

SALMONELLOSIS IN RIO GRANDE DO SUL, BRAZIL, 1997 TO 1999

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Submitted: September 13, 2001; Returned to authors for corrections: March 15, 2002; Approved: December 05, 2002

ABSTRACT

Salmonella spp. was the major cause of reported foodborne diseases in the last years in the State of Rio Grande do Sul, South of Brazil. Epidemiological data on salmonellosis, occurred in the period of 1997 to 1999 and supplied by the Division of Sanitary Surveillance (DVS/RS), were analysed according to the following factors: total number of confirmed outbreaks, number of people involved, outbreaks incidence according to the period of the year, age and sex of involved people, food vehicle, food storage conditions, local where the disease occurred, and possible causes of the outbreaks. The results indicated that 8217 people were involved, and 1557 had to be hospitalized. The highest number of outbreaks occurred during springtime and the principal age group affected was between 16 and 50 years. The most common food vehicle was salad prepared with homemade mayonnaise (42.45%). The principal causes of salmonellosis were raw-materials not submitted to regulatory inspection (22.92%), mainly eggs, and foods maintained at room temperature for more than 2 hours (20.55%). The majority of the outbreaks occurred in private homes (43.70%) and commercial food establishments (25.21%).

Key words: *Salmonella* spp., foodborne disease, salmonellosis

INTRODUCTION

Salmonella spp. has been recognized worldwide as a common cause of foodborne gastroenteritis in humans (13,15,25) and is also responsible for important economic losses (17).

In the last years, global surveillance data indicated that the number of salmonellosis has increased mainly associated with the consumption of raw or undercooked eggs, poultry, meat or dairy products (11,12,20), demonstrating the importance of controlling this pathogen in food processes. One step towards the understanding of *Salmonella* spp. epidemiology is to improve surveillance services activities, especially related to the detection and reporting of outbreaks, followed by the organization and public information of the real occurrence of salmonellosis. These data are needed to perform risk assessment, set priorities, and decide on

preventive measures to reduce foodborne diseases (14). In Brazil, we are at beginning of this complex organization, being very important to report regional salmonellosis data, when existent, from health services.

The Division of Sanitary Surveillance of Rio Grande do Sul (DVS/RS) is composed by nineteen Regional Health Sections which investigate notified foodborne diseases in coordination with municipalities. Once an outbreak is notified, the suspected food is taken to the Central Laboratory (LACEN/RS) or accredited laboratories to be analyzed. Based on microbiological analysis and epidemiological data, annual reports for DVS/RS demonstrated *Salmonella* spp. as the major etiological agent responsible to foodborne diseases in Rio Grande do Sul in the last years (21). The objective of the present work was to analyze *Salmonella* spp. outbreaks occurred in Rio Grande do Sul, south of Brazil, during the period of 1997 to 1999.

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MATERIALS AND METHODS

Epidemiological data on outbreaks of salmonellosis occurred in the State of Rio Grande do Sul, South of Brazil, during the period between January 1997 to December 1999 were analyzed. Data were supplied by the Division of Sanitary Surveillance of Rio Grande do Sul (DVS/RS) based on final reports of epidemiological investigation of foodborne diseases carried out by inspectors of Regional Health Sections.

Outbreaks were investigated interviewing the involved people and, when possible, collecting samples of suspected foods and feces of ill persons and food handlers. The samples were analyzed for the presence of *Salmonella* spp. in Central Laboratory of Rio Grande do Sul (LACEN/RS) or in accredited laboratories close to the places of occurrence of outbreaks, using methods described by Food and Drug Administration (5).

RESULTS

Among 323 investigated outbreaks occurred in Rio Grande do Sul during the period from 1997 to 1999, 116 (35.7%) were caused by *Salmonella* spp. In these outbreaks, 8217 people were involved, 2846 became ill, and 1557 were hospitalized. No death was registered (Table 1).

