

# Knowledge and attitudes towards the use of antibiotics in the paediatric age group: a multicenter survey in Italy

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**Background:** The misuse of antibiotics is one of the leading causes of antibiotic resistance. Paediatric patients are highly involved in this issue, as they are those who receive the largest amount of prescriptions of these drugs. Therefore, this study aimed to investigate the general knowledge regarding the use of antibiotics, as well as the attitudes related to the administration of these drugs to children, amongst parents of children in the paediatric age-group. **Methods:** In 2014, a multicentre cross-sectional study was conducted amongst parents of children aged 0–14. A questionnaire made up of 33 items was administered in waiting rooms of outpatient departments. Multivariable logistic regression models were performed, in order to assess the potential predictors of a better knowledge about antibiotics. **Results:** A total of 1247 parents took part to the survey. Around 33% of the samples declared that antibiotics are useful for viral infections, 20.6% that antibiotics are useful for every kind of pain and inflammation, while 14% of the parents stated that they stop giving antibiotics to their children when they start feeling better. Multivariable models showed that males, unemployed and those with lower levels of education are less prone to answer correctly to the questions about antibiotics. **Conclusion:** The present study demonstrates that parents have a lack of knowledge regarding the use of antibiotics, which results in bad habits and inappropriate attitudes when it comes to giving antibiotics to their children. Attention should be particularly focused on disadvantaged parents.

## Introduction

Antibiotic resistance is the resistance of a bacterium to an antibiotic that was originally effective for the treatment of the infections caused by it.<sup>1</sup> In recent years, this phenomenon has become a public health issue worldwide. According to the data of the 2011 European Commission report on antimicrobial resistance,<sup>2</sup> resistant bacteria infections cause around 25 000 deaths every year within the EU, leading to an increase of healthcare expenses and to productivity losses. One of the main causes of antibiotic resistance is the misuse of antibiotics in terms of self-prescriptions, incomplete therapies, missing doses, and re-use of leftover antibiotics.<sup>3</sup> These inappropriate practices also have implications regarding the administration of antibiotics to the paediatric population. This is even more alarming, considering that paediatric patients are the category of patients who receive the largest amount of prescriptions of these drugs.<sup>4</sup> Ciofi degli Atti et al. and Nyquist et al. found out that more than 40% of paediatric patients visited by physicians for respiratory infections receive antibiotics.<sup>5,6</sup> Moreover, a recent study conducted by Adam et al. showed that *Streptococcus Pneumoniae* and *Escherichia Coli*, resistant to the most common antibiotic drugs, were more frequently found in children than in adults.<sup>7</sup> In this context, the role of children's caregivers is crucial, as they are usually those who take care of the administration of antibiotics. Many studies highlighted a lack of knowledge on the use of antibiotics of parents of children in the paediatric age-group.<sup>8–19</sup> This could lead to the inappropriate administration of antibiotics to

children, given that 10% to 60% of parents admit that they administer antibiotics without a medical prescription.<sup>9–12,14,18</sup> Moreover, several studies demonstrated that parents' attitudes could influence the decision of the physician regarding the prescription of antibiotics, making parents' lack of knowledge of antibiotics even more dangerous.<sup>13,20,21</sup>

To date, no studies have evaluated the knowledge and attitudes towards antibiotics among parents of children aged 0–14 in Italy. It should be noted that in 2011 this country had one of the highest consumptions of antibiotics in Europe, only surpassed by Greece, Cyprus, France and Luxembourg, with a consequent higher likelihood of inappropriate assumptions.<sup>22</sup> Several studies confirmed this finding, especially in paediatric subjects.<sup>5,23</sup> Therefore, the present study aimed to investigate, in a sample of parents in seven Italian cities, the general knowledge regarding the correct use of antibiotics, the frequency of administration of these drugs to children, the mode of acquisition (with or without prescription, generic or branded) and the awareness of the meaning of antibiotic resistance.

## Methods

### The sample

A multicenter cross-sectional survey was carried out in seven Italian cities (Cassino, Chieti, Napoli, Palermo, Roma, Turin and Udine) between February and May 2014. Participants were recruited in waiting rooms of outpatient departments, with the exclusion of

paediatric departments in order to avoid selection bias, as parents of children who visit paediatric departments might have a higher knowledge of drug therapies, and of antibiotics specifically. Only parents of children aged 0–14 who were able to read and understand the questionnaire in the Italian language were interviewed and therefore included in the study. When both parents were present, only one was asked to participate in this study. In that case, we asked them to select the one who was more involved in the administration of drugs to their children.

