ScienSage

Journal of Advanced Scientific Research

Available online through http://www.sciensage.info

ISSN
0976-9595
Research Article

ATTITUDES AND AWARENESS ABOUT ANTIMICROBIALS USAGE AND RESISTANCE IN DELHI, INDIA

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ABSTRACT

Antimicrobial Resistance (AMR), as warned by WHO, is a worldwide threat to the public health which may lead to more than 10 million deaths by 2050. Among various factors responsible for AMR like irrational/misuse of antibiotics, easy access as over the counter medicine, one important factor is perception of general public about antibiotics and its use. The present study was undertaken to understand the attitude and awareness of consumers towards AMR and to evaluate the demographic patterns of various contributing factors. Questionnaire based survey was used to analyze the awareness towards AMR. Three sections of the questionnaire analyzed the attitude towards antimicrobial usage, awareness about AMR and use of antibiotics in agriculture. Out of 916 participants 79.25% were found to have good attitude towards antibiotic usage. Significant difference was noted in their attitude towards antibiotic usage and completion of antibiotic course with respect to gender, place of residence, and subjects studied. Over 70.96% participants took antibiotics only after prescription by the doctor. 72.27% participants had the awareness about AMR. Male participants studying science had significant knowledge about AMR. The awareness level towards the use of antibiotics in agriculture was low among participants and it differs with age and area of residence. Participants in our study have a good awareness and attitude towards use of antibiotics and AMR, still there is difference in awareness with gender, place of residence and subjects studied. Therefore, we need multi-directional approach to augment nationwide corrective measures and public awareness against AMR.

Keywords: Antibiotics, AMR (Anti-Microbial Resistance), Superbug, Antimicrobial usage

1. INTRODUCTION

Antibiotics are chemicals which are produced by various microorganisms to inhibit the growth of, or kill, other microorganisms [1]. First antibiotic Penicillin was discovered by Alexander Fleming 1928 from a contaminated culture plate [2]. In developing countries, due to increase in incidence of infectious diseases the antibiotics became one of the most frequently used drugs [3]. Due to poor prescribing practices such as misuse arising from the economic factors, health policies related to medical insurance, patient's expectations, illiteracy of patient and health care professionals, competitive/unethical pharmaceutical practices, antibiotic selling without a prescription [4], inadequate antibiotic dosage, broad-spectrum antibiotics usage [5], over-the-counter antibiotics availability [6], incomplete course of antibiotics [7], mistreatment of viral infections by antibiotics [8], the prevalence of self-medication [9], and over-medication and misuse/overuse in agriculture throughout the world led to development of resistance in many pathogenic organisms known as antimicrobial resistance (AMR) [10, 11]. This property of antibiotic resistance can be transferred between different groups of bacteria thus leading to AMR pandemic with serious health complications. In developing countries, additional factors like prior knowledge of antibiotics, age and monthly income etc. have been identified as cause of AMR spread [12, 13]. Around 10 million deaths have been caused worldwide due to AMR alone [14]. Therefore, World Health Organization (WHO) has declared AMR a top priority matter to be resolved by collective global action [15]. Antibiotic consumption increased 103% in India from the year 2000 to 2015 [16]. Various pathogens have developed AMR against

most of the available antibiotics and become untreatable. These pathogenic strains are known as "superbug" [17]. In 2008, a superbug strain of *Klebsiella pneumonia* was isolated from a Swedish patient in an Indian hospital known as NDM1 (New Delhi Metallo beta-lactamase 1) which was resistant to all the antibiotics [18].

To summarize, collaboration between different stake holders such as health authorities, health policy makers, health care providers, patients and caregivers is crucial to overcome AMR. Proper strategies need to be followed such as easy access to an affordable qualitative health care service, formation of national antibiotic policy, restriction of unlimited access to antimicrobial drugs with penalties and adoption of educational programs to aware consumers and health care providers about AMR. Community perception about antibiotics and its use is an important factor responsible for AMR. Thus, the objective of this study was to evaluate demographic patterns of various contributing factors affecting the attitudes and awareness about antimicrobials usage and AMR in Delhi, India.

2. METHODS

The present study aims to analyze the awareness status of the general public for use of antibiotics and antimicrobial resistance. A questionnaire was adopted from WHO global survey on AMR awareness for collection of data. All questions were multiple choices. A policy for using the collected data and protection of personal information was observed. The approval of the Ethics Committee for this study was not required because of the anonymous question survey.

