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Cross-Sectional Survey of Sausage Consumers in Algeria: Prevalence and Risk Factors for Development of Food-Borne Illnesses and Antibiotic Use Behavior

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ABSTRACT

This cross-sectional questionnaire study was designed to determine the prevalence of food-borne illnesses and potential risk factors among Algerian sausage consumers, and to assess antibiotics use behavior among sick consumers. From August, 2018 to June, 2019, a total of 800 structured questionnaires were distributed randomly to sausage consumers from ten (10) departments of Algiers, Algeria. The data collected were analyzed with different statistical approaches. The results showed that out of the 384 sausage consumers surveyed, 22.39% reported having food-borne illnesses after sausage consumption, with 8.14% of sick consumers hospitalized. The prevalence of foodborne illnesses among sausage consumers was significantly higher among males (25.69%) than females (21.09%) (OR=1.36), and also significantly higher (p<0.01) among consumers without children (24.54%) than among those who had children (17.12%). Sausage consumers who were immuno-deficient had the highest frequency of being sick, 41.38% (OR=3.62, p<0.0001), followed in descending order by consumers who had children, 34.85% (OR=1.9, p=0.01), and pregnant consumers, 28.12% (OR=1.56, p=0.03). For antibiotic use behavior, out of 86 sick consumers, 59.3% had self-medicated on antibiotics, and 17.44% had interrupted the antibiotics treatment. This study provides for the first-time information about baseline of the attitude and behavior regarding antibiotic use among Algerian sausage consumers who developed food-borne illness. Thus, it can be concluded that raw sausage must be consumed with precaution for vulnerable groups at risk. Public education programs should be developed to target misconceptions of antibiotics use and vulnerable groups at risk.

KEYWORDS: Antibiotics-use, consumers, foodborne, risk factors, sausages, Algeria

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1. INTRODUCTION

The human population is projected to increase to 9.7 billion by 2050 according to United Nations population projections (FAO, 2019). This situation will trigger an increase in global food consumption emphasizing the more importance of food safety from "farm to fork". However, when pathogens contaminate food, they can cause food-borne illnesses, often called "food poisoning". Aside bacteria pathogens, there is a wide range of viruses that have been linked to food-borne poisoning (Iturriza-Gomara and O'Brien, 2016). Norovirus is the most commonly cause of non-bacterial gastroenteritis (Somura et al., 2019).

Food poisoning is an infection resulting from the ingestion of food contaminated by certain infectious agents or their toxins (Kassahun and Wongiel, 2019). When an outbreak of food poisoning outbreak is resulting from the ingestion of a common food of two or more cases of a similar food-borne disease, it is called toxi infection alimentare collective (TIAC) or "collective food poisoning", which can cause rapid symptoms such as nausea, vomiting and diarrhea but also long-term illnesses such as renal or hepatic insufficiency, cancer and cerebral or nervous disorders (Hernández-Cortez et al., 2017). While the burden of food-borne illness is a global public health problem, the WHO regions of Africa have the highest incidence and mortality rates, especially children under five years of age, with more than 91 million affected each year and 137,000 deaths (FAO, 2019). These infections are more serious in children, pregnant women, elderly and immunodeficient individuals and diarrhea illnesses remain the leading cause of death, especially among children in resource poor developing countries (Odeyemi and Sani, 2016). Children who survive some of the most serious food-borne illnesses may have delayed physical and mental development, with adverse consequences on their quality of life.

In Algeria, more than 15,233 cases of food-borne illnesses with hospitalization and 16 deaths were reported between 2016 and 2017. Moreover, 14 regions had more than 200 cases during year 2017 (Allioua et al., 2021). Recently, there has been a renewed interest in food safety consumers to typical food such as "Merguez", a North African raw sausage widely consumed in Algeria (Hachemi et al., 2019), and made in non-industrial environment, characterized by small scale batch production (Conter et al., 2008), which is favorable to pathogen growth (Ed-Dra et al., 2018).