The estimated number of parents that had to be interviewed in each city in order to obtain validated data was calculated on the basis of demographic data of the resident population in the age group 0–14 years in the different cities participating in the study,<sup>24</sup> and data of the National Institute of Health in 2009 indicating that 56% of Italian children received during the previous year at least one antibiotic prescription.<sup>25</sup> It was decided to double the number of subjects involved for each city, in order to provide an adequate margin of safety in the calculation of the sample size. The value of Worst Acceptable was calculated on 46% of prescriptions. Finally, by summing the results stratified for each city, we calculated the final sample size, composed of 1330 parents, for a confidence level of 95%. The calculation of the sample size was performed with the software EpiInfo.

Participation was voluntary, anonymous and without compensation. The researchers ensured the participants' anonymity and the observance of ethical principles: prior to the administration of the survey, the objectives of the study were explained, and the parents were asked to sign an informed consent form. The study was approved by the Ethics committee of the 'Città della Salute e della Scienza' Hospital of the city of Turin.

### The questionnaire

The questionnaire, addressed to parents of children in the paediatric age-group, was developed after a review of studies on this topic in scientific databases, and validated by a pilot study on 20 parents. It was composed of 33 items and divided in five sections, as follows:

- (1) Socio-demographic characteristics of the parents interviewed, such as gender, age, place and year of birth and level of education (nine items);
- (2) Consumption of antibiotics by their children in the last year (two items);
- (3) Knowledge about antibiotics and related adverse reactions (nine items);
- (4) Knowledge about antibiotic resistance (five items);
- (5) Attitudes and behaviours related to the administration of antibiotics to their children (eight items).

Both a four-point Likert-scale, whose responses ranged from 'Strongly disagree' to 'Strongly agree', and dichotomous answers (yes/no) were used.

### Statistical analysis

Statistical analyses were performed using STATA V.13 (Stata Corp, College Station, Texas, USA, 2013). A descriptive analysis of the sample was conducted. Results were expressed in frequencies and percentages.

The answer given through the four-point Likert scale (items of Section 3—*Knowledge about antibiotics and related adverse reactions* and Section 4—*knowledge about antibiotic resistance*) were dichotomized as follows: 'totally agree' and 'agree' versus 'totally disagree' and 'disagree'. For each outcome, the percentages of appropriate answers ('Strongly agree/agree' or 'Strongly disagree/disagree', depending on the meaning of the question) were assessed.

Moreover, for each statement in which the Likert scale was used, a score based on the correctness of the answer (from 1 if totally incorrect to 4 if totally correct) and ranging from 1 to 4 was

applied. Four overall scores were then elaborated by grouping the statements as follows:

- (1) First group: '*Identification of antibiotics*' (Penicillin is an antibiotic/Aspirin is an antibiotic/Paracetamol is an antibiotic);
- (2) Second group: '*Knowledge about the role of antibiotics*' (antibiotics are useful for bacterial infections/antibiotics are useful for viral infections/antibiotics are equivalent to anti-inflammatory agents);
- (3) Third group: '*Knowledge about the side effects of antibiotics*' (antibiotics can cause side effects/antibiotics can cause allergic reactions/antibiotics can cause secondary infections by killing good bacteria present in our organism);
- (4) Fourth group: '*Knowledge about antibiotic resistance*' (antibiotic resistance is a phenomenon that takes place when a bacterium loses its sensitivity to an antibiotic/the misuse of antibiotics can lead to antibiotic resistance/it is admissible to stop taking antibiotics when symptoms are improving).

Since each group had three statements, the score ranged from 3 (all three answers entirely incorrect) to 12 (all three answers entirely correct). A score was considered 'good' if the total points were 10 or more, and 'bad' if the total points ranged from 3 to 9. It should be remarked, however, that Likert scale is an ordinal scale, not an interval scale.

As far as attitudes and practices are concerned, eight outcome variables were considered ([Supplementary material 1](#)):

- Do you usually give antibiotics to your child/children every time they have a cold or a sore throat?
- Do you usually give antibiotics to your child/children when they have a fever?
- Do you usually interrupt the full cycle of antibiotics administered to your child/children when they start feeling better?
- Do you give antibiotics to your child/children only when prescribed by the paediatrician (in other words, only when you have a regular medical prescription)?
- Do you keep leftover antibiotics at home because they might be useful in the future for your child/children?
- Do you usually use leftover antibiotics when your child/children has/have a cold, a sore throat or a flu without consulting your paediatrician?
- Do you usually buy antibiotics for your child/children without a medical prescription?
- Do you usually give antibiotics to your child/children only after a phone consultation with the paediatrician, without a proper medical examination?

