

Food poisoning in Morocco: Evolution and Risk factors

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Abstract—In order to contribute in reducing the morbidity and the mortality resulting from food poisoning in Morocco and improving the treatment of patients, this study is an analysis of the current situation of this pathology over a period of five years. This analysis consists of describing the different characteristics linked to food poisoning cases recorded in the Anti Poison and Pharmacovigilance Center of Morocco (CAPM) between 2007 and 2011 in Morocco, as well as identifying the risk factors that are related to these cases. During the study period, 6 960 poisoning cases have been collected, included 24 deaths. The average age of patients was 24 years. The two sexes were affected in the same way. The males were more exposed to fatal poisonings. Meat and meat products were the most incriminated. However, the fatal poisoning was mainly linked to dairy products. The urban areas were the most affected, while the rural areas were more exposed to fatal poisonings (RR=5, p<0,001). The majority of reported cases had showed clinical signs from which the most frequent ones were disorders in the gastrointestinal system (89%).

Index Terms— Food poisonings, pathology, risk factor, CAPM.

1 Introduction

The development and the increase of the number of commercialized food products make food poisoning (FP) a more common disease in all countries. This disease causes human sufferings and significant health costs [1]. The contribution of anti-poison centers in the treatment of FP is clear. According to a study of Harrison and al, these centers reduce significantly the costs related to the treatment of these diseases [2, 3, 4].

The epidemiological situation in some countries

In the United States, 76 million of food poisonings (26 000 in 100 000 residents) from which 325 000 persons were hospitalized (111 in 100 000 residents) and 5000 persons died (1,7 in 100 000 residents) [5]. In the United Kingdom, in 2000, the number of poisonings increased to 2 million (nearly 3400 in 100 000 residents). The involved bacteria was: *Campylobacter jejuni* (77,3%), *Salmonella* (20,9%), *Escherichia Coli* O 157 : H7 (1,4%) and all others (<0,1%). In France, in 250 000 to 750 000 food poisonings per year (400 to 1210 in 100 000 residents), 70 000 were subject to emergency consultation (113 in 100 000 residents), 15 000 persons were hospitalized (24 in 100 000 residents) and 400 persons died (65 in 100 000 residents).

The epidemiological situation in Morocco

A gradual increase in the last ten years has been noticed. Indeed, the number of FP cases and episodes doubled from 1996 to 2001. In Morocco, the FP cases represent 11% of poisonings. More than 90% of FP cases are caused by confirmed or probable bacteria. Approximately 7% cases have a chemical cause: food contamination especially by pesticides. Nearly 1% of FP cases are of plant cause (Addad). The rest had an unidentified cause (1,5%) [6]. Food contamination can come from raw materials or food processors. Water supply can also be a cause of FP. The FPs are under-reported in Morocco as in many countries of the world. Since the Moroccan population had not known the FP risks, these FPs are reported only in aggravated cases. Thus, we can estimate 10 cases for each report [7]. In order to contribute in reducing the morbidity and the mortality resulting from food poisonings in Morocco and improving the treatment of patients, this study is an analysis of the current situation of this pathology over a period of five years. This analysis consists of describing the different characteristics linked to food poisoning cases recorded in the Anti Poison and Pharmacovigilance Center of Morocco (CAPM) between 2007 and 2011 in Morocco, as well as identifying the risk factors that are related to these cases.

2 Data and methods

This is a retrospective study over a period of 5 years (from 2007 to 2011) that concern 6960 food poisonings cases reported to the Anti Poison and Pharmacovigilance Center of Morocco (CAPM).