Antibiotics, commonly used in modern medical practices, are the most frequently prescribed drugs, which have saved hundreds of millions of people over the past century (Liu et al., 2019). Unfortunately, patients often have misconceptions about the benefits of antibiotic treatment for food-borne poisoning (Saengcharoen et al., 2012) including viral and toxin-producing bacteria forms, and often engage in inappropriate antibiotic use, including misuse, dose skipping and self-medication. Therefore, over-prescription of antibiotics is widespread worldwide, with up to 50% of unnecessary antibiotic prescriptions occurring in ambulatory settings (Liu et al., 2019). Thus, prudent antibiotics use is essential for preserving their clinical effectiveness, while reduction of unnecessary use will decrease the complexity of antibiotic resistance (El Sherbiny et al., 2019), reduce the length of hospital stay and lower healthcare resource utilization (Sutthiruk et al., 2018).

This situation has been complicated by the emergence of new forms of antibiotic resistance and multidrug-resistant strains, which cause 700,000 deaths annually, from high therapeutic failures, occasioned by the increased use of antibiotics in human medicine and veterinary practice, with multiple routes of transmission to humans, including food of animal origin and in particular meat (Kassahun and Wongiel., 2019). Predictive statistics estimate that by 2050, more than 10 million people would die every year because of antimicrobial resistance, surpassing cancer as a leading cause of death. Evidence of inappropriate antibiotic prescribing are found in all countries (Kaae et al., 2019) of the world but the situation in developing countries is more critical because of the widespread availability of antibiotics and prescription without medical authorization (El Sherbiny et al., 2019), which make treatment ineffective.

Studies on antibiotic use and prescription in the North-African countries are relatively sparse in the literature (Kaae et al., 2019). In Algeria, information on red meat consumption in general and 'Merguez' sausage in particular are needed for target interventions in the future (Hachemi et al., 2019). However, to our knowledge, many relevant aspects of antibiotic use for food-borne illnesses and the health-seeking behavior of consumers of 'Merguez' sausage who become ill remain largely undocumented in Algeria. This study was therefore designed to determine the prevalence of and potential risk factors associated with food-borne gastrointestinal illnesses among consumers of sausage, and to assess the antibiotics use behavior in targeted sick or hospitalized consumers.

2. MATERIALS AND METHODS

2.1. Study location and design

This study was a cross-sectional survey of a total of 261 butcheries from 10 departmental areas (Figure 1) with 50 municipalities of Algiers, the capital of Algeria, which include; Bab El Oued, Beraki, Bir Mourad Rais, Cheraga, Dar El Beida, Draria, El Harrach, Hussein Dey, Rouiba, and Zeralda. The study was based on self-administered questionnaires, conducted between June, 2018 and April,

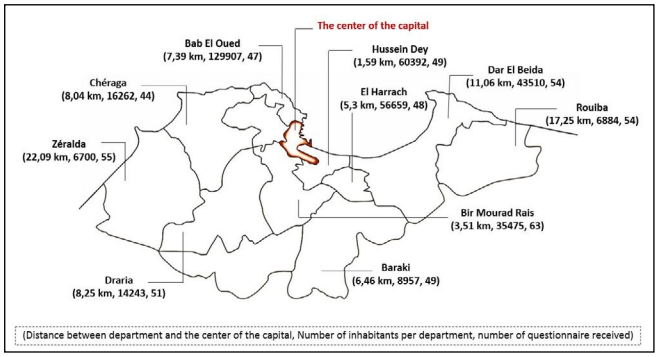

Figure 1: Map of Algiers showing location of the ten departments of questionnaires distribution

2019. A total of 800 structured questionnaires were administered to randomly selected Algerian meat consumers from the selected departmental areas.

2.2. Ethical approval

The present study did not involve any invasive procedure, and hence, ethical approval was not required, but informed consent was obtained from each participant.

2.3. Data collection tool and administration

The data collection tool was a structured questionnaire containing close-ended questions used to collect information on various aspects of sausage consumption, divided into three categories. Subjects invited to participate in the study were consumers who had purchased meat at the butcheries where traditional sausages were usually sold. The questionnaire was self-administered. However, consumers were assisted by the researcher if requested. The average time to complete the survey was 15 minutes.