For each of these questions, the total percentages of 'yes' and 'no' answers were calculated. It was decided to use the word 'paediatrician' instead of 'medical doctor' or 'physician', because in Italy the primary care of children in paediatric age is usually performed by paediatricians, who act as gatekeepers.

Finally, multivariable logistic regression models were performed to assess the potential predictors of a better knowledge regarding antibiotics. The covariates to be included into the final model were selected using a stepwise forward selection process, with a univariate  $P < 0.25$  as the main criterion.<sup>26</sup> Results were expressed as OR with 95% CI, and a two-tailed  $P < 0.05$  was considered significant for all analyses.

## Results

### Descriptive analysis

A total of 1247 parents (mothers or fathers) were interviewed. Females were 70.1%, with an average age of 40.8 years (SD  $\pm 7.5$ ). The majority of the people interviewed were Italian (93.9%). Half of the sample declared to have more than one child, with a mean of 1.6 children for each parent and a standard deviation of  $\pm 0.7$

**Table 1** Characteristics of the sample (N = 1247)

		Total % (N)
Age (mean)		40.8 ( $\pm$ 7.5) <sup>a</sup>
Age class	18–40 years	49.2 (613)
	41–70 years	50.8 (633)
Gender	Male	29.9 (371)
	Female	70.1 (871)
Nationality	Italian	93.9 (1156)
	Foreign	6.1 (75)
N° of children	One	49.9 (609)
	More than one	50.1 (612)
No of children (mean)		1.6 ( $\pm$ 0.7) <sup>a</sup>
Marital status	Married/cohabiting	88 (1096)
	Single or other <sup>b</sup>	12 (149)
Educational level	College or more	32.7 (407)
	High school	47.9 (597)
	Less than high school	19.4 (241)
Occupation	Employed	70.7 (880)
	Not employed/student	29.3 (365)
Occupation in a health care-related field	Yes	17.9 (212)
	No	82.1 (971)
Relatives working in a health care-related field	Yes	25.3 (314)
	No	74.7 (926)
Use of antibiotics in the last year	Yes	69.8 (862)
	No	30.2 (372)

a: Mean  $\pm$  standard deviation.

b: Divorced, separated, widow/widower.

(median=2, minimum number of children=1 and maximum number=6). Moreover, 88% of the interviewed persons stated to be married or to live with a partner. Around 18% of the sample had an occupation in the healthcare field. Almost 70% of the sample declared they had given antibiotics to their child/children at least one time in the previous year (table 1).

### Knowledge about antibiotics

Answers to the 12 statements related to the knowledge regarding the identification, role and side effects of antibiotics and antibiotic resistance are presented in table 2, together with the score obtained for each group of statements. Regarding the identification of antibiotics, a bad score was racked up by more than 10% of the respondents, while, in the group of items on the role of antibiotics, 43% of the parents interviewed got a bad score. In particular, 32.8% of the sample declared that antibiotics are useful for viral infections, and 20.7% that antibiotics are useful for every kind of pain and inflammation, as they are equivalent of anti-inflammatory agents. A bad score on 'side effects of antibiotics' was totalized by 20.9% of the sample. Specifically, 18% of the parents disagreed with the fact that antibiotics can kill good bacteria present in our organism. Regarding antibiotic resistance, 13.7% of the sample did not agree with the statement "Antibiotic resistance is a phenomenon that takes place when a bacterium loses its sensitivity to an antibiotic", and 14.9% declared that it is admissible to stop taking antibiotics when symptoms decrease. An overall bad score about this group of statements was achieved by 26.7% of the parents (table 2).

### Attitudes towards antibiotics

Results about parents' attitudes towards the administration of antibiotics to their children are described in table 3. Interestingly, 14% of the sample stated that they stop giving antibiotics to their children when they start feeling better, despite being advised by paediatricians to do a complete cycle of these drugs. Moreover, 17% declared that they give antibiotics to their children without the prescription of the paediatrician and 25.9% that they buy antimicrobial drugs without a medical prescription. Furthermore, the majority of the parents interviewed (55%) stated that they give antibiotics to their children after

a phone consultation with the paediatrician, without a proper medical examination (table 3).