Morocco is bordered in the East and in the Southern East by Algeria, in the South by Mauritania, in the West by the Atlantic Ocean and in the north by the Mediterranean Sea. Morocco has a surface area of 710 850 Km², and in the administrative level, it is divided, according to the Dahir NO -97-84 of 23 Dhu al-Qa'da 1417 / 2 April 1997, into sixteen regions (fig 1). Morocco had a population of 29 680 069 inhabitants in 2004 [8]. The country is generally characterized by a mild and temperate climate, with a humid and cold winter, and a dry and hot summer. The thermal variations are sometimes brutal. The irregular and heavy rain-falls are concentrated in short periods, with an alternation in the period of floods and the period of droughts [9].

Moroccan people have a very varied alimentation. Cereals are the base of their alimentation, followed by fruits and vegetables, and then beef and game meat [10].

All data of poisoning report sheets, filled in by the doctor in charge of the case or, failing that, by the nurse, coming from health facilities (in sixteen Moroccan regions) to the Toxicovigilance unit of the center regularly, and data of medical files filled in according to telephone responses by the CAPM doctor of the Toxicological information unit, were entered in a special database and then submitted to treatment. For data processing, we have used some descriptive tools such as the frequencies and the specific lethality rates (refers to the link between the recorded deaths as a result of a poisoning and the total number of poisoning cases, and it is specific to a given modality). The description of the sample concerned the characteristics of the poisoned population (year, sex, age, origin, type of poisoning, symptoms, clinical signs, gradation and evolution) and the characteristics related to the suspected food. The studies and the associations between the dependent variable (evolution: cure/death) and all these characteristics were tested, particularly by the chi-square test (represented by its signification *p*) and the estimation of the relative risk (RR) for a joint analysis of the two variables. The gravity evaluation is done by the Poisoning Score Severity (PSS) [11]. Vector foods were classified according to Codex Alimentarius done by the Anti Poison and Pharmacovigilance Center of Morocco [12].