The first category of the questionnaire contained questions regarding the socio-demographic characteristics (age, gender, place of purchase, with/without children, living/not living with family, and level of educational studies). The second category contained information on consumption and potential risk factors (young, old, pregnancy and immunodeficiency) for gastrointestinal infection. The third category contained information on sick or hospitalized consumers and their relationship with the occurrence of gastrointestinal symptoms following sausage consumption. The last category contained information on antibiotic use behavior following gastrointestinal symptoms including reasons for consultation, antibiotics prescription and interruption of antibiotherapy among the sick and hospitalized consumers. The questionnaire was pretested, modified, and refined before the commencement of the study.

2.4. Statistical analysis

Data were analyzed using IBM SPSS statistical software version 20.0 (IBM, USA) for Windows with descriptive statistics. Chi-square test and odds ratio (OR) was in the univariable logistic model to analyze potential risk factors and their relation to the independent variables with OR>1. All analyses were carried out at 95% confidence level, and significance level for homogeneity was fixed at $p<0.05$.

3. RESULTS AND DISCUSSION

Foods made with traditional raw materials using ingrained production methods have become more popular because of the increasing homogenization of food, which is contributing to the progressive loss of the cultural identity of people. Among these food products made from meat, sausage is perceived by consumers as closely linked to traditions (Conter et al., 2008). Artisanal sausage or "Merguez" is a North African specialty regarded as the most popular variety of meat products broadly consumed despite the fact that it is very favorable to pathogen growth mainly due to its richness in nutriments (Ed-Dra et al., 2017). Moreover, each year around the world, 48 million people get sick from a food-borne illness, 128,000 get hospitalized, and 3,000 die (Kassahun and Wongiel, 2019). Our cross-sectional questionnaire study was designed to determine the prevalence of food-borne illnesses and secondly investigate the potential risk factors among Algerian sausage consumers.

3.1. Socio-demographic characteristics of sausage consumers

There were 445 respondent meat consumers, out of the 800 questionnaires administered, giving a response rate of 55.62%. The distribution of sausage consumers and their characteristics are shown in the following figure 2.

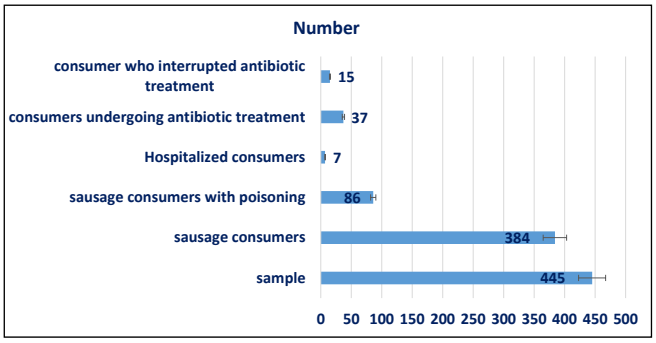

Figure 2: Distribution of sausage consumers and their characteristics

The frequency of sausage consumption among the respondents was 86.29% (384 out of 445). Among this category, a total of 86 consumers were poisoned, 52 of whom were hospitalized after consuming sausage, and 37 were undergoing an antibiotic medication.

Our results showed the highest prevalence of sausage consumption among meat consumers who responded to the questionnaire survey. Our data are in agreement with those obtained previously in the same country (Hachemi et al., 2019). With respect to the prevalence of

food-borne illnesses in our survey, 19.32% of the sausage consumers had features of food-poisoning and 8.14% of sick consumers were hospitalized. A less consistent rate was recorded in the United States through a work carried out previously by Danielle et al. (2019) revealed that 25,606 got sick after infections of food origin, 5,893 were hospitalized and 120 died in 2018. A situation that may be due to the multiple origin of contamination, concerning sausage poisoning including animal origin, lack of hygiene or cross-contamination due to insufficient hygienic and sanitary practices (Gounadaki et al., 2008, Gutierrez et al., 2012, Sergelidis and Angelidis, 2017). More specifically, the quality of sausage is mainly influenced by bacterial contamination of carcasses often linked to the intestinal contents contamination during slaughter (Khanal and Poudel, 2017). Thus, the poor quality of sausage manufacturing practices (Simon and Sanjeev, 2007) such as processing, storage, handling, poor personal hygiene and uncontrolled sanitary conditions in the food industries. Furthermore, butchers have a huge role in prevention of meat-borne diseases.