### Multivariable analysis on knowledge about antibiotics

Table 4 describes the likelihood of obtaining a good score in the four groups of items related to the knowledge regarding antibiotics and antibiotic resistance. After adjusting for confounding factors, females resulted to have a greater likelihood of obtaining a good score in all the four outcome variables. In particular, females had a higher probability to totalize a good score related to the identification of antibiotics (OR 4.15, 95% CI 2.61–6.61). Moreover, for three out of four outcomes taken into consideration (identification of antibiotics, knowledge regarding the role of antibiotics and knowledge about antibiotic resistance), parents with a lower level of education (not reaching high school level) had a significant lower chance to obtain a good score than parents with at least a college diploma, with OR 0.27 (95% CI 0.15–0.50), 0.26 (95% CI 0.18–0.38) and 0.26 (95% CI 0.17–0.41), respectively. Besides, unemployed parents and students had a lower likelihood of getting a good score in all the four outcomes considered, if compared with employed parents. In that case, odds ratios ranged from 0.62 (95% CI 0.45–0.84) for the variable 'Knowledge about antibiotic role' to 0.32 (95% CI 0.20–0.52) for the variable 'Identification of antibiotics'. As expected, working in a health-related field seemed to improve the chances of obtaining a good score.

### Discussion

This multicenter study aimed at investigating the knowledge, attitudes and practices regarding antibiotics in a sample of parents in seven Italian cities. To our knowledge, this is the first study investigating this issue in the Italian context. Previous Italian studies on this topic were indeed focused on the general population,<sup>27</sup> or on medical students.<sup>28</sup> The results of our study showed how parents have a general lack of knowledge related to the role of antibiotics, the potential side effects of these drugs and the issue of antibiotic resistance. Indeed, the scores obtained combining the answers of homogeneous groups of statements were 'bad' in 10–40% of the cases.

**Table 2** Knowledge about antibiotic consumption and resistance (*N* = 1247)

		Total % (N)
Use of antibiotic in the last year	Yes	69.8 (862)
	No	30.2 (372)
Penicillin is an antibiotic	Strongly agree/agree	93.5 (1153)
	Disagree/strongly disagree	6.5 (80)
Aspirin is an antibiotic	Strongly agree/agree	3.8 (47)
	Disagree/strongly disagree	96.2 (1195)
Paracetamol is an antibiotic	Strongly agree/agree	6.0 (75)
	Disagree/strongly disagree	94.0 (1168)
Score: identification of antibiotics	Good	89.4 (1099)
	Bad	10.6 (131)
Antibiotics are useful for bacterial infections	Strongly agree/agree	87.0 (1073)
	Disagree/strongly disagree	13.0 (160)
Antibiotics are useful for viral infections	Strongly agree/agree	32.8 (406)
	Disagree/strongly disagree	67.2 (832)
Antibiotics are equivalent to anti-inflammatory agents	Strongly agree/agree	20.7 (256)
	Disagree/strongly disagree	79.3 (984)
Score: knowledge about the role of antibiotics	Good	57.2 (700)
	Bad	42.8 (524)
Antibiotics can cause side effects	Strongly agree/agree	92.6 (1148)
	Disagree/strongly disagree	7.42 (92)
Antibiotics can cause allergic reactions	Strongly agree/agree	94.77 (1178)
	Disagree/strongly disagree	5.23 (65)
Antibiotics can cause secondary infections by killing good bacteria present in our organism	Strongly agree/agree	82.0 (1008)
	Disagree/strongly disagree	18.0 (221)
Score: knowledge about side effects of antibiotics	Good	79.1 (968)
	Bad	20.9 (255)
Antibiotic resistance is a phenomenon that takes place when a bacterium loses its sensitivity to an antibiotic	Strongly agree/agree	86.3 (960)
	Disagree/strongly disagree	13.7 (153)
Misuse of antibiotics can lead to antibiotic resistance	Strongly agree/agree	88.1 (1055)
	Disagree/strongly disagree	11.9 (143)
It is admissible to stop taking antibiotic when symptoms are improving	Strongly agree/agree	14.9 (181)
	Disagree/strongly disagree	85.1 (1030)
Score: knowledge about antibiotic resistance	Good	73.3 (809)
	Bad	26.7 (294)