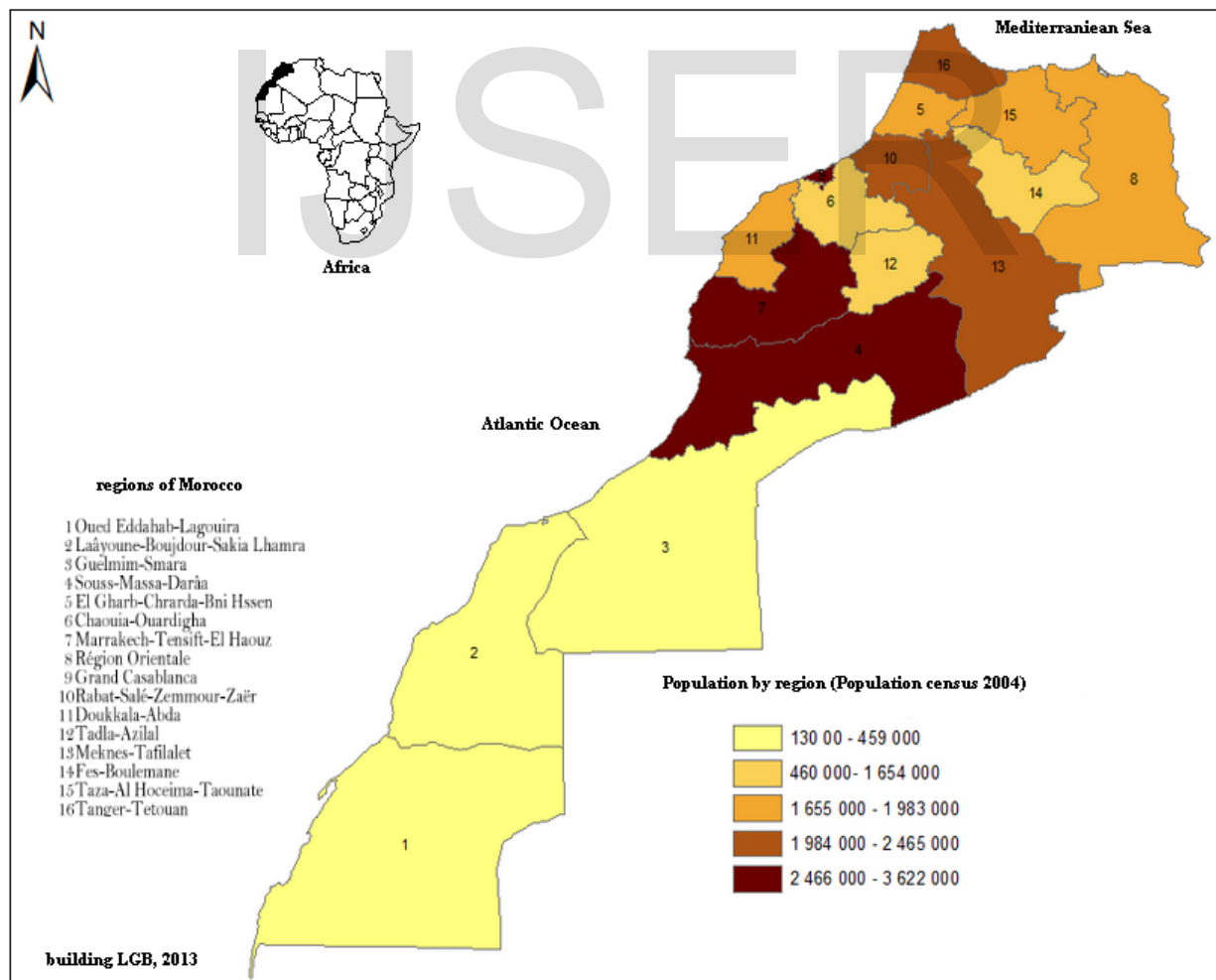


Fig 1: Distribution of the Moroccan population according to the General Census of the Population

3 Results

3-1 Characteristics of the poisoned population

The average annual number of reports was of 1392 cases. The year 2009 had recorded the minimum of cases, namely 1074 cases, while the year 2010 had recorded the maximum of cases, namely 2075 cases (Fig 2). The seasonal distribution shows that more than the third of food poisoning diseases was noticed in summer with a specific lethality of 0,32%. This increase may be justified, on the one hand, by the role of temperature in the spread of germs in foods and water, and the increased consumption of fruits and vegetables during this period of year, and on the other hand, by poor preservation of food. The geographical distribution of the cases shows that all the regions were affected, with a maximum of declarations was recorded in the region of Marrakech-Tansift-AlHaouz (1 160 cases), followed by the region of the Oriental (1 009 cases). The age group that is superior to 15 (>15) was the most affected with 59,8 and a lethality of 0,3%. The average age of patients was 24 years. The distribution according to sex showed that both sexes were affected in the same way. Males were the most exposed sex to lethal poisonings with a specific lethality of (0,46%). Patients of urban origin were the most affected (76,8%). The highest specific lethality was recorded in patients of rural origin. This may be explained by the lack of health infrastructures and means of communication (telephone, Fax...) as well as the absence of food hygiene in rural areas. The FPs were frequent at home with 65,7%. Most of poisoning cases were collective (57,0%) with a specific lethality of 0,48%. The severity of patients' health status was often moderate (level 25; 765 cases), probably due to the mildness of the created diseases (often considered as transient). Complications appeared in 176 cases (level 3). The fatality was noticed in 24 cases (level 4). The progression was positive in 99 % of cases. 28 cases had after-effects and 24 cases died (a lethality of 2,9%). Most of reported cases had symptoms (namely 87%) (Table 1). According to the results of the analysis, almost all cases had disorders in the gastrointestinal system (89%), associated or not with disorders in the central and peripheral nervous system (7%) and general disorders (2%). Other disorders were shown at low frequencies. The gastrointestinal system's most frequent disorders were vomiting, abdominal pain, nausea and diarrhea (Table 2).

