can kill viruses' (43% if aware versus 56% if not aware, $P < 0.0005$).

Although awareness of the campaign was less in Scotland, there was no difference between countries in the percentage of

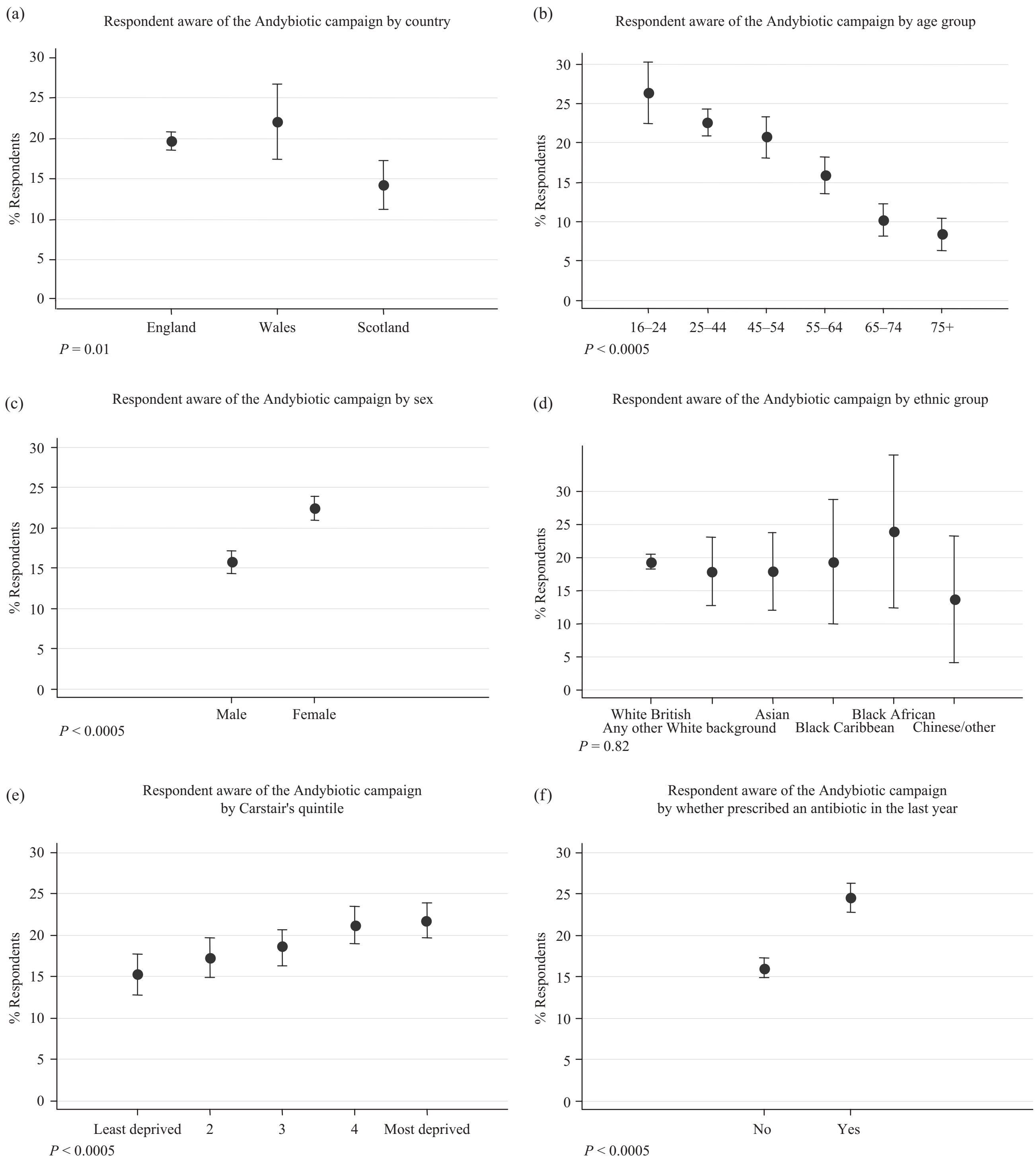

Figure 2. Percentage respondents (and 95% CI) aware of the Andybiotic campaign and respondents' characteristics.

incorrect responses given by participants (26% in Scotland versus 24% in England and 24% in Wales, $P = 0.27$).

Was knowledge about antibiotics associated with behaviour?