2.1. Study participants

The investigator selected samples from students studying in different colleges having various educational backgrounds as well as persons working in pharmacy shops of rural and urban areas in Delhi, India. They used normative survey method to collect data for the present study. The survey participants selected were of 16-64 years of age.

2.2. Data collection

We collected data on sex (male and female), age (16-24 years and ≥25 years), education level (class12 or less, undergraduate and post-graduate), subject studied (science and non-science), area of residence (urban and rural) and profession (pharmacist and other profession). The AMR awareness status was analysed for each variable.

The questionnaire was divided into 3 parts to analyse the awareness status.

a) Attitude regarding antimicrobial usage- In this part the awareness of the participants were analysed on the basis of two criteria- (i) Use of antibiotics with prescription or not and (ii) Complete course of antibiotics was taken or not. The participants who have consumed antibiotics only after the prescription from doctor and completed their course are considered under good awareness status.

b) Awareness about Antimicrobial resistance (AMR) - The awareness was analysed on the basis of their knowledge regarding the various terms like AMR and Superbug. The participants who have knowledge about these terms related to antimicrobial resistance such as AMR, drug resistance and superbugs are considered under good awareness status.

c) Awareness of Agricultural use of antibiotics- The awareness of participants regarding antibiotic usage in agriculture was also analysed. The participants who knew that the antibiotics are used in agriculture had good awareness status.

2.3. Statistical Analysis

The data obtained was analysed using the R programming language software. Awareness status is reported as "Good Awareness" and "Poor Awareness" for all variables against demographic characters. The Chi Square test ($\chi 2$) was used to establish significant difference and p-values were calculated to check significant associations.

3. RESULTS

3.1. Demographic characteristics of Participants

Nine hundred ten individuals have participated in the survey. Gender, age, education, subject studied, area of residence and profession were considered in the study as demographic variables. Out of 916 participants, 432 (47.16%) were male and 484 (52.84%) were female. 796 (86.9%) participants were in 16-24 age group and 120 (13.1%) were above the age of 24 years. 174 (19%) were living in rural area whereas 742 (81%) in urban area. Participants have different education levels, 191 (20.85%) have education upto 12 class or less, 650 (70.96%) were graduate and 75 (8.19%) were post graduate. However, 793 (86.57%) of participants have studied science and 123 (13.43%) studied non-science subject. Out of 916 participants, 97 (10.59%) were pharmacists and 819 (89.41%) were involved in other professions (Table 1).

Table 1: Socio-demographic characteristics of the participants

S. No.	Characteristics	Frequency (N)	Percentage (%)
1	**Gender**		
	Male	432	47.16
	Female	484	52.84
2	**Age (Years)**		
	16-24	796	86.9
	25 and above	120	13.1
3	**Area of residence**		
	Rural	174	19
	Urban	742	81
4	**Education**		
	Class 12 grade or less	191	20.85
	Under Graduate	650	70.96
	Post Graduate	75	8.19
5	**Subject Studied**		
	Science	793	86.57
	Non-Science	123	13.43
6	**Profession**		
	Pharmacist	97	10.59
	Other profession	819	89.41
	Total	**916**	

3.2. Analysis of attitude about antibiotics usage among demographic variables

In this study, the awareness of participants regarding the use of antibiotics was analysed on the basis of their consumption of antibiotics after prescription from doctor or without prescription. Also, whether the respondent had taken full course of antibiotic or left in between is considered.

It was observed that79.25% of participants have good attitude towards the usage of antibiotic. However, overall attitude regarding use of antibiotic was found to be not significantly different among participants in different age groups, education levels and profession (p=0.3473, 0.9864, 0.7667) but a statistically significant difference was observed between gender, area of residence, and subject studied by participants and overall attitude regarding use of antibiotics. Male participants, living in urban area and studying science subject have good attitude regarding the use of antibiotics as compared to Female, rural and non-science participants (p=0.0171*, 0.0234*, 0.0028*).