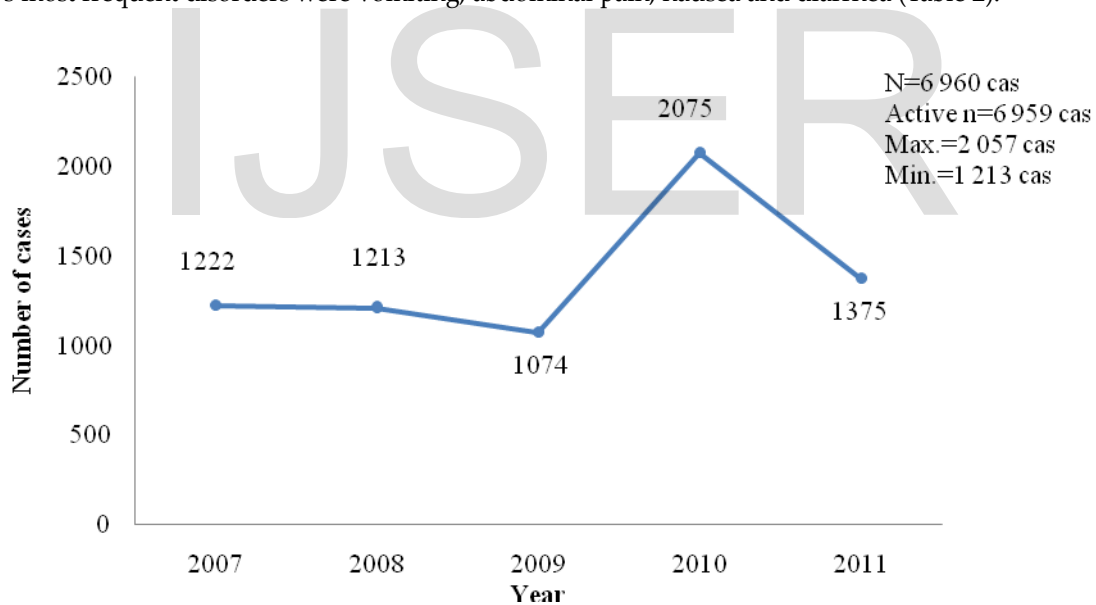


Fig 2: Distribution of poisoning cases by years and months

Table 1: Epidemiological characteristics of the study population

Epidimological Para- metrs	Global		Evolution		Specific Lethality (%)
	Numbers (N=6 960)	Percentage (100 %)	Cured (N=5 890)	Deceased (N=24)	
Age groups					
>15 years	4 164	59,83	3 508	13	0,31
≤ 15 years	2 299	33,03	1 926	4	0,17
Active n	6 463	92,89	5 434	17	

Sex					
Male	3 326	47,79	2 687	15	0,46
Female	3 257	46,80	2 865	6	0,18
Active n	6 583	94,59	5 552	21	
Origin					
Urban	5 349	76,85	1 190	9	0,17
Rural	1 429	20,53	4 562	11	0,77
Active n	6 778	97,38	5 752	21	
Place of poisoning					
Home	4 573	65,70	3 852	9	0,20
Job	570	8,19	528	2	0,35
Public	1 654	19,45	1 192	9	0,66
Other	49	0,70	40	-	0,0
Active n	6 846	94,04	5 612	20	
Type of poisoning					
Isolated	3 971	42,93	2 448	5	0,17
Collective	2 988	57,05	3 442	19	0,48
Active n	6 959	99,98	5 890	24	
Season					
Autumn	1 452	20,86	1 260	1	0,07
Winter	1 009	14,50	837	3	0,30
Spring	1 859	26,71	1 607	3	0,16
Summer	135	35,99	2 074	8	0,32
Active n	4 455	98,06	5 778	15	
Clinical status					
Symptomatic	6 083	87,40	5 190	12	1,37
Asymptomatic	876	12,59	700	12	0,20
Active n	6 959	99,99	5 890	24	
Gradation					
None (Level 0)	185	2,66	175	-	-
Minor (Level 1)	510	7,33	462	-	-
Moderate (Level 2)	5 765	82,33	5 034	-	-
Severe (Level 3)	176	2,53	132	-	-
Fatal (Level 4)	24	0,34	24	24	100,0
Active n	6 660	95,19	5 827	24	