**Table 3** Attitudes and behaviours towards the administration of antibiotics (*N* = 1247)

		Total % (N)
Do you usually give antibiotics to your child/children every time they have a cold or a sore throat?	Yes	9.9 (123)
	No	90.1 (1121)
Do you usually give antibiotics to your child/children when they have a fever?	Yes	13.3 (165)
	No	86.7 (1076)
Do you usually interrupt the full cycle of antibiotics administered to your child/children when they start feeling better?	Yes	14.2 (176)
	No	85.8 (1067)
Do you give antibiotics to your child/children only when prescribed by the paediatrician (in other words, only when you have a regular medical prescription)?	Yes	82.9 (1026)
	No	17.1 (212)
Do you keep leftover antibiotics at home because they might be useful in the future for your child/children?	Yes	40.1 (494)
	No	59.9 (739)
Do you usually use leftover antibiotics when your child/children has/have a cold, a sore throat or a flu without consulting your paediatrician?	Yes	13.2 (163)
	No	86.8 (1075)
Do you usually buy antibiotics for your child/children without a medical prescription?	Yes	25.9 (320)
	No	74.1 (914)
Do you usually give antibiotics to your child/children only after a phone consultation with the paediatrician, without a proper medical examination?	Yes	55.0 (678)
	No	45.0 (554)

Our results are consistent with those of a survey conducted among parents of children < 5 years old. In the latter case, 40% of the sample was not aware that antibiotics are useful only for bacterial infection.<sup>29</sup> In a previous study on this topic, conducted in Cyprus among parents of children between four and seven years of age, 93% of the sample acknowledged that antibiotics have side effects and 87% that fever is not a symptom requiring the administration of antibiotics.<sup>15</sup> In the general population, a recent meta-analysis of 24 observational studies showed how 50% of the sample believes that

antibiotics are useful for colds and the flu and 54% that antibiotics can treat viral infections.<sup>30</sup> A study on this topic in a sample of students of a Medical School, gave, as expected, more promising results.<sup>28</sup>

The multivariable models, performed in order to identify the possible predictors of high levels of knowledge on antibiotics, showed how fathers have a remarkable lower knowledge regarding the identification, role and side effects of antibiotics, and concerning the issue of antibiotic resistance. Moreover, the level of education

**Table 4** Multivariable results on knowledge about antibiotic consumption and resistance (N = 1247)

		Identification of antibiotics	Knowledge about the role of antibiotics	Knowledge about the side-effects of antibiotics	Knowledge about antibiotic resistance
Age (Continuous)		1.02 (0.99–1.05)	<b>1.03 (1.01–1.05)</b>	<b>1.02 (1.01–1.04)</b>	<b>1.04 (1.02–1.06)</b>
Gender	Male	Ref	Ref	Ref	Ref
	Female	<b>4.15 (2.61–6.61)</b>	<b>1.77 (1.32–2.36)</b>	<b>1.83 (1.30–2.56)</b>	<b>1.76 (1.26–2.46)</b>
Country of birth	Italy	—	Ref	—	—
	Foreign	—	0.63 (0.37–1.07)	—	—
Number of children	One	—	—	—	Ref
	More than one	—	—	—	1.29 (0.96–1.73)
Marital status	Married/Cohabitee	Ref	Ref	—	—
	Single/Widowed	<b>0.54 (0.32–0.91)</b>	0.77 (0.52–1.13)	—	—
Educational level	University or more	Ref	Ref	Ref	Ref
	High School	0.71 (0.40–1.27)	<b>0.51 (0.37–0.69)</b>	0.86 (0.60–1.24)	<b>0.55 (0.38–0.80)</b>
	< High school	<b>0.27 (0.15–0.50)</b>	<b>0.26 (0.18–0.38)</b>	0.88 (0.56–1.38)	<b>0.26 (0.17–0.41)</b>
Occupation	Employed	Ref	Ref	Ref	Ref
	Unemployed/student	<b>0.32 (0.20–0.52)</b>	<b>0.62 (0.45–0.84)</b>	<b>0.54 (0.38–0.78)</b>	<b>0.58 (0.41–0.83)</b>
Working in a health-related field	No	Ref	Ref	Ref	Ref
	Yes	2.10 (0.89–4.93)	<b>2.03 (1.36–3.04)</b>	<b>2.77 (1.53–5.03)</b>	<b>2.14 (1.27–3.60)</b>
Relatives working in a health-related field	No	Ref	Ref	Ref	Ref
	Yes	1.13 (0.67–1.91)	1.29 (0.95–1.76)	<b>2.22 (1.47–3.37)</b>	1.21 (0.84–1.74)
Use of antibiotics in the last year	No	Ref	—	Ref	—
	Yes	1.49 (0.97–2.29)	—	0.73 (0.52–1.03)	—