When participants attitude was analysed towards the doctors prescribed antimicrobial usage, it was observed that over 70.96% participants usually take antibiotics only when prescribed by the doctor. However, no significant difference was observed between the doctors prescribed antimicrobial usage and various demographic variables (p=0.1276, 0.3703, 0.1159, 0.7476, 0.1200, 0.1061). Participants attitude regarding the completion of full course of antibiotics also varies among considered demographic variables. Approximately half participants (50.65%) have attitude to complete antibiotic course even when they have recovered from the illness. Male participants, participants living in urban area, belonging to age group (16-24 year), studied up to graduation and science subject, working in non- pharmacy profession were found to have good attitude regarding the completion of full course of doctors prescribed antibiotic as compared to that of female participants, participants living in rural area, belonging to age group 25 years and above, studied 12th/less or post-graduation, science subject, or worked as pharmacist (2.8284*10^(-7), 1.5467*10^(-20),0.01262*, 4.79*10 ^(-13),0.0001*, 8.613* 10^(-7)). These participants usually prefer to complete the full course of antibiotic than their counter part (Table 2).

3.3. Analysis of awareness about AMR among demographic variables:

The awareness of participants regarding the antimicrobial resistance (AMR) was analysed on the basis of their knowledge regarding the various terms like AMR (Antimicrobial resistance, Drug resistance) and Superbug using the same demographic variables. Overall awareness about AMR and superbug was observed 78.6% among participants. A significant difference was observed between AMR awareness level and gender, area of residence, education, subject and profession (p= 0.0017*, 3.594*10^(-11), 9.0930*10^(-23), 0.0014*, 0.01064*)of participants whereas, different age groups

have statistically insignificant difference in AMR awareness (p=0.3799). Male graduate participants living in urban areas, studying science subjects and working in non-pharmacy profession have more awareness about AMR compared to female participants living in rural area, studying upto 12/less or having post-graduation, with non-science subject or working as pharmacist. However, different age groups have no effect on AMR awareness status among participants.

Approximately, 72.27% and 39.52 % participants have knowledge about AMR and superbugs respectively. When AMR awareness was analysed among different variables, it was observed that males participants living in urban area, studied up to graduation and having science subjects or not working as pharmacist, have significant knowledge about AMR in comparison to females participants living in rural area, studied 12/less or post-graduation, with non -science subjects or working as pharmacist {p= 2.406*10^(-12), 2.0140* 10^(-37), 4.411*10^ (-9), 0.0008*, 7.4616* 10^(-5)}. Male Participants belonging to urban area and studied science subject showed more awareness regarding superbug as compared to the female participants living in rural area and studying non-science subject (0.0462*, 1.3747*10^(-5) ,2.2345*10^(-5)*). Age, education and profession was observed to have no effect on knowledge of superbugs (p=0.7755, 0.2904, 0.34 11367) (Table 3).

Table 2: Analysis of attitude about antibiotics usage among demographic variables

Variable	Doctors prescribe antimicrobial usage			Full Course of antibiotics taken			Total Awareness		
	Awareness Status, N (%)			Awareness Status, N (%)			Awareness Status, N (%)		
	Good	Poor	P value	Good	Poor	P value	Good	Poor	P value
Gender									
Male	317 (34.61)	115 (12.55)	0.1276	256 (27.95)	176 (19.21)	8.613 * 10^(-7)	357 (38.97)	75 (8.19)	0.0171*
Female	333 (36.35)	151 (16.48)		208 (22.71)	276 (30.13)		369 (40.28)	115 (12.55)	
Age									
16-24	569 (62.12)	227 (24.78)	0.3703	377 (41.16)	419 (45.74)	2.8284*10^(-7)	627 (68.45)	169 (18.45)	0.3473
25 and Above	81 (8.84)	39 (4.26)		87 (9.50)	33 (3.60)		99 (10.81)	21 (2.29)	
Area of residence									
Rural	115 (12.55)	59 (6.44)	0.1159	33 (3.60)	141 (15.39)	1.5467*10^(-20)	127 (13.86)	47 (5.13)	0.0234*
Urban	535 (58.41)	207 (22.60)		431 (47.05)	311 (33.95)		599 (65.39)	143 (15.61)	
Education									
Class 12 grade or less	120 (13.10)	44 (4.80)	0.7476	98 (10.70)	66 (7.21)	0.01262*	130 (14.19)	34 (3.71)	0.9864
Under Graduate	456 (49.78)	193 (21.07)		309 (33.73)	340 (37.12)		515 (56.22)	134 (14.62)	
Post Graduate	74 (8.08)	29 (3.17)		57 (6.22)	46 (5.02)		81 (8.84)	22 (2.40)	
Subject studied									
Science	570 (62.23)	223 (24.34)	0.1200	439 (47.93)	354 (38.65)	4.79*10^(-13)	641 (69.98)	152 (16.59)	0.0028*
Non-Science	80 (8.73)	43 (4.69)		25 (2.73)	98 (10.70)		85 (9.28)	38 (4.15)	
Profession									
Pharmacist	62 (6.77)	35 (3.82)	0.1061	67 (7.31)	30 (3.28)	0.0001*	78 (8.52)	19 (2.07)	0.7667
Other profession	588 (64.19)	231 (25.22)		397 (43.34)	422 (46.07)		648 (70.74)	171 (18.67)	