The 116 outbreaks of salmonellosis were confirmed by Attack Rate (No. of ill people/No. of involved people x 100), or/and by the isolation of *Salmonella* spp. from the suspected food or feces of ill persons and food handlers.

The incidence of outbreaks of salmonellosis was higher in springtime (October, November, and December) (n = 48) than in the summertime (January, February, and March) (n = 38). The same was observed regarding the incidence of other etiological agents (eg. *Staphylococcus aureus*) of foodborne diseases in Rio Grande do Sul (data not shown). Table 2 shows that the most affected group classified by age was people between 16 and 50 years old (64.31%), followed by children and teenagers from 6 to 15 years (18.60%). The incidence of salmonellosis in male and female population was similar, 51.8% and 48.2%, respectively.

Table 1. General data about outbreaks of *Salmonella* spp. in Rio Grande do Sul, 1997 to 1999.

	1997	1998	1999	Total
Confirmed outbreaks	48	33	35	116
Involved people	2360	2854	3003	8217
Ill people	1073	960	813	2846
Estimate ill people	1775	2129	2471	6375
Hospitalized people	550	504	503	1557
Deaths	0	0	0	0

A total of 139 food vehicles were responsible for the 116 investigated salmonellosis (Table 3), demonstrating the involvement of more than one food in some outbreaks.

Foods containing mayonnaise (42.45%) and meats (16.55%) were responsible for 58.9% of the incidents (Table 3).

The major incidence of outbreaks of salmonellosis occurred in private homes (43.70%), followed by commercial food establishments (25.21%). Clubs and associations, and community rooms were involved in 7.56% of the incidents (Table 4).

Data presented in Table 1 indicates that 48, 33, and 35 *Salmonella* spp. outbreaks occurred during the years 1997, 1998, and 1999, respectively. There is a small discrepancy between these data and those presented in Table 4 (48, 34, and 37 outbreaks, respectively) for the same period. This can be explained by the occurrence of the same outbreak in different places after a common food preparation.

Table 2. Age and sex of people involved in outbreaks of *Salmonella* spp. in Rio Grande do Sul State, Brasil, during the period of 1997 to 1999.

Age (years)	1997	1998	1999	Total	%
0 - 1	5	1	3	9	(0.31)
2 - 5	45	22	27	94	(3.25)
6 - 15	198	169	170	537	(18.60)
16 - 50	765	621	470	1856	(64.31)
51 - 70	91	109	119	319	(11.05)
> 70	18	16	19	53	(1.83)
Unknown	7	7	4	18	(0.62)
Sex					
Male	506	443	415	1364	(51.8)
Female	362	509	398	1269	(48.2)

Table 3. Food vehicles of outbreaks of *Salmonella* spp. in Rio Grande do Sul State, Brasil, during the period of 1997 to 1999.

Food vehicle	Number of outbreaks			Total	
	1997	1998	1999	n	%
Salad* with mayonnaise	24	19	16	59	(42.45)
Pastry products	12	7	4	23	(16.55)
Meat and meat products	8	7	8	23	(16.55)
Milk and dairy products	2	1	1	4	(2.88)
Ice cream	-	1	-	1	(0.72)
Bean	-	1	-	1	(0.72)
River water	-	1	-	1	(0.72)
Not identified	10	7	10	27	(19.42)
Total	56	44	39	139	100

* Salad of: potato, apple, paste, sweet cassava, vegetables, and others.

Table 4. Place eaten of outbreaks of *Salmonella* spp. in Rio Grande do Sul State, Brasil, during the period of 1997 to 1999.