Results highlighted in bold are statistically significant.

and the employment status seemed to influence the knowledge of caregivers about antibiotics. Indeed, parents with a high school diploma were more likely to obtain good scores than those with a lower educational level. As expected, those who work in a health related field had better results than those who do not. These results are similar to those presented in the study conducted in Cyprus, where level of education, gender, income, residency, being or not an immigrant, having or not a health insurance and number of children proved to be the main socio-demographic factors associated with knowledge about antibiotics.<sup>13</sup> Another study, conducted on a sample of more than five thousand Greek parents, reported that male gender, low income, low education, immigrant status and the number of children (less than two or more than three) were all variables associated with a lower knowledge about antibiotics for upper respiratory tract infections.<sup>15</sup>

This general lack of knowledge leads to bad attitudes towards the consumption of antibiotics. Almost 15% of the parents declared that they stop giving antibiotics to their children when they start feeling better, without completing the full cycle of therapy. It is even more worrying that one out of four of the parents included in our sample declared that they give antibiotics to their children without any medical prescription. This might be surprising, as pharmacists in Italy are not allowed to sell antibiotics without a medical prescription. However, previous studies on this topic demonstrated that buying antibiotics at the pharmacy without a medical prescription is still possible in Italy.<sup>28,31</sup> These findings are similar to those of the previously mentioned study conducted in Greece, that pointed out that 10% of the parents would consider giving their children antibiotics without previous medical advices, and that 44% received antibiotic recommendation from their paediatrician over the phone.<sup>15</sup>

These results make it clear that there is the need to inform and form the caregivers of children in paediatric age on the good practices and attitudes regarding antibiotic usage, and many initiatives have been implemented in recent years in these regards.<sup>21,32,33</sup> It is worth mentioning e-Bug, a project that aimed at distributing antibiotic and hygiene educational packs in school across Europe. Both this educational program and some correlated initiatives demonstrated that it is possible to improve the level of knowledge of children and parents about antibiotics and antibiotic resistance.<sup>34,35</sup> Moreover, it is necessary to involve general

practitioners in these educational programmes, as they are the primary source of information about antibiotics in more than half of the population.<sup>36</sup>

This study had some strengths and limitations that should be acknowledged. One of the main strengths is represented by the sample size of parents of children between 0 and 14 years of age interviewed (1247). This sample size is larger than the one of previous studies on this topic.<sup>10–12,16–18</sup> The second main strength is that face-to-face interviews were carried out. Indeed, this is considered the gold standard method of survey administration.<sup>37</sup> Another strength is that interviews were carried out in different cities in the north, centre and south of Italy, giving the opportunity to obtain a representative sample of the different Italian contexts, even more important when considering that people living in different cities have diverse approaches to many health related issues.<sup>38,39</sup> The differences concerning the knowledge and attitudes on antibiotics and antibiotic resistance between the cities that are included in this study will be assessed in another paper.

A possible limitation of this study is the fact that face-to-face interviews could lead to a selection bias, given that the most introspective persons are less prone to participate in the survey. Moreover, the selection methods for the survey may have led to an over-representativeness of certain categories of parents (e.g. females over males). However, when both the parents were present, we selected the one who was more involved in the administration of drugs to their children, and therefore we are quite confident that our sample is representative of the parents who usually give antibiotics to their children. Finally, the multicenter nature of this study could lead to a certain variability between interviewers. However, all the persons that administered the questionnaire were trained researchers.

In conclusion, this study demonstrates that parents of children between 0 and 14 years of age have a lack of knowledge about the use of antibiotics, which results in bad habits and inappropriate attitudes when it comes to giving antibiotics to their children. Attention should be focused in particular on the most disadvantaged parents (those who have lower levels of education and/or are unemployed), as they showed a significant lower level of knowledge about antibiotics. This data underlines the need to implement specific programs aimed at increasing the health

literacy of Italian parents on antibiotics consumption and antibiotic resistance.

## Ethical approval

The study was approved by the Ethics committee of the "Città della Salute e della Scienza" Hospital of the city of Turin.

## Acknowledgments

The authors would like to thank Martina Tormena who edited the manuscript and all the study participants.

*Conflicts of interest:* None declared.

### Key Points

- Italian parents have a lack of knowledge regarding the use of antibiotics, and this results in inappropriate attitudes towards the administration of antibiotics to their children.
- Males, less educated and unemployed parents are those who achieved the worst results.
- European governments should strengthen their actions addressed at fighting the incorrect use of antibiotics in the general population.