Table 3: Analysis of awareness about AMR among demographic variables

S. No	Variable	Knowledge about AMR			Knowledge about Superbug			Total Awareness		
		Awareness Status, N (%)			Awareness Status, N (%)			Awareness Status, N (%)		
		Good	Poor	P value	Good	Poor	P value	Good	Poor	P value
1	**Gender**									
	Male	339 (37.01)	93 (10.15)	$7.4616*10^{-5}$	156 (17.03)	276 (30.13)	0.0462*	359 (39.19)	73 (7.96)	0.0017*
	Female	323 (35.26)	161 (17.58)		206 (22.49)	278 (30.35)		361 (39.41)	123 (13.42)	
2	**Age**									
	16-24	569 (62.12)	227 (24.78)	0.1698	316 (34.50)	480 (52.40)	0.7755	622 (67.90)	174 (18.99)	0.3799
	25 and above	93 (10.15)	27 (2.95)		46 (5.02)	74 (8.08)		98 (10.69)	22 (2.40)	
3	**Area of residence**									
	Rural	163 (17.79)	11 (1.20)	$2.406*10^{-12}$	94 (10.26)	80 (8.73)	$1.3747*10^{-5}$	169 (18.44)	5 (0.545)	$3.594*10^{-11}$
	Urban	499 (54.48)	243 (26.53)		268 (29.26)	474 (51.75)		551 (60.15)	191 (20.85)	
4	**Education**									
	Class 12 grade or less	51 (5.57)	113 (12.34)	$2.0140*10^{-37}$	59 (6.44)	105 (11.46)	0.2904	81 (8.84)	83 (9.06)	$9.0930*10^{-23}$
	Under Graduate	527 (57.53)	122 (13.32)		256 (27.95)	393 (42.90)		550 (60.04)	99 (10.8)	
	Post Graduate	84 (9.17)	19 (2.07)		47 (5.13)	56 (6.11)		89 (9.71)	14 (1.52)	
5	**Subject studied**									
	Science	546 (59.61)	247 (26.97)	$4.411*10^{9}$	292 (31.88)	501 (54.69)	$2.2345*10^{-5}$	601 (65.61)	92 (10.04)	0.0014*
	Non -Science	116 (12.66)	7 (0.76)		70 (7.64)	53 (5.79)		119 (12.99)	4 (0.44)	
6	**Profession**									
	Pharmacist	84 (9.17)	13 (1.42)	0.0008*	34 (3.71)	63 (6.88)	0.3411367	86 (9.38)	11 (1.2)	0.01064*
	Other profession	578 (63.10)	241 (26.31)		328 (35.81)	491 (53.60)		634 (69.21)	185 (20.19)	

3.4. Analysis of awareness about antibiotic usage in agriculture

Antibiotics are use in the food producing organisms to increase the production of food and to protect them from infection. Through food, these antibiotics are consumed by the consumer unintentionally and thus, producing ill-effects on consumer's health. Therefore, in the present study we evaluated the awareness of participants about the antibiotics usage in agriculture. More than half of the participants (55.1%) were aware about the use of antibiotics in agriculture and it varied among different age groups and place of residence of the participants. Participants living in urban areas and in the age group (16-24) years have statistically significant difference in awareness regarding the use of antibiotics in agriculture (p= 0.00641*, 0.0285*) in comparison to participants of age group 25 years and above and living in rural area. However, other demographic variables (Gender, education, subject and profession) showed no significant difference in awareness regarding antibiotics usage in agriculture (p=0.43751, 0.6114, 0.5343, 0.5859). Male as well as Female, participants having different education level, studying science/ non-science subject or working as pharmacist/in other profession have similar level of awareness about of use of antibiotics in agriculture (Table 4).