Table 2: Distribution of the clinical signs of the poisoned cases by effects' categories according to the system or the concerned organ

Effect's categories according the system or the organ	Number	%
Disorders in skin and its adnexa	27	0,60
Disorders in the musculoskeletal system	3	<0,1
Disorders in the central and peripheral nervous system	312	6,89
Disorders in the visual system	2	<0,1

Psychiatric disorders	2	<0,1
Disorders in the gastrointestinal system	4 026	89,0
Disorders in the general cardiovascular system	4	0,1
Disorders in heart rate and rhythm	30	0,66
Disorders in the respiratory system	24	0,53
Disorders in the red bloodline	1	<0,1
Disorders in the general condition	97	2,14
Active n	4 528	100,00

3-2 Characteristics linked to the suspected food

According to the Codex Alimentarius classification, meat and meat products (11,9%) were on top of the most incriminated food, followed by fish products (8,0%) and dairy products (7,3%) (Table 3).

Table 3 : Distribution of the poisoned cases according to the nature of the suspected food

Studied Variables	Global		Evolution		Specific Lethality (%)
	Number (N=6 960)	%	Cure (N=5 890)	Death (N=24)	
Food categories					
Dairy products	511	7,34	423	6	1,17
Fats and oils	21	0,30	14	-	-
Ice cream	37	0,53	33	-	-
Fruits and vegetables	253	3,64	198	5	2
Sweets	21	0,30	18	-	-
Cereals and cereal-based products	51	0,73	40	-	-
Bakery products	417	5,99	391	2	0,48
Meat and meat products	830	11,93	737	3	0,36
Fish and fish products	562	8,07	488	2	0,36
Eggs and egg-based products	80	1,15	78	-	-
Sweeteners including honey	8	0,11	6	-	-
Salts, spices, soups, sauces, salads	84	1,21	72	1	1,19
Foods for a special nutritional use	25	0,36	25	-	-
Beverages	190	2,73	138	-	-
Salty appetizers	16	0,23	12	-	-
Composite foods	262	3,76	226	2	0,76
active n	3 368	48,38	2 899	21	0,08

The dominance of meat products in the poisoning may be explained by the fact that meat is a good place for the growth of most microorganisms, and that because of the non-respect of health conditions principally, especially in the slaughterhouses during the slaughter phase. The poisoning may also occur if the meat is eaten raw, undercooked or recontaminated after cooking. The suspected food products in lethal poisoning were mainly dairy products (6 cases) and fruits and vegetables (5 cases). However, the highest lethality was noticed in cases of poisoning by fruits and vegetables (SL=2%).

3-3 Study of the influence of epidemiological variables on the prognosis of patients

Factors influencing the prognosis of poisoned patients are illustrated in table 4.

Table 4: Factors influencing the prognosis of poisoned patients

Variable (Modality 1 vs Modality 2)	Evolution (Cured vs Deceased)	RR [CI 95%]	P
Sex (Male vs Female)	5 552 vs 21	2.66 [1.03-6,88]	0,047
Origin (Rural vs Urban)	5 752 vs 20	4.68 [1.93-11.33]	0,001
<i>Significant link (5 %) ; 0,001 < p ≤ 0,01 : very significant link (1 %). RR : Relative risk ; CI 95 % : confidence interval at 95 %.</i>			

On the six studied variables (sex, age, origin, poisoning type, clinical status, symptoms), it turned out that males were the most affected and that the difference between the two sexes is significant ($\chi^2=4,443$, $0,01 < p \leq 0,05$). Men are twice more likely to progress to death than women (RR =2,666; CI 95 % : 1,033-6,880).