## References

- 1 WHO. *The evolving threat of antimicrobial resistance. Options for action*. World Health Organization, 2012. Available at: [http://apps.who.int/iris/bitstream/10665/75389/1/WHO\\_IER\\_PSP\\_2012.2\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/75389/1/WHO_IER_PSP_2012.2_eng.pdf) (10 May 2016, date last accessed).
- 2 European Commission. Action plan against the rising threats from Antimicrobial Resistance. Available at: [http://ec.europa.eu/dgs/health\\_food-safety/docs/communication\\_amr\\_2011\\_748\\_en.pdf](http://ec.europa.eu/dgs/health_food-safety/docs/communication_amr_2011_748_en.pdf) (10 May 2016, date last accessed).
- 3 Kardas P, Devine S, Golembesky A, et al. A systematic review and meta-analysis of misuse of antibiotic therapies in the community. *Int J Antimicrob Agents* 2005;26:106–13.
- 4 Cebotarenco N, Bush P. Reducing antibiotics for colds and flu: a student-taught program. *Heal Educ Res* 2008;23:146–57.
- 5 Ciofi degli Atti ML, Massari M, Bella A, et al. Clinical, social and relational determinants of pediatric ambulatory drug prescriptions due to respiratory tract infections in Italy. *Eur J Clin Pharmacol* 2006;62:1055–64.
- 6 Nyquist AC, Gonzales R, Steiner JF, et al. Antibiotic prescribing for children with colds, upper respiratory tract infections, and bronchitis. *JAMA* 1998;279:875–7.
- 7 Adam HJ, Baxter MR, Davidson RJ, et al. Comparison of pathogens and their antimicrobial resistance patterns in pediatric, adult and elderly patients in Canadian hospitals. *J Antimicrob Chemother* 2013;68 Suppl 1:i31–7.
- 8 Huang S, Rifas-Shiman S, Kleinman K, et al. Parental knowledge about antibiotic Use: results of a cluster-randomized, multicommunity intervention. *Paediatrics* 2007;119:698–706.
- 9 Bi P, Tong SL, Parton KA. Family self-medication and antibiotics abuse for children and juveniles in a Chinese city. *SocSci Med* 2000;50:1445–50.
- 10 Larsson M, Kronvall G, Chuc NTK, et al. Antibiotic medication and bacterial resistance to antibiotics: a survey of children in a Vietnamese community. *Trop Med Int Health* 2000;5:711–21.
- 11 Abobotain AH, Sheerah HA, Alotaibi FN, et al. Socio-demographic determinants of antibiotic misuse in children. A survey from the central region of Saudi Arabia. *Saudi Med J* 2013;34:832–40.
- 12 Togoobaatar G, Ikeda N, Ali M, et al. Survey of non-prescribed use of antibiotics for children in an urban community in Mongolia. *Bull World Health Organ* 2010;88:930–6.
- 13 Rousounidis A, Papaevangelou V, Hadjipanayis A, et al. Descriptive study on parents' knowledge, attitudes and practices on antibiotic use and misuse in children with upper respiratory tract infections in Cyprus. *Int J Environ Res Public Health* 2011;8:3246–62.
- 14 Panagakou SG, Papaevangelou V, Chadjipanayis A, et al. Risk factors of antibiotic misuse for upper respiratory tract infections in children: results from a cross-sectional knowledge-attitude-practice study in Greece. *ISRN Pediatr* 2012;2012:685302.
- 15 Panagakou SG, Spyridis N, Papaevangelou V, et al. Antibiotic use for upper respiratory tract infections in children: a cross-sectional survey of knowledge, attitudes, and practices (KAP) of parents in Greece. *BMC Pediatr* 2011;11:60.
- 16 Bagshaw SM, Kellner JD. Beliefs and behaviours of parents regarding antibiotic use by children. *Can J Infect Dis* 2001;12:93–7.
- 17 Salazar ML, English TM, Eiland LS. Caregivers' baseline understanding and expectations of antibiotic use for their children. *Clin Pediatr (Phila)* 2012;51:632–7.
- 18 Chan GC, Tang SF. Parental knowledge, attitudes and antibiotic use for acute upper respiratory tract infection in children attending a primary healthcare clinic in Malaysia. *Singapore Med J* 2006;47:266–70.
- 19 Wun YT, Lam TP, Lam KF, et al. Antibiotic use: do parents act differently for their children?. *Int J Clin Pract* 2012;66:1197–203.