Thirty-eight percent of respondents (95% CI 36.4–38.8%) recalled that they had been prescribed an antibiotic in the past year, and 4.8% (95% CI 4.3–5.4%) had ever used an antibiotic without advice from a health care professional. In addition, 1.7% (95% CI 1.3–2.3%) of respondents reported giving antibiotics to someone else to use for whom it was not prescribed and 4.7% (95% CI 4.2–5.3%) had obtained an antibiotic in another country without a prescription.

There was no relationship between knowledge about antibiotics and being prescribed an antibiotic in the past year (Figure 3a and Table 3), but there were significant relationships

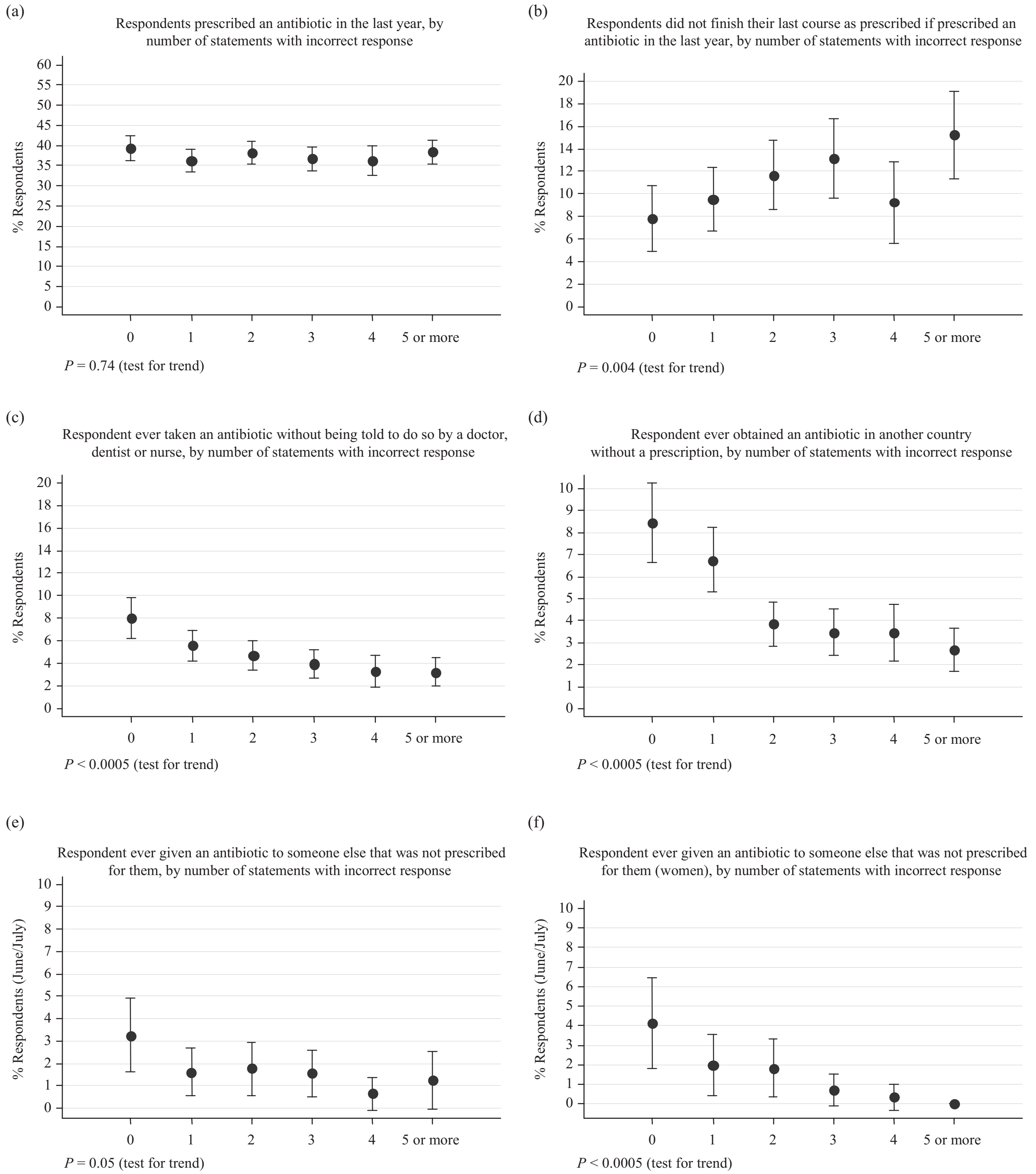

Figure 3. Reported antibiotic use in relation to the number of antibiotic statements with incorrect responses. Figures show percentage of respondents and 95% CI.