When attitude about the antimicrobial usage, awareness regarding AMR and awareness about antibiotics usage in agriculture was analysed among male and female participants, it was observed that attitude of male and female participants towards the antimicrobial usage, AMR awareness and antibiotics usage awareness in agriculture was not affected by various demographic variable. However, Male and female have significant high level of awareness towards the antimicrobial usage, AMR awareness and antibiotics usage awareness in agriculture (p=2.20*10^(-16),2.12*10^(-16))(Table 5).

Table 4: Analysis of awareness about antibiotic usage in agriculture

S. No	Variable	Antibiotics usage in Agriculture Awareness Status, N (%)		
		Good	Poor	P value
1	**Gender**			
	Male	244 (26.64)	188 (20.52)	0.43751
	Female	261 (28.49)	223 (24.34)	
2	**Age**			
	16-24	425 (46.4)	371 (40.50)	0.00641*
	25 and above	80 (8.73)	40 (4.37)	
3	**Area of residence**			
	Rural	83 (9.06)	91 (9.93)	0.0285*
	Urban	422 (46.07)	320 (34.93)	
4	**Education**			
	Class 12 grade or less	96 (10.48)	68 (7.42)	0.6114
	Under Graduate	354 (38.65)	295 (32.21)	
	Post Graduate	55 (6.00)	48 (5.24)	
5	**Subject studied**			
	Science	434 (47.38)	359 (39.19)	0.5343
	Non-Science	71 (7.75)	52 (5.68)	
6	**Profession**			
	Pharmacist	56 (6.11)	41 (4.48)	0.5859
	Other profession	449 (49.02)	370 (40.39)	

Table 5: Gender perspective of AMR Awareness (based on other demographic characteristics)

S. No.	Variable	Male			Female		
		Awareness Status, N (%)			Awareness Status, N (%)		
		Good	Poor	P value	Good	Poor	P value
1	**Age**						
	16-24	313 (34.17)	10 (1.09)	0.4884	458 (50)	15 (1.64)	0.5485
	25 and above	107 (11.68)	2 (0.22)		11 (1.2)	0 (0)	
2	**Area**						
	Rural	3 (0.32)	0 (0)	0.7689	169 (18.45)	2 (0.22)	0.0702
	Urban	417 (45.52)	12 (1.31)		300 (32.75)	13 (1.42)	

3	**Education**						
	Class 12 grade or less	45 (4.91)	2 (0.22)		110 (12.01)	7 (0.76)	
	Under Graduate	330 (36.03)	9 (0.98)	0.7941	303 (33.08)	7 (0.76)	0.1157
	Post Graduate	45 (4.91)	1 (0.11)		56 (6.11)	1 (0.11)	
4	**Subject**						
	Science	392 (42.79)	12 (1.31)	0.355	374 (40.81)	15 (1.64)	0.0518
	Non-Science	28 (3.05)	0 (0)		95 (10.37)	0 (0)	
5	**Working field**						
	Pharmacist	83 (9.06)	2 (0.21)	0.7903	12 (1.31)	0 (0)	0.5304
	Other profession	337 (36.79)	10 (1.09)		457 (49.89)	15 (1.64)	
	Total Awareness	420 (45.85)	12 (1.31)	2.20*10^(-16)	469 (51.20)	15 (1.64)	2.12*10^(-16)

4. DISCUSSION

Antibiotics have transformed the medical practices and given life to millions of people. The misuse of antibiotics, lack of discovery of new antibiotic and less public awareness about the use of antibiotics are the main factors which contributes towards rise in the AMR among the people [19]. In 2015, World Health Organization started a global campaign to give various guidelines to increase public awareness about AMR and encourage the prudent use of antimicrobials [15]. These guidelines include use of antibiotic only when prescribed by physician and the patient should always complete the full course of antibiotics [15]. Factors associated with antibiotic use, resistance and safety have been well recognized worldwide in the literature. India has been referred to as 'the AMR capital of the world' [20]. Nevertheless, only a few studies on public awareness and attitude about AMR have been reported in India. Therefore, the present study was conducted to analyse the attitude about antibiotics usage, knowledge of AMR and awareness about use of antibiotics in the agriculture among the north Indian population.