Place	Number of outbreaks			Total	
	1997	1998	1999	n	%
Private homes	22	14	16	52	(43.70)
Commercial food establishments	11	12	7	30	(25.21)
Clubs and associations	5	2	2	9	(7.56)
Community rooms	1	3	5	9	(7.56)
Schools, nurseries, or asylums	3	2	1	6	(5.04)
Hospitals	2	-	-	2	(1.69)
Refectories	-	-	1	1	(0.84)
Industrial kitchens	1	-	-	1	(0.84)
Industries	1	-	-	1	(0.84)
Others	2	1	5	8	(6.72)
Total	48	34	37	119	100

The principal factors that contributed to salmonellosis in Rio Grande do Sul during the analyzed period are presented in Table 5. Raw-materials without regulatory inspection (mainly eggs) were the major cause, being responsible for 22.92% of the outbreaks. Other causing factors were also detected: holding at ambient temperature for more than 2 hours (20.55%); improper manipulation (13.04%); inadequate refrigeration (12.65%); poor hygiene of equipment and utensils (7.11%), and cross-contamination (5.53%).

DISCUSSION

It is known that only a small fraction of the foodborne diseases are reported to the sanitary authorities. Actually, probably less than 1% of the incidents are notified (14). Norling (18) reported that only 7% of the people involved in foodborne diseases in Sweden contacted the medical authorities, 3% contacted the suspected restaurant or similar places, and none contacted the environmental or public health authorities, demonstrating the low consumer awareness. Even in countries where surveillance services are very efficient, the real occurrence of foodborne diseases is not precisely known (10).

Based on reported cases, it is estimated that 4.6 million cases of salmonellosis occur each year in the United States (7). However, data from Brazil suggest that only 34.000 people per year become involved with salmonellosis (4), demonstrating huge differences between both estimates.

Few States in Brazil have surveillance services that organize the epidemiological data on foodborne diseases. Difficulties, such as low number of inspectors, economic difficulties, and improper systems of food poisoning notifications contribute to inadequate organization of data. The present work is a regional report on salmonellosis, which even incomplete, may contribute to the understanding of the agents, food vehicles, and contributing factors to the Brazilian foodborne diseases.

In the outbreaks of salmonellosis occurred in Rio Grande do Sul during the analyzed period, 2846 people became ill, and 1557 persons were hospitalized. Peresi *et al.* (19) demonstrated lower numbers of involved people in the State of São Paulo, where 295 persons were hospitalized among 906 involved people due to salmonellosis occurred between 1993 to 1997.

Table 5. Factors that contributed to the outbreaks of *Salmonella* spp. in Rio Grande do Sul State, Brasil, during 1997 to 1999.

Factors contributing to outbreak	Number of outbreaks			Total	
	1997	1998	1999	n	%
Raw material without regulatory inspection	21	19	18	58	(22.92)
Holding at ambient temperature for more than 2 hours	23	13	16	52	(20.55)
Improper manipulation	13	8	12	33	(13.04)
Inadequate refrigeration	19	8	5	32	(12.65)
Poor hygiene of equipment and utensils	5	6	7	18	(7.11)
Cross-contamination	3	4	7	14	(5.53)
Contamination by infected food handler	3	2	1	6	(2.37)
Inadequate hot holding	3	2		5	(1.98)
Inadequate cooking	1	1	3	5	(1.98)
Ingestion of contaminated water	-	1	3	4	(1.58)
Improper reheating	-	-	1	1	(0.40)
Improper place of food processing	-	1	-	1	(0.40)
Use of wood utensils	1	-	-	1	(0.40)
Unknown	11	8	4	23	(9.09)
Total	103	73	77	253	100

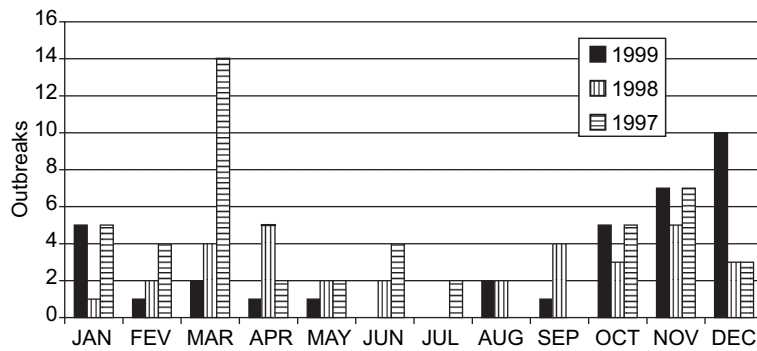


Figure 1. Monthly occurrence of outbreaks of *Salmonella* spp. in Rio Grande do Sul State, Brazil, in the period of 1997 to 1999.