In a cross-sectional survey conducted by Khanal and Poudel (2017) in Nepal to ascertain factors associated with meat hygiene among the butchers, the study showed that despite regular handling of the meat, the butchers lacked knowledge and practices in terms of meat hygiene. Similar results were obtained in other works in Kenya (Chepkemoi et al., 2015), and Ethiopia (Garedew et al., 2015), which revealed that none of the meat handlers or butchers had any formal training on meat handling hygiene. Also, one of the factors that should not be underestimated and can explain the high prevalence of food poisoning due to Merguez is the poor storage habits including the transport time (more than 2 hours after purchase); methods of storing sausages at home, before and during consumption; and the fact that consumers freeze the sausage (Hachemi et al., 2019).

According to the following table, the frequency of sausage consumption was high among adult respondents aged 18–40 years (87.72%), consumers who live with their families (87.82%), and those with professional status (87.6%) (Table 1).

3.1. Socio-demographic variables associated with sausage consumption

Table 2 shows the socio-demographic variables associated with foodborne illnesses after sausage consumption. The frequency of foodborne illnesses among sausage consumers was significantly higher among males (25.69%) than females (21.09%) [OR=1.36], and among consumers who had no children (24.54%) than among those with children (17.12%) ($p< 0.0154$). Our data also demonstrated that consumers living with their families (23.55%) were more affected and more likely to get food-borne diseases after sausage consumption than those living alone (17.57%) [OR=1.65].

Our survey included a total of 261 butchers from ten departments of Algiers, the capital of Algeria, with departments of Zeralda, Dar El Beida, El Harrach, Hussein Dey, Draria and Rouiba that having higher frequencies of sick consumers. This can be explained by the distance between these departments and the capital. More precisely, Zeralda, Dar El Beida, Draria and Rouiba are located far from the Center of Algiers. Therefore, there is less rigorous control. However, the high rate of food poisoning registered in the departments of El Harrach and Hussein Dey can be directly related to high agglomeration. Also, a hypothesis advanced is that these two departments have meat supply services with the two largest slaughterhouses of cattle and sheep.

Regarding the risk factors analysis, our results agree with those obtained before (Hachemi et al., 2019) showing that consumers who belong to the age category between 18 to 40 years were most affected by food poisoning. For gender variable, men consumers reported having a food-borne poisoning after Merguez consumption against more women consumers and they were more likely to get sick than women. This observation is the same as that observed in the investigation previously established. In the survey conducted by in Ethiopia, a total of 35 cases of non-fatal food poisoning were included. Among risk factors recorded, males (OR=3.57; 95%; CI=1.37–9.32) were significantly associated with food poisoning. The higher rate among males can be explained by the fact that the Algerian men tend to eat more sausage than women. This specificity in males is associated with masculinity and power as explained (Rozin et al., 2012). Thus, to emphasize that the Algerian man eats more outside this is still a risk factor.

In this study, consumers who live with their families were more likely to have food-borne illness than those living alone. Similar results have been obtained before (Hachemi et al., 2019) and may suggest again that handling during preparation is one of the main causes of food-borne poisoning (Chepkemoi et al., 2015). For consumers with or without children, respondents which had children were more affected and more likely to get food-borne diseases after sausage consumption, perhaps due to a possible negligence from mothers, consequence of a greater workload. Otherwise, consumers with high-level studies were more affected and more likely to contract food-borne illness after eating sausage. Rozin et al. (2012) had already shown that highly educated persons have less serious healthcare concerns than those with lower levels of education (Radulescu and Cetina, 2011).