Poisoned patients in rural areas are four times more likely to progress to death than those who are poisoned in urban areas (RR= 4,686 ; CI 95 % : 1,937-11,333). This may be explained by the increased consumption of fruits and vegetables, that are often unwashed, by the inhabitants of rural areas on the one hand, and on the other hand by the poor preservation of food (lack of refrigerators and storage equipments).

4 Discussion

Food poisonings are considered to be an everyday growing public health problem whether in developed countries or in developing countries [1, 13, 14]. In Morocco, according to data from CAPM, the FPs occupy the first position (22,1 %) of all poisonings, apart from scorpion infections and stings [15]. During the period from 1992 to 2009, 17 896 FP cases were reported to the CAPM including 59 deaths. For most people they are sporadic and minor and often are unnoticed by health professionals or patients. Therefore, only 6960 FP cases were reported to the CAPM over five years including 24 deaths.

This figure does not reflect the reality since in France, between 2001 and 2003, there was 1656 episodes of FP reported including 22113 patients and 11 deaths of whom 60% had a salmonella origin and 65% occurred in institutional catering [16]. Worldwide, 2,1 million adults and 3 million children die because of the consumption of water or contaminated food [13,17]. In the United States, in 1994, an outbreak of salmonellosis due to ice cream affected 224000 persons [17]. The disparity of the epidemiological situation of FPs is due to changes in people's lifestyles and the behavior of microbial germs [1,17].

In our series, as in literature, the FPs are more and more common due to the change in lifestyle (preparing food long before consumption because of women's work outside the house, buying pre-prepared food...), food habits (preparation of leben from raw milk left exposed to open air for a few days...), the intense development of informal sales sector as well as the new agri-food technologies.

As for the frequency, the urban areas occupy the first place: this is related to the overcrowding in urban areas and the access to health facilities. The FP phenomenon is seasonal with an increase in summer and spring. This is explained by the important role of temperature in the spread of germs in food and water, the increased consumption of fruits and vegetables during these seasons as well as people's movements especially in summer (holidays, outings, trips...). The FPs affect male adults/city-dwellers at home. This is probably related to rural exodus of the population of young men who live alone and eat anyhow because of their low purchasing power. Meat and meat products (11%) was on top of the most incriminated food, followed by fish products (8%) and dairy products (7%): in fact they are easily perishable and can be contaminated by chemicals. The microbiological risks and the FPs they cause are considered as a growing health problem. In many countries, we noticed in the last decades significant increases of the negative impacts of diseases caused by microorganisms transmitted mainly by food, such as *Salmonella* spp and *Campylobacter* spp. New serious threats emerged in the food chain such as the enterohemorrhagic *Escherichia coli* and the bovine spongiform encephalopathy (BSE). In addition to that, the chemical risks remain as an important source. Among chemical contaminants in food, we can mention natural toxicants such as mycotoxins and marine toxins, environmental contaminants such as mercury and lead, and substances that exist naturally in plants. Food additives, micronutrients, pesticides and veterinary drugs are deliberately used in the food chain. However, we must make sure that their use is safe [18]. Clinically,

the affection of the gastrointestinal system was normal in this series. We note that diarrhea is also a main cause of the malnutrition of infants and young children. The high prevalence of diarrheal diseases is a sign of implicit major problems of food safety [1, 13]. Generally, the evolution was favorable with some deaths whose number was significant though.

5 Conclusion

The number of reported FP was almost stable between 2007 and 2001, while in 2011, a remarkable decrease was noted. This may be related to the efforts made by the Anti Poison and Pharmacovigilance Center of Morocco and the organization of many open days of awareness on the dangers of food poisonings, health education, information and communication regarding food hygiene. The institutional catering shall require a regular monitoring and particularly households in which FPs had occurred previously. We must be aware that each reported FP limits its aggravation. We must also make extra efforts to improve the epidemiological system of investigation.

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