In Rio Grande do Sul, *Salmonella* spp. was responsible for 35% of the outbreaks that occurred between 1997 to 1999. Similar results were reported in different places of the world. *Salmonella* spp. have accounted for 45% of foodborne disease outbreaks of known etiology during 1973 to 1987 in the United States (7). Higher percentages were observed by Scuderi *et al.* (23) in Italy during 1991 to 1994, when *Salmonella* spp. was responsible for 81% of the outbreaks, being *S. Enteritidis* related to 34% of them. Machado and Bernardo (16) also reported that since 1984, the same microorganism has been the most frequent cause of human salmonellosis in Portugal. All these findings confirm the importance of this etiological agent concerning public health issues.

In relation to the time of the year and the incidence of salmonellosis, Binsztein *et al.* (1), and Cliver (3) demonstrated higher incidence of salmonellosis in Argentina, and USA, respectively, in summertime. In opposite, our findings showed that the highest number of outbreaks of salmonellosis in Rio Grande do Sul occurred in springtime. According to the Surveillance Service, this can be explained by the more frequent food handlers negligence, especially inadequate food refrigeration, during seasons with mild temperatures. Such carelessness is easily observed during winter and is prolonged into spring when temperature in Rio Grande do Sul is frequently lower than 10°C. It is important to emphasize that the higher incidence of outbreaks in springtime also occurred with other etiological agents of foodborne diseases, confirming the negligence in general good manufacturing practices mainly in this season.

Based on Food and Drug Administration (6), all ages are susceptible to *Salmonella* spp., but the symptoms are more severe to the elderly and children (24). In this study, *Salmonella* spp. outbreaks were more frequent in people with ages between 16 and 50 years (64.31% of the cases).

As shown in the present study, many kinds of foods were vehicle of *Salmonella* spp. by salads prepared with homemade

mayonnaise were the major foods involved with the incidents. Other important vehicles were meats, meat products and pastry products. Many authors outlined the consumption of raw eggs and egg products as the principal cause to the increase of *Salmonella* gastroenteritis worldwide (2,8,9,19,22). Nevertheless, meats, milk and dairy products have been involved with many outbreaks (11).

In the last years, the number of outbreaks involving eggs have been reduced in Rio Grande do Sul. This can be attributed to the less utilization of homemade mayonnaise and to the development of a program to control the quality of raw eggs, elaborated by the Center of Sanitary Surveillance (CVS) of Porto Alegre city, DVS/RS, Agriculture Ministry, and Associação Gaúcha de Avicultores (ASGAV). Due to this program, since 1996, all egg producer establishments should indicate the shelf-life of eggs and confirm the regulatory inspection.

In a high percentage of the salmonellosis outbreaks (19.42% - Table 3), the responsible food could not be identified, showing that the sanitary authorities have difficulties with sample collection, reports from sick people, and also with unreliable information during the epidemiological investigation.

With relation to location and factors contributing to the outbreaks, the majority of them occurred in private homes and commercial food establishments. The main causes were holding of foods for more than 2 hours at room temperature or utilization of non inspected raw-materials (especially eggs). Similar data were presented by Caffer and Eiquer (2) and by Lindqvist *et al.* (14) who demonstrated that 94% of the *Salmonella* outbreaks in Argentina and 80% of the outbreaks in Sweden, respectively, occurred in residences or food shops.