Table 1: Socio-demographic characteristics of sausage consumers

Variables	No. of sausage consumers n (%)	*p*-value (logistic regression)	Odds ratio	CI (95%)
Age group (years)				
18–40 (n=342)	300 (87.72%)	0.0388*	1.61	0.84–3.01
41–65 (n=103)	84 (81.55%)			
Gender				
Male (n=128)	109 (85.16%)	0.7337	0.88	0.47–1.67
Female (n=317)	275 (86.75%)			
Residence				
Live with family (n=353)	310 (87.82%)	0.1037	1.75	0.9–3.31
Live alone (n=92)	74 (80.43%)			
Consumers children				
Without children (n=316)	273 (86.39%)	0.7645	0.97	0.52–1.87
With children (n=129)	111 (86.05%)			
Educational level				
Secondary (n=29)	25 (86.21%)	0.6122	0.99	0.32–4.07
Graduate (n=416)	359 (86.30%)			
Professional status				
Yes (n=242)	212 (87.60%)	0.8439	1.27	0.71–2.27
No (n=203)	172 (84.73%)			
Employed women				
Yes (n=218)	189 (86.70%)	0.8084	1.07	0.60–1.91
No (n=227)	195 (85.90%)			
Place of sausage purchase				
Beraki (n=48)	42 (87.5%)	0.2801	/	/
Birtouta (n=51)	42 (82.35%)			
BMR (n=41)	36 (87.80%)			
Bouzareah (n=51)	43 (84.31%)			
Cheraga (n=40)	33 (82.5%)			
D.beida (n=42)	40 (95.24%)			
H.dey (n=24)	21 (87.5%)			
Harrach (n=48)	46 (95.83%)			
Rouiba (n=54)	45 (83.33%)			
S. mhamed (n=46)	36 (78.26%)			

3.2. Frequency of sickness among vulnerable consumers

As shown in Table 3, sausage consumers who were immuno-deficient had the highest frequency of being sick with 41.38% (OR=3.618, $p<0.0001$), followed in descending order by consumers who had children, 34.85% (OR=1.90, $p=0.012$), and pregnant consumers, 28.12% (OR=1.56, $p=0.03$).

As mentioned in the statements of the federal food safety awareness campaign, there are four vulnerable populations: the elderly, young children, people with compromised immune systems, and pregnant women. Our results showed that among vulnerable people, immuno-deficient consumers and woman consumers giving birth were recorded to be the leading risk factors, respectively. Similar data had also been advanced (Murray et al., 2017) with over 75% for each group for populations vulnerable to food-borne illness. In contrast, the Canadian study had identified the elderly as being at

Table 2: Socio-demographic and risk factors of sausage consumers associated with gastrointestinal infections

Variables/Risk factors	Number of sick consumers (%)	*p*-value	OR	95% CI
Age group (years)				
18–40 (n= 300)	66 (22%)	0.6298	1.1993790	0.50 -1.69
41–65 (n= 84)	20 (23.81%)			
Gender				
Male (n=109)	28 (25.69%)	0.2901	1.3645721	0.74 -2.23
Female (n=275)	58 (21.09%)			
Residence				
Live with family (310)	73 (23.55%)	0.1646	1.6577904	0.73- 3.03
Live alone (n=74)	13 (17.57%)			
Consumers with/without children				
Without children (n=273)	67 (24.54%)	0.0154 *	0.4061517	0.34- 1.14
With children (n=111)	19 (17.12%)			
Educational level				
Secondary (n=25)	7 (28%)	0.7610	0.8471250	0.47- 3.61
Graduate (n=359)	79 (22.01%)			
Place of purchase				
Beraki (n=42)	9 (21.43%)	0.06759	/	/
Birtouta (n=42)	15 (35.71%)			
BMR (n=36)	5 (13.89%)			
Bouzareah (n=43)	12 (27.91%)			
Cheraga (n=33)	4 (12.12%)			
D.beida (n=40)	10 (25%)			
H.dey (n=21)	6 (28.57%)			
Harrach (n=46)	13 (28.26%)			
Rouiba (n=45)	10 (22.22%)			
S. mhamed (n=36)	2 (5.56%)			

higher risk of food-borne illness than young adults. As an explanation, our results can be extremely linked to lifestyle and the Algerian traditions. A society that gives meat and meat products much more to immune-deficient persons and women giving birth, as a synonymous of take care.

3.3. Antibiotics use behavior of sick consumers

As shown in Figure 3, out of the 86 sick consumers, 43.02% (n=37 out of 86) received antibiotic therapy as a medicine after food-borne poisoning. Referring to interruption of antibiotherapy, 17.44% (n=15 out of 86) claimed to have interrupted the antibiotics treatment, and over half of the sick consumers (59.30%) resorted to self-medication (n=51 out of 86).