- 20 Teixeira Rodrigues A, Roque F, Falcão A, et al. Understanding physician antibiotic prescribing behaviour: a systematic review of qualitative studies. *Int J Antimicrob Agents* 2013;41:203–12.
- 21 Taylor JA, Kwan-Gett T, Mc Mahon E. Effectiveness of an educational intervention in modifying parental attitudes about antibiotic usage in children. *Paediatrics* 2003;5:e548–53.
- 22 ECDC Surveillance Report. Surveillance of antimicrobial consumption in Europe 2011. <http://www.ecdc.europa.eu/en/publications/Publications/antimicrobial-consumption-europe-surveillance-2011.pdf> (20 April 2016, date last accessed).
- 23 Resi D, Milandri M, Moro ML. Emilia Romagna study group on the use of antibiotics in children. Antibiotic prescriptions in children. *J Antimicrob Chemother* 2003;52:282–6.
- 24 Istituto Nazionale di Statistica (ISTAT). <http://dati.istat.it/> (10 May 2016, date last accessed).
- 25 Istituto Superiore di Sanità. Giornata europea degli antibiotici: uso responsabile per il controllo dell'antibiotico-resistenza. A cura di Annalisa Pantosti e Maria Del Grosso. 2009, 42 p. Rapporti ISTISAN 09/32. <http://www.iss.it/binary/publ/cont/0932web.pdf> (26 April 2016, date last accessed).
- 26 Hosmer DW, Lemeshow S. *Applied Logistic Regression*. New York: John Wiley & Sons, Inc. 1989.
- 27 Napolitano F, Izzo MT, Di Giuseppe G, et al. Public knowledge, attitudes, and experience regarding the use of antibiotics in Italy. *PLoS One* 2013;8:e84177.
- 28 Scaiola G, Gualano MR, Gili R, et al. Antibiotic use: a cross-sectional survey assessing the knowledge, attitudes and practices amongst students of a School of Medicine in Italy. *PLoS One* 2015;10:e0122476.
- 29 Belongia EA, Naimi TS, Gale CM, et al. Antibiotic use and upper respiratory infections: a survey of knowledge, attitudes, and experience in Wisconsin and Minnesota. *Prev Med* 2002;34:346–52.
- 30 Gualano MR, Gili R, Scaiola G, et al. General population's knowledge and attitudes about antibiotics: a systematic review and meta-analysis. *Pharmacoepidemiol Drug Saf* 2015;24:2–10.
- 31 Agenzia Italiana del Farmaco (AIFA). Resistenza antimicrobica: AIFA al lavoro per fronteggiare una minaccia globale. <http://www.agenziafarmaco.gov.it/it/content/resistenza-antimicrobica-aifa-al-lavoro-fronteggiare-una-minaccia-globale> (15 July 2016, date last accessed).
- 32 Trepka MJ, Belongia EA, Chyou PH, et al. The effect of a community intervention trial on parental knowledge and awareness of antibiotic resistance and appropriate antibiotic use in children. *Pediatrics* 2001;107:E6.
- 33 Versporten A, Sharland M, Bielicki J, et al. The antibiotic resistance and prescribing in European Children project: a neonatal and pediatric antimicrobial web-based point prevalence survey in 73 hospitals worldwide. *Pediatr Infect Dis J* 2013;32:e242–53.
- 34 Lecky DM, Hawking MK, Verlander NQ, et al. Using interactive family science shows to improve public knowledge on antibiotic resistance: does it work?. *PLoS One* 2014;9:e104556.
- 35 Lecky DM, McNulty CA, Touboul P, et al. Evaluation of e-Bug, an educational pack, teaching about prudent antibiotic use and hygiene, in the Czech Republic, France and England. *J Antimicrob Chemother* 2010;65:2674–84.

- 36 Hoffmann K, Ristl R, Heschl L, et al. Antibiotics and their effects: what do patients know and what is their source of information?. *Eur J Public Health* 2014;24:502–7.
- 37 De Leeuw E, Hox J, Dillmann D. *International Handbook of Survey Methodology*. New York: Taylor & Francis Group. 2008.
- 38 Lovato E, Bert F, Bruno S, et al. Role of the Web on behaviors and health choices in six Italian cities: results of a multicenter study. *Ann Ig* 2011;23:283–94.
- 39 Scaioli G, Bert F, Galis V, et al. Pregnancy and internet: sociodemographic and geographic differences in e-health practice. Results from an Italian multicenter study. *Public Health* 2015;129:1258–66.