4.1. Attitude about the usage of antibiotics

In our study participants showed good attitude towards antimicrobial usage (79.2%). When attitude towards antimicrobial usage was analysed among different variables, it was observed that age, education level and profession of participants have no effect on their attitude regarding the use of antibiotics (p=0.3473, 0.9864, 0.7667). Voidăzan *et al* (2019) reported that young population of age group 18-34years and 35-49 years showed positive attitude for antibiotic usage which is in contrast to our observation [21]. A significant positive correlation was found between the education level and attitude towards the usage of antibiotics in various studies conducted in Jeddah, Malaysia, Lithuania, Italy, Hong Kong and Poland. According to these studies the participants who have studied up to graduation and above showed a positive attitude towards the usage of antibiotics. This was not in line with our observation as we found no significant difference between education level and attitude regarding usage of antibiotics [22-25]. Similarly, we did not observe any significant difference between participant working in pharma and other profession. However, poor attitude about the usage of antibiotics was observed among students studying pharma [26] although these students possess good knowledge about use of antibiotics. A Malaysia based studied showed a significant difference between respondents working in healthcare sector to that of other profession [27].

In our study, gender, area of residence, and subject studied by participants produced a significant effect regarding the usage of antibiotics (p=0.0171*, 0.0234*, 0.0028*). We observed that male participants have positive attitude about the antibiotic usage in comparison to the female participants which is in contrast to previous studies which stated that female respondents showed more positive attitude towards the usage of antibiotic [28, 29]. However, the participants living in urban area have more positive attitude towards the usage of antibiotics [21] which is similar to our finding. Science students showed a positive attitude for antibiotic usage in our study which is in line with previous studies. Medical students have more positive attitude towards the usage of antibiotics as compared to the non-medical students [30-33]. Medical students of Jorden, UAE, Nepal and India are found to have positive attitude about the usage of antibiotics.

The response was analysed regarding the use of antibiotics only by prescription of doctor. It was also observed that over 70.96% participants usually preferred to take antibiotics only after taking prescription from the doctor. Similarly, in a previous study, 73.4% of the participants took antibiotics conforming to the instructions on the label[29]. This was

consistent with the study conducted on the Romanian patients where approximately 65.9% of participants have taken permission form from their physician before taking the medication [21]. However, in another study, 64.5% of the respondents have used antibiotics without a doctor's prescription [34].Our study showed that 50.65% participants have completed the course of antibiotic even when the symptoms start getting improved. A study conducted on Nigerian study depicted that 42.2% of students always complete the dose as prescribed by physicians [34]. It was nearly comparable to the study conducted on Saudi Arabia population where 50.9% of respondents answered that they preferred to stop the antibiotic usage when they start feeling better [29].

To summarize, the variations which we observed in attitude about the usage of antibiotics in the participants might be due to the variation in knowledge of participants about antibiotics as it was noted that antibiotic knowledge and attitude was significantly related to each other [29]. Secondly, variation might be due to the difference in the questions considered for evaluation of attitude in different studies.

4.2. Awareness about AMR

Overall awareness about AMR was observed 78.6% among participants. Participants gender, area of residence, education, subject and working field showed significant difference about AMR awareness (p= 0.0017*, 3.594*10^(-11), 9.0930*10^(-23), 0.0014*, 0.01064*) whereas, age of the participants did not produce any significant effect on AMR awareness level (p=0.3799). As we have considered different questions for the evaluation of awareness about AMR and due the unavailability of previous data, we are discussing these questions separately.

4.2.1. Knowledge about AMR

Approximately, 72.27% participants showed good knowledge about AMR. This is in line with the study conducted on Romanian and American people which stated a high level of knowledge about antimicrobial resistance *i.e.* 85.14% and 70% among Romanian and American people respectively [21, 35]. This study also outlined a positive relationship between the knowledge about AMR to that of education, place of residence and age groups. These findings are in accordance with our observation, as significant difference in knowledge about AMR was found between the rural/urban, 12 or low class/graduation, male/female, pharmacist/other profession participants. People living in urban area, studied up to graduation level have more knowledge about AMR in comparison to their counterpart. However, we did not observe any difference in knowledge of AMR between different age groups which was in contrast to the reported study which defined more knowledge about AMR among young population [21]. Similarly, education level, age were positively associated with awareness about AMR [36].