with other behaviours (Figures 3b–3f). Respondents who had no incorrect responses were about half as likely to report that they had not finished their last course of antibiotics as prescribed compared with people who gave five or more incorrect answers (7.9% versus 15.2%) (Figure 3b). However, respondents who gave no incorrect responses were about two and a half times as likely to have ever taken an antibiotic without advice from a doctor, dentist or nurse (8.0% versus 3.2%) (Figure 3c), about three times as likely to have taken an antibiotic abroad without a prescription (8.4% versus 2.7%) (Figure 3d) and about two and a

Table 3. Multivariable analysis of reported antibiotic use in relation to the number of statements about antibiotics with incorrect responses

Number of incorrect responses	% (95% CI)	Crude OR (95% CI)	P[a]	Adjusted OR (95% CI)[b]	P[a]
Outcome = respondent prescribed an antibiotic in the last year (38%, number with known outcome 2670)					
0	39.3 (36.2, 42.4)	1	0.68	1	0.17
1	36.4 (33.6, 39.3)	0.89 (0.74, 1.06)		0.89 (0.75, 1.06)	
2	38.2 (35.5, 41.1)	0.96 (0.80, 1.14)		0.93 (0.79, 1.10)	
3	36.7 (33.9, 39.6)	0.90 (0.75, 1.07)		0.83 (0.69, 1.98)	
4	36.3 (32.8, 40.0)	0.88 (0.72, 1.08)		0.82 (0.67, 1.00)	
≥5	38.4 (35.4, 41.5)	0.96 (0.80, 1.16)		0.82 (0.68, 0.98)	
Outcome = respondents did not finish their last course of antibiotic as prescribed, if prescribed an antibiotic in the last year (11.3%, number with known outcome 2670)					
0	7.9 (5.4, 11.3)	1	0.03	1	0.02
1	9.5 (7.0, 12.7)	1.23 (0.73, 2.07)		1.28 (0.78, 2.11)	
2	11.7 (8.9, 15.1)	1.55 (0.94, 2.56)		1.64 (1.01, 2.65)	
3	13.2 (10.1, 17.1)	1.78 (1.07, 2.96)		1.90 (1.16, 3.12)	
4	9.3 (6.2, 13.5)	1.20 (0.66, 2.16)		1.25 (0.71, 2.22)	
≥5	15.2 (11.8, 19.4)	2.11 (1.28, 3.48)		2.11 (1.28, 3.46)	
Outcome = respondent has ever used an antibiotic without being told to do so by a doctor, dentist or nurse (4.8%, number with known outcome 7047)					
0	8.0 (6.4, 10.0)	1	<0.0005	1	<0.0005
1	5.6 (4.4, 7.1)	0.68 (0.47, 0.97)		0.76 (0.54, 1.06)	
2	4.7 (3.6, 6.3)	0.57 (0.39, 0.84)		0.58 (0.41, 0.84)	
3	4.0 (2.9, 5.4)	0.47 (0.32, 0.71)		0.56 (0.38, 0.83)	
4	3.3 (2.2, 5.0)	0.39 (0.24, 0.64)		0.47 (0.29, 0.76)	
≥5	3.2 (2.2, 4.7)	0.38 (0.24, 0.61)		0.37 (0.24, 0.59)	
Outcome = respondent has ever obtained an antibiotic in another country without a prescription (4.7%, number with known outcome 7111)					
0	8.4 (6.8, 10.4)	1	<0.0005	1	0.0006
1	6.8 (5.4, 8.4)	0.79 (0.56, 1.10)		0.89 (0.65, 1.22)	
2	3.8 (2.9, 5.0)	0.43 (0.30, 0.62)		0.57 (0.40, 0.82)	
3	3.5 (2.5, 4.7)	0.39 (0.26, 0.58)		0.56 (0.38, 0.83)	
4	3.5 (2.4, 5.0)	0.39 (0.25, 0.61)		0.64 (0.41, 1.00)	
≥5	2.7 (1.8, 3.8)	0.30 (0.19, 0.46)		0.44 (0.28, 0.69)	
In women only: Outcome = respondent has ever given an antibiotic to someone else that was not prescribed for them (1.7%, number with known outcome 3923)					
0	4.2 (2.4, 7.2)	1	0.01	1	0.006
1	2.0 (0.9, 4.3)	0.46 (0.17, 1.25)		0.41 (0.16, 1.06)	
2	1.8 (0.8, 4.1)	0.43 (0.16, 1.19)		0.39 (0.14, 1.10)	
3	0.7 (0.2, 2.2)	0.17 (0.05, 0.60)		0.26 (0.07, 1.00)	
4	0.3 (0.0, 2.4)	0.08 (0.01, 0.61)		0.16 (0.02, 1.35)	
≥5	0.0 (−, −)	0.0 (−, −)		0.0(−, −)	