Regarding the antibiotics use behavior, out of 86 sick consumers, almost half received antibiotic therapy as a medication for food-borne poisoning. Similar results were reported by Awad and Aboud (2015) with 44.3%. In contrast, El Sherbiny et al. (2019) reported a higher rate of 66.7% in Egypt. Also, 17.44% of sick consumers claimed to have interrupted the antibiotics treatment which remains a very low rate, compared to that reported in Egypt and Thailand by El Sherbiny et al. (2019) and Saengcharoen et al. (2012) with 63.7% and 45%, respectively. Besides, over half of the sick consumers resorted to self-medication. Other data were reported by Vaananen et al. (2006) in Spain with 41% and El Sherbiny et al. (2019) in Egypt with 32.7%.

Previous studies in Egypt (Elmasry et al., 2013), and in Kuwait (Awad and Aboud, 2015) had reported low rate of antibiotics use without prescription, with 29.8%, and 27.5%, respectively. These findings may be explained by ease purchase of antibiotics in developing countries without

Table 3: Risk factors associated with foodborne illnesses among sick sausage consumers

Risk factors	No. of sick consumers (%)	*p*-value	OR	95% CI
Immunodeficient				
Yes (n=87)	36 (41.38%)	5.53e-06***	3.6187569	1.99–6.07
No (n=297)	50 (16.83%)			
Pregnancy				
Yes (n=160)	45 (28.12%)	0.03141	1.5667127	1.05–2.92
No (n=224)	41 (18.30%)			
Age group (years)				
<8 years (n=278)	67 (24.10%)	0.4346	1.2839701	0.80–2.72
>8 years (n=106)	19 (17.92%)			
Childbirth				
Yes (n=66)	23 (34.85%)	0.01227	1.9017433	1.15–3.98
No (n=318)	63 (19.81%)			

*=statistically significant

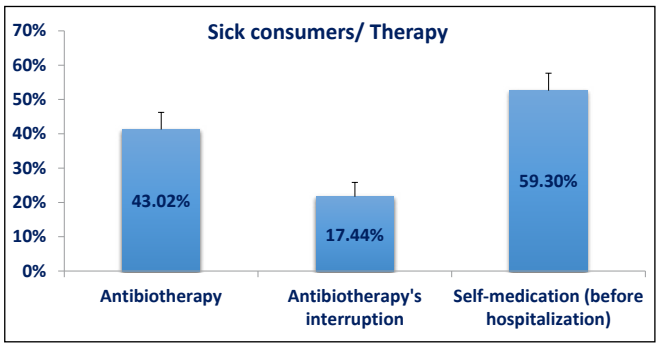

Figure 3: Antibiotics use among sick consumers

prescription (Murray et al., 2017). It has been estimated that from 20% to 50% of antibiotics use is either unnecessary or inappropriate (Dellit et al., 2007) which contributed to the development of antimicrobial resistance, although multidrug-resistance are directly related to the time patients spend in hospital and the departments to which they were admitted (Abat et al., 2018). The inappropriate and excessive uses of antibiotics arise from an interaction between numerous factors related to patient's knowledge and attitude, such as patient demand, wrong habits of self-medication, patients' experience with antibiotics, and insufficient patient education (Costelloe et al., 2010). Self-medication can be linked also to poor socio-economic status, the high cost of doctors' fees and the inaccessibility of health care in certain regions. Many factors could influence doctors' decisions, leading them to breach the principles of a good clinical practice (Gualano et al., 2015). This situation is more critical in developing countries resulting from inadequate regulation of the distribution and sale of prescription drugs (El Sherbiny et al., 2019).

4. CONCLUSION

The population of Algiers suffered from an inappropriate use of antibiotics (self-medication), which must be guided by different strategies: easy access to a health service in order to monitor the use of antibiotics by health professionals, adopt educational programs for consumers in order to raise their awareness of the dangers of antibiotic abuse, including bacterial resistance, as well as the high financial cost, and finally, implement regulations aimed at restrict unlimited access to antimicrobial drugs.

5. ACKNOWLEDGMENT

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