Surveillance of foodborne diseases is becoming more important in the control and prevention of food pathogens. However, the quality of reported data by the Surveillance Services needs to be improved in order to originate reliable conclusions and appropriate decisions. In addition, it is important to implement Good Manufacturing Practices, and the principles of the Hazard Analysis of Critical Control Point (HACCP) system to decrease the impact of foodborne diseases.

ACKNOWLEDGMENTS

We would like to thank the staff of Water and Food Microbiology Laboratory of LACEN/RS, and especially the Veterinarians Dr. Denise Maria da Silva Figueiredo and Dr. Clair Rejane Dutra, from the Health Secretary of Rio Grande do Sul, who have worked intensively to improve the regional Surveillance Service in the last years.

RESUMO

Salmoneloses no Rio Grande do Sul, Brasil, de 1997 a 1999

Salmonella spp. foi a principal causa de doenças transmitidas por alimentos nos últimos anos no estado do Rio Grande do Sul, sul do Brasil. Foram avaliados dados epidemiológicos de salmoneloses ocorridas durante o período de 1997 a 1999 fornecidos pela Divisão de Vigilância Sanitária do Rio Grande do Sul. Os seguintes fatores foram investigados: número total de surtos confirmados, número de pessoas envolvidas, incidência dos surtos de acordo com a estação do ano, idade e sexo das pessoas envolvidas, principais alimentos envolvidos, local de armazenagem dos alimentos envolvidos e local de ocorrência dos surtos e suas causas prováveis. Os resultados demonstraram 8217 pessoas envolvidas, das quais 1557 foram hospitalizadas. O maior número de surtos ocorreu durante a primavera, enquanto as pessoas na faixa etária de 16 a 50 anos foram mais frequentemente afetadas. O alimento mais comumente relacionado aos surtos foi a maionese caseira (42,45%), enquanto as principais causas das salmoneloses foram a utilização de matéria-prima sem inspeção (22,92%), na grande maioria ovos, e alimentos mantidos à temperatura ambiente por mais de 2 horas (20,55%). A maioria dos surtos ocorreu dentro de residências (43,70%) e estabelecimentos comerciais (25,21%).

Palavras-chave: *Salmonella* spp., surtos de doenças transmitidas por alimentos, salmonelose.