4.2.2. Knowledge about Superbug

Low level of knowledge was observed among participants about superbugs (39.52 %). A low knowledge about superbugs (8%) was reported in a study conducted on Nigerian general population. However, 50% of the Americans were found to be aware about the superbugs. Gender, place of residence, and subject studied showed difference in level of knowledge regarding superbug (0.0462*, 1.3747*10^(-5), 2.2345*10^(-5)*). However, no effect on knowledge of superbugs was observed among different age groups, education level and profession (p=0.7755, 0.2904, 0.3411367).Due to the unavailability of previous studies we were not able to draw any conclusion about the variation in knowledge/awareness of superbug among the considered variable.

4.3. Awareness about antibiotic usage in agriculture

Antibiotics have been used in agriculture for control and treatment of infections, for improvement in growth and for increasing the food efficacy. Due to the misuse of antibiotics in agriculture, the resistance is increasing in the agriculture products and it is passed on to its consumers. The rise in AMR produces ill-effects on health which includes delay or failure of treatment, limited availability of antibiotics to treat a disease [37]. So, AMR awareness of general population is important for the proper use of antibiotics in agriculture. In our study, it was observed that 55.1% participants were aware about the use of antibiotics in agriculture. When awareness status was analysed among different variables, it was observed that age and place of residence have positive effect (p= 0.00641*, 0.0285*) on awareness regarding the use of antibiotics in agriculture in comparison to the gender, education, subject studied and profession (p=0.43751, 0.6114, 0.5343, 0.5859). A study conducted on Turkey farmers stated that overall farmers have low level of knowledge about the use of antibiotics. A significant difference was observed

between participant's level of education, place of residence and age. Participants with a low education level, residing in rural areas and of older age have low level of knowledge of antibiotic use in agriculture. This is in line with the observed results in our study [38]. The difference in the observation might be due to the limited data available on antimicrobial utilization in farming and evaluation of different population set.

4.4. Limitations

These data are subject to several limitations. Firstly, the study was conducted in Delhi which limits the generalization of the results on a national scale. Secondly, the self-administered questionnaire has self-reported data which may lead to non-response bias, recall bias and social desirability bias. Thirdly, pharmacists as front-line practitioners can educate the patients but in developing countries like India medicine dispensers are the pharmacy assistants and not pharmacists. Fourthly, factors like poverty, insecure income or lack of access to healthcare can influence attitude towards AMR preventive measures.

5. CONCLUSION

Our findings revealed good awareness and attitude towards AMR in participants. Therefore, AMR based health education measures may be helpful and necessary for better preparedness against AMR. India has used media to create AMR awareness among the public and its effect on college going students is significant. As media dialogues help in construction of risk by providing the definition and language that people will use to make assessment of risks and validating some facts while ignoring others. Therefore, health education and communication research is the need of the hour to counter the global threat of AMR To summarize, a multi-sectoral and multidisciplinary approach with combined efforts of government and non-government organizations is required to tackle this problem.

6. ACKNOWLEDGEMENT

We would like to acknowledge under-graduate students of Institute of Home Economics and Department of Statistics, University of Delhi, Delhi, India and Hindu Girls College, Sonipat, Haryana, India for their participation in the study.

Conflict of interest statement

The authors declare that they have no conflicts of interest.