[a]The P values here are for a test of any difference between categories of the number of incorrect answers, and the footnote to the graphs in Figure 3 show a test for linear trend across these categories.
[b]The differences for each factor are determined after adjusting for age group, region, ethnicity, deprivation of area of residence, and education.

half times as likely to have given an antibiotic to someone else that was not prescribed for them (3.2% versus 1.2%) (Figure 3e). Women who gave no incorrect answers were much more likely to have given an antibiotic to someone for whom it was not prescribed than women with five or more incorrect answers (4.2% versus 0.0%) (Figure 3f). This relationship was not seen in men.

Multivariable analyses were done for each of these behaviours to assess the association with knowledge of and attitudes to antibiotics controlled for age group, sex, region, ethnicity, deprivation of area of residence and education (Table 3). Knowledge of and attitude to antibiotics had no effect on whether respondents were prescribed an antibiotic in the past year ($P = 0.17$). Knowledge of and attitude to antibiotics was associated with being more likely to finish a course of antibiotics as prescribed ($P = 0.02$), but was also associated with being more likely take antibiotics without being told to do so ($P < 0.0005$), and with being more likely to obtain antibiotics in another country without a prescription ($P = 0.0006$). In women, a better knowledge of and attitude to antibiotics was associated with being more likely to give an antibiotic to someone else that was not prescribed for them ($P = 0.006$).