REFERENCES

1. Binsztein, N.; Eguier, T.; D'empaire, M. Epidemia de salmonellosis em Buenos Aires y sus alrededores. *Medicina*, Buenos Aires, 42: 161-167. 1982.
2. Caffer, M.I.; Eguier, T. *Salmonella* enteritidis in Argentina. *Int. J. Food Microbiol.*, 21: 15-19, 1994.
3. Cliver, D.O. *Foodborne diseases*. San Diego: Academic Press, 1990, Academic Press. Inc. San Diego, 191p.
4. Flores, M.L.; Silva, J.H.S.; Nascimento, V.P.; Kader, I.I.T.A.; Santos, L.R.; Pontes, A.P.; Salle, C.T.P.; Lopes, R.F.F. Detecção de *Salmonella* sp. em ovos de galinhas através da reação em cadeia pela polimerase-PCR. *Higiene Alimentar*, 15: 63-68, 2001.
5. Food and Drug Administration (FDA). *Bacteriological Analytical Manual*. 8. ed. Washington, 1995, 1050 p.
6. Food and Drug Administration (FDA). Center for Food Safety & Applied Nutrition *Foodborne pathogenic microorganisms and natural toxins handbook*. <http://vm.cfsan.fda.gov/.../chap1.html>>. Access 24/03/2001
7. Hao, Y.Y.; Scouten, A.J.; Brackett, R.E. Cheesecake: a potential vehicle for salmonellosis? *J. Food. Protect.*, 62: 26-29, 1999.
8. Hobbs, B.C.; Roberts, D. *Toxinfecções e controle higienico-sanitário de Alimentos*, Varela, São Paulo, 1999. 425 p.
9. Humphrey, T.J. Contamination of egg shell and contents with *Salmonella enteritidis*: a review. *Int. J. Food Microbiol.*, 21: 31-40, 1994.
10. Jay, J. *Modern food microbiology*. 5. ed. Chapman e Hall, New York, 1996, 516 p.
11. Khakhria, R.; Woodward, D.; Johnson, W. M.; Poppe, C. *Salmonella* isolated from humans, animals, and other sources in Canada, 1983-92. *Epidemiol. Infect.*, 119: 15-23, 1997.
12. Laconha, I.; López-Molina, N.; Rementeria, A.; Audicana, A. Perales, I.; Garaizar. Phage typing combined with pulsed-field gel electrophoresis and random amplified polymorphic DNA increases discrimination in the epidemiological analysis of *Salmonella enteritidis* strains. *Int. J. Food Microbiol.*, 40: 27-34, 1998.
13. Laconha, I.; Baggesen, D.L.; Rementeria, A.; Garaizar, J. Genotypic characterization by PFGE of *Salmonella enterica* serotype Enteritidis phage types 1,4,6, and 8 isolated from animal and human sources in three European countries. *Vet. Microbiol.*, 75: 155-165, 2000.
14. Lindqvist, R.; Andersson, Y.; Jong, B.; Norberg, P. A summary of reported foodborne disease incidents in Sweden, 1992 to 1997. *J. Food Protec.*, 63:1315-1320, 2000.
15. Lopalco, P.L.; Germinario, C.; Di Martino, V.; Frisoli, L.; Pagano, A.; Quarto, M.; Barbuti, S. Epidemiologic study and cost analysis of an *Salmonella* Enteritidis epidemic. *Ann Ig*, 12: 279-285, 2000.
16. Machado, J.; Bernardo, F. Prevalence of *Salmonella* in chicken carcasses in Portugal. *J. Appl. Bacteriol.*, 69: 477-480, 1990.
17. Miyamoto, T.; Horie, T.; Baba, E.; Sasai, K.; Fukata, T. Arakawa, A. *Salmonella* penetration through egg shell associated with freshness of laid eggs and refrigeration. *J. Food Protec.*, 61: 350-353, 1998.
18. Norling, B. *Food poisoning in Sweden: reports of a field survey*. National Food Administration, Uppsala, Sweden. Report No 41/94.
19. Peresi, J.T.M.; Almeida, I.A.Z.C.; Lima, S.I.; Marques, D.F. Rodrigues, E.C.A.; Fernandes, S.A.; Gelli, D.S.; Irino, K. Surtos de enfermidades transmitidas por alimentos causados por *Salmonella* Enteritidis. *Res. Saúde Pública*, 32: 477-483, 1998.
20. Pinto, S.A. Aspectos sanitários da salmonelose como uma zoonose. *Higiene Alimentar*, 14: 32, 2000.
21. Rio Grande do Sul. Secretaria Estadual da Saúde. Divisão de Vigilância Sanitária. *Relatório anuais de DTA*. Porto Alegre, 2001 (não paginada).
22. Santos, D.M.S.; Junior, A.B.; Fernandes, S.A.; Tavechio, A.T.; Amaral, L.A. *Salmonella* em carcaças de frango congeladas. *Pesq. Vet. Bras.*, 20: 39-42, 2000.
23. Scuderi, G.; Fantasia, M.; Filetici, E.; Anastasio, M.P. Foodborne outbreaks caused by *Salmonella* in Italy, 1991-1994. *Epidemiol. Infect.*, 116: 257-265, 1996.
24. Saeed, A.M. *Salmonella enterica* Serovar *Enteritidis* in humans and animals. Epidemiology, pathogenesis, and control. Iowa State University Press, Ames, 1999. 443p.
25. Tsen, H.Y.; Hu, H.H.; Lin, J.S.; Huang, C.H.; Wang, T.K. Analysis of *Salmonella typhimurium* isolates from food-poisoning cases by molecular subtyping methods. *Food Microbiol.*, 17: 143-152, 2000.