7. REFERENCES

1. Van der Meij A, Worsley SF, Hutchings MI, van Wezel GP. *FEMS Microbiol Rev*., 2017; **41(3)**:392-416.
2. Fleming A.*Influenza Br J Exp Pathol.* 1929; **10(3)**:226-236.
3. Gebeyehu E, Bantie L, Azage M. *PloS One,* 2015; **10 (9):**e0138179.
4. Al-Azzam SI, Al-Husein BA, Alzoubi F, Masadeh MM, Al-Horani MA. *Int J Occup Med Environ Health*, 2007; **20(4):**373-380.
5. Ochoa C, Eiros JM, Inglada L, Vallano A, Guerra L. *J Infect*, 2000; **41(1)**:73-83.
6. Yagupsky P.*Pediatr Infect Dis J*., 2006; **25(10)**:974-976.
7. Pechère JC.*Clin Infect Dis.*2001; **33(3)**:S170-S173.
8. Kutty N.*Oman Med J.* 2011; **26(5)**:303-305.
9. Parimi N, Pinto Pereira LM, Prabhakar P.*BMC Fam Pract,* 2004; **5**:28.
10. Machado-Alba JE, Echeverri-Cataño LF, Londoño-Builes MJ, Moreno-Gutiérrez PA, Ochoa-Orozco SA, Ruiz-Villa JO. *Biomedica,* 2014; **34(4)**:580-588.
11. Tangcharoensathien V, Chanvatik S, Lekagul A*Bull World Health Organ World Health Organ,* 2018; **96**:141-144.
12. Ocan M, Bwanga F, Bbosa GS, Bagenda D, et al. *PloS One*. 2014; **9(3)**:e92323.
13. Pan H, Cui B, Zhang D, Farrar J, Law F, Ba-Thein W. *PLoS One,* 2012; **7(7)**:e41314.
14. de Kraker ME, Stewardson AJ, Harbarth S. *PLoS Med.,* 2016; **13(11)**:e1002184.
15. WHO Global action plan on AMR. 2016. https://www.who.int/antimicrobial-resistance/global-action-plan/en/. Accessed 31 Jan 2019
16. Klein EY, Van Boeckel TP, Martinez EM, et al. *PNAS,* 2018; **115(15)**:E3463-E3470.
17. Pittalis S, Ferarro F, Puro V. *Infez Med*., 2011; **19(4)**:224-234.
18. Yong D, Toleman MA, Giske CG, et al. *Antimicrob Agents Chemother*., 2009; **53(12)**:5046-5054.
19. Ventola CL. *PT,* 2015; **40(4)**:277-283.
20. Chaudhry D, Tomar P. *Int J Community Med Public Health,* 2017; **14**:2632-2636.
21. Voidăzan S, Moldovan G, Voidăzan L, Zazgyva A, Moldovan H. *Infect Drug Resist*., 2019; **12**:3385-3396.
22. Bahlas R, Ramadan I, Bahlas A et al. *Life Sci J*., 2016; **13(1)**:56-64.

23. Pavydė E, Veikutis V, Mačiulienė A, Mačiulis V, Petrikonis K, Stankevičius E. *Int J Environ Res Public Health*. 2015; **12(6)**:7002-7016.
24. Napolitano F, Izzo MT, Di Giuseppe G, Angelillo IF. *PloS One* 2013; **8(12)**:e84177.
25. Mazińska B, Strużycka I, Hryniewicz W. *PloS One* 2017; **12(2)**:e0172146.
26. Ahmad A, Khan MU, Patel I, Maharaj S, Pandey S, Dhingra S. *J Res Pharm Pract.*, 2015; **4(1)**:37-41.
27. Qamar M, Abdullah NS,Khan J, Mahmud A, Ahmad A.*UK J Pharm Biosci,* 2014; **2(6)**:60-66.
28. You JH, Yau B, Choi KC, Chau CT, Huang QR, Lee SS. *Infection.*, 2008; **36(2)**:153-157.
29. Alqarni SA, Abdulbari M. *Saudi Pharm J.*, 2019; **27 (1)**:106-111.
30. Suaifan G, Shehadeh M, Darwish D, Al-Ije H, Darwish R. *Afr J Pharm Pharmacol.*, 2012; **6(10)**:763-7706.
31. Jairoun A, Hassan N, Ali A, Jairoun O, Shahwan M. *BMC Public Health,* 2019; **19(1)**:518.
32. Gupta MK, Vohra C, Raghav P.*J Family Med Prim Care,* 2019; **8(9)**:2864-2869.
33. Shah P, Shrestha R, Mao Z et al. *Int J Environ Res Public Health,* 2019; **16(20)**:3996.
34. Ayepola OO, Onile-Ere OA, Shodeko OE, Akinsiku FA, Ani PE, Egwari L. *Data Brief*, 2018; **19**:2084-2094.
35. Muñana C. Data Note: Public Awareness Around Antibiotic Resistance Published: Jun 21, 2019 https://www.kff.org/other/issue-brief/data-note-public-awareness-antibiotic-resistance/view/footnotes/
36. Ha TV, Nguyen AT, Thi Nguyen HS.*BioMed Res Int* 2019, Article ID 9398536, 8 pages https://doi.org/10.1155/2019/9398536
37. Manyi-Loh C, Mamphweli S, Meyer E, Okoh A. *Molecules*, 2018; **23(4):**795.
38. Ozturk Y, Celik S, Sahin E, Acik MN, Cetinkaya B. *Animals (Basel).*, 2019; **9(9):**653.