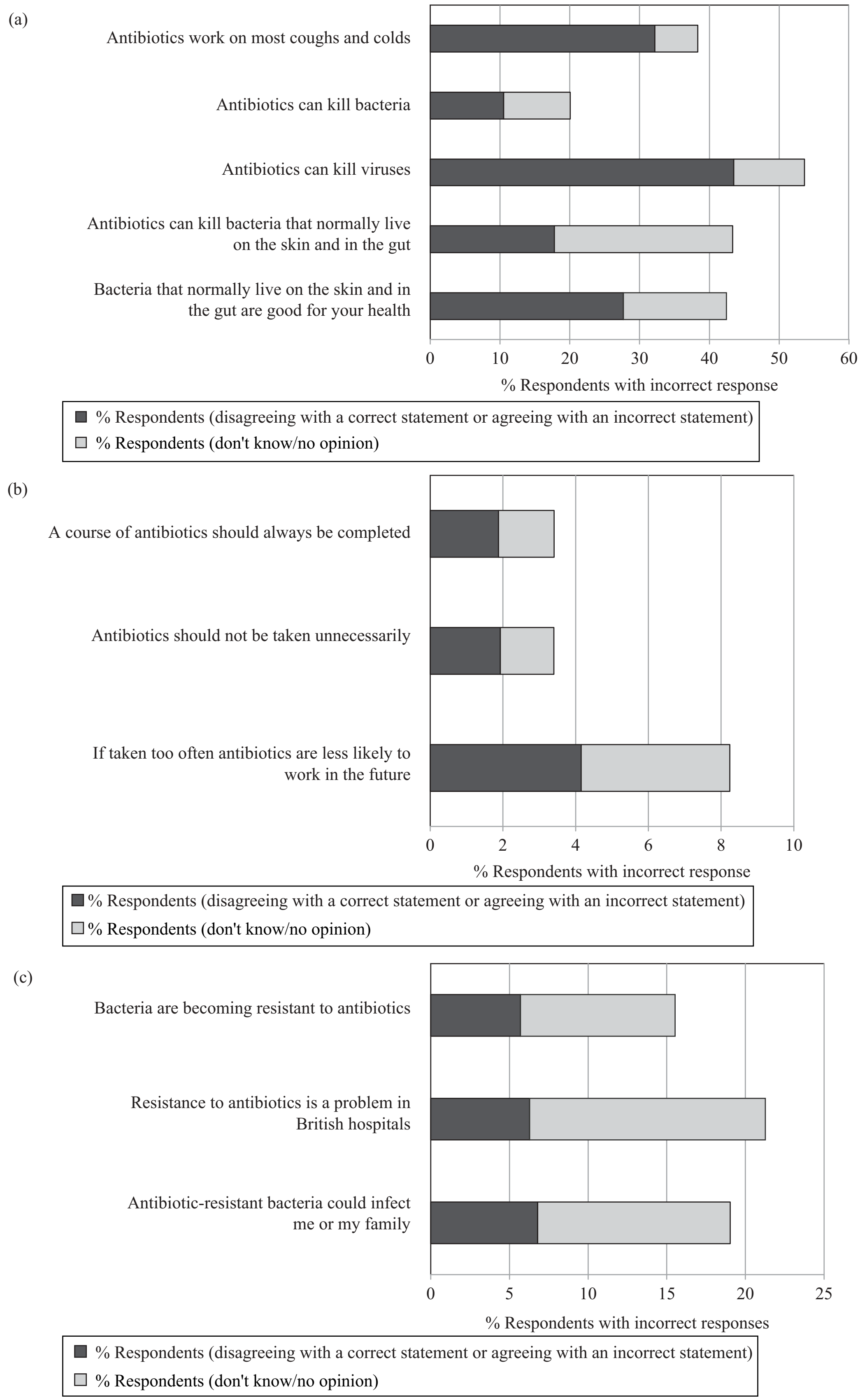

Figure 4. (a) Action of antibiotics and knowledge of good bacteria; (b) prudent antibiotic use; (c) antibiotic resistance.

Discussion

Knowledge and attitudes

This very large British face-to-face survey found that 97% of our respondents knew that antibiotics should not be taken unnecessarily and 79% were aware that antibiotic resistance was a problem in British hospitals. However, 38% thought antibiotics work on most coughs and colds, 54% that antibiotics can kill viruses and 43% did not know that antibiotics can kill the bacteria that normally live on the skin and in the gut. Respondents with lower educational qualifications, 16–24 year olds, those aged ≥75, Asians and blacks were less knowledgeable about antibiotics.

Our respondents' knowledge about the effectiveness of antibiotics is broadly similar to previous studies. Most attitudinal surveys have been undertaken in the USA in parallel with the Centres for Disease Control led antibiotic resistance campaign 'Get Smart'.[15] The US surveys have shown that about one-third to one-half of patients, or parents with children, presenting with mild respiratory symptoms expected antibiotics for a cough or cold.[16–21] As we found, a higher general level of education is strongly associated with a better knowledge about the effectiveness of antibiotics.[20]

In a Scottish survey in 2000, 45% of respondents stated that 'antibiotic resistance does not matter to me',[10] and in a multinational survey, none of the 5379 respondents mentioned antibiotic resistance as a negative consequence of taking antibiotics.[5] In our survey, only 19% of respondents did not know or disagreed with the statement 'antibiotic resistant bacteria could affect me or my family'. The British public has, therefore, probably become more aware of antibiotic resistance in the intervening 3 years through increasing media publicity about antibiotics in general and through public information campaigns.

Awareness of the Andybiotic campaign

At best, our results showed low awareness of the Andybiotic campaign (up to 22% in Wales), but the 14% reported awareness in Scotland suggests that even this figure cannot reliably be attributed to genuine awareness of the Andybiotic campaign. Plausible explanations for the reported awareness of the Andybiotic campaign in Scotland include effective distribution of the campaign materials by Health Boards in Scotland without additional central support, confusion between the Andybiotic campaign and local public information campaigns and a tendency of people who are knowledgeable or confident to say that they are aware of national campaigns. The Andybiotic campaign was concentrated in GP surgeries, so respondents who reported being prescribed antibiotics in the last year were more likely to have seen the posters or received campaign leaflets. This would also be true of information campaigns in Scotland, for example, the 'Not All Bugs Need Drugs' leaflets, which were published by the Health Education Board for Scotland in 2002.[22]

Experience in Belgium, Canada and the USA indicates that use of prime-time television is critical to public awareness of educational campaigns about antibiotics,[4] but television was not used in the Andybiotic campaign. Moreover, the Andybiotic campaign materials were only distributed twice in 1999 and 2001, and so by the time of this survey in 2003, awareness would have fallen. Experience with social marketing for other health issues such as alcohol and driving shows that campaigns must be sustained over several years to have a prolonged impact.[23]

Behaviour

Overall, 5% of our respondents said that they had ever taken an antibiotic without being told to do so by a doctor, dentist or nurse. This is similar to the results obtained in a pan-European survey which showed that self-medication varied from 0.1% to 21% and was higher in East and South Europe and lower in North and West Europe.[24] This is lower than reported antibiotic self-medication rates in some other studies, for example, 26% in Honduras,[25] 19% in Malta,[26] 19% in Trinidad and Tobago[27] and 14% in New York.[27] Similarly, our reported rate of giving antibiotics to another person (2%) is much lower than in other countries: 11% in Malta[26] and 7% in New York.[28]

In the analysis of left-over antibiotics at home, we found that individuals with higher educational qualifications were more likely to be holding left-over antibiotics.[11] We have now shown that individuals with a better knowledge of and attitude to antibiotics are more likely to report self-medication and obtain antibiotics in another country without a prescription, and women with a better knowledge of and attitude to antibiotics are more likely to give antibiotics to others without a prescription. These findings are consistent with the pan-European survey[24] and results of two previous studies. In Malta, 31% of university graduates said that they would self-administer antibiotics, compared with 6% of those with no formal qualification.[26] In Vietnam, households in which the highest educational qualification was greater than primary school were 4.7 times (95% CI 2.3–10.9) more likely to keep antibiotics for future use than other households.[29] However, in Honduras, there was no association between reported self-medication and level of education.[25] Overall, the evidence is consistent with the theory that self-confidence in the use of medicines in the better educated is likely to be associated with increased levels of self-medication.[29]

Strengths and weaknesses of this survey

This is the largest face-to-face questionnaire survey about public knowledge of and attitudes to antibiotics in Britain; the only comparable international study was the survey of 10 780 respondents to the US FoodNet population survey in 1998–99.[20] The very large sample size allowed us to confidently examine how knowledge of and attitude to antibiotics was associated with a variety of individual characteristics and reported behaviour. Additional strengths of our study were the use of random sampling for obtaining representative samples from the national population. The ONS had undertaken regular audits of their sampling methods and found respondents representative of the whole population. Moreover, our sample was found to be closely representative in respect of region, Carstairs' deprivation quintile, age group and sex, as sampling weights defined for each of these groups were applied but found to make very little difference to our results.

Our study does have weaknesses. As with all public surveys, the results rely heavily on reported rather than measured behaviour. However, part of the study was an audit of antimicrobials physically present at home; this audit may have made respondents more likely to answer the questions on antibiotics truthfully. With respect to the impact of the Andybiotic campaign, the survey was not undertaken before and after the Andybiotic campaign and the quite high awareness in Scotland cast serious doubt on the reliability of reported awareness in

England and Wales. In the analysis of reported antibiotic use (Figure 3 and Table 3), the groups being compared were determined by the respondent's knowledge/attitude at the time of the survey and therefore some time after the reported behaviour. This is not ideal for investigating the influence of knowledge/attitude on behaviour. It seems likely to us that knowledge and attitudes at the time of the survey are a fair indication of the knowledge and attitudes that the respondent had before the behaviour took place. But it is possible that the behaviour was an influence on knowledge/attitude rather than the other way round.

Implications of this work

We have shown that there is no simple relationship between increased knowledge and prudent antibiotic use. Our survey clearly identifies some specific groups with relatively low knowledge about antibiotics. However, we have shown that there is very little association between knowledge of antibiotics and being prescribed an antibiotic in the last year and that greater knowledge is associated with more self-medication (the reduction of which is one of the three key aims of WHO for public involvement).[2] Before embarking on further campaigns about antibiotics, we need to be more clearer about what we are trying to accomplish.[23] If the aim is to reduce antibiotic use for acute respiratory infections, then the evidence shows that public education works best when aligned with interventions aimed at prescribers,[30,31] and so a community-based intervention may be more appropriate than a national public information campaign.[23]

Our results suggest that simply increasing the public's knowledge about antibiotics may actually be counterproductive with respect to self-medication. If we want to reduce self-medication with antibiotics, then we need to understand the values and motivations that support self-medication and use these to encourage healthier options.[32] Social marketing uses behavioural and persuasion theories and repetition to target changes in health risk behaviour.[33] We need to be able to offer patients the same symptomatic benefit they perceive they will obtain with antibiotics in a more healthy manner using other or no medication. We need to convince them that in less-severe infections, especially if respiratory, non-antibiotic-containing medications are as effective and better for them in the long term. This will require repeated campaigns and constructive involvement of health professionals to encourage prudent antibiotic use. This repeated message will become increasingly important as over-the-counter antimicrobials become more available and more heavily advertised in the UK. Overall, a more targeted campaign based on influencing behaviour may be a better strategy than a campaign focused on knowledge.

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Transparency declarations

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Supplementary data

The questionnaire is available as Supplementary data at JAC Online (http://jac.oxfordjournals.org/).

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