

REFERENCES

1. Smithsonian Institution. Cerro Negro. Bull Global Volcanism Network 1992 Apr: 7-9.
2. Naciones Unidas. Emergencia erupción "Volcán Cerro Negro" Managua, Nicaragua: UN, April 1992.
3. Census projections. Department of León, Nicaragua. Sistema Local de Atención Integral en Salud, 1992.
4. Vandenbrouke JP. A shortcut method for calculating the 95 per cent confidence interval of the standardized mortality ratio. Am J Epidemiol 1984; 115: 303-4.
5. Rocha JC, Ordonez, AM. Accidentes del 10 al 14 de Abril emergencia, HEDRA, 1992. Ministerio de Salud, Oficina de Vigilancia Epidemiológica, Region 2, April, 1992.
6. Personal communication. Ing. Helman Taleno, Instituto Nicaragüense de Estudios Territoriales, Managua, Nicaragua. April 21, 1992.
7. Personal communication. Dr. Ricardo Cuadro, Hospital Escuela Dr. Oscar Danilo Rosales A., León, Nicaragua. April 21, 1992.
8. Personal communication. Dr. Mariana Guido Real, Sistema Local de Atención Integral en Salud, León, Nicaragua. April 23, 1992.
9. Personal communication. Dr. Roberto López, Oficina Panamericana de Salud, Managua, Nicaragua. April 20, 1992.
10. Weniger BG, Blaser MJ, Gedrose, J, Lippy EC, Juranek DD. An outbreak of waterborne giardiasis associated with heavy water runoff due to warm weather and volcanic ashfall. Am J Public Health 1983; 8: 868-72.
11. Baxter PJ, Bernstein RS, Falk H, French J, Ing R. Medical aspects of volcanic disasters: an outline of the hazards and emergency response measures. Disasters 1982; 6(4): 268-76.
12. Personal communication. Hermana Rosa Marie, Religiosas de la Asunción, Lechecuagos, Nicaragua. April 21, 1992.

13. Baxter PJ. Volcanoes. In: Gregg MB, French J, Binder S, Sanderson L, editors. The Public Health Consequences of Disasters 1989. Atlanta: Centers for Disease Control, 1989.
14. Bernstein RS, Baxter PJ, Buist AS. Introduction to the epidemiological aspects of explosive volcanism. Am J Public Health 1986; 76 Suppl: 3-9.
15. Newhall C, Fruchter JS. Volcanic activity: a review for health professionals. Am J Public Health 1986; 76 Suppl: 10-24.
16. Bernstein RS, Baxter PJ, Falk H, Ing R, Foster L, Frost F. Immediate public health concerns and actions in volcanic eruptions: lessons from the Mount St. Helens' eruptions, May 18-October 18, 1980. Am J Public Health 1986; 76 Suppl: 25-38.
17. Dollberg, DD, Bolyard ML, Smith DL. Evaluation of physical health effects due to volcanic hazards: crystalline silica in Mount St. Helens volcanic ash. Am J Public Health 1986; 76 Suppl: 53-8.
18. Martin TR, Wehner AP, Butler J. Evaluation of physical health effects due to volcanic hazards: the use of experimental systems to estimate the pulmonary toxicity of volcanic ash. Am J Public Health 1986; 76 Suppl: 59-64.
19. Baxter PJ, Ing R, Falk H, Plikaytis B. Mount St. Helens eruptions: the acute respiratory effects of volcanic ash in a North American community. Arch Environ Health 1983; 38(3): 138-43.
20. Baxter PJ. Medical effects of volcanic eruptions. Bull Volcanol 1990; 52: 532-44.
21. Baxter PJ, Ing R, Falk H, French J, Stein GF, Bernstein RS, et al. Mount St. Helens eruptions, May 18 to June 12, 1980: an overview of the acute health impact. JAMA 1981 Dec 4; 246(22): 2585-9.
22. Yano E, Yokoyama Y, Nishii S. Chronic pulmonary effects of volcanic ash: an epidemiologic study. Arch Environ Health 1986; 41(2): 94-9.
23. Yano E, Yokoyama Y, Higashi H, Nishii S, Maeda K, Koizumi A. Health effects of volcanic ash: a repeat study. Arch of Environ Health 1990; 45(6): 367-73.
24. Seaman J, Hogg C. Volcanoes. In: Seaman, J, Lewesley S, Hogg C, editors. Contributions to Epidemiology and Biostatistics, Volume 5. Basel, Switzerland: S. Karger, 1984: 157-72.

25. Bernstein RS, Buist SA, editors. Public health aspects of volcanic hazards: evaluation and prevention of excessive morbidity and mortality due to natural disasters. Proceedings on volcanic hazards of the First International Symposium on Public Health in Asia and the Pacific Basin; 1983 Mar 3-11; Honolulu. Disasters 1984; 8(1): 6-8.
26. Smithsonian Institution. Cerro Negro. Bull Global Volcanism Network 1992 Mar: 2-3.
27. Leus X, Kintanar C, Bowman V. Asthmatic bronchitis associated with a volcanic eruption in St. Vincent, West Indies [letter]. Disasters 1981; 5: 67-9.
28. Boushey HA, Holtzman MJ, Sheller JR, Nadel JA. Bronchial hyperreactivity. Am Rev Respir Dis 1980; 121: 389-413.
29. Weiss ST, Tager IB, Weiss JW, Munoz A, Speizer FE, Ingram RH. Airways responsiveness in a population sample of adults and children. Am Rev Respir Dis 1984; 129: 898-902.
30. Bonis S, Salazar O. The 1971 and 1973 eruptions of Volcán Fuego, Guatemala and some socio-economic considerations for the volcanologist. Bull Volcanol 1973; 37; 1-7.
31. Field epidemiology training program. Philippine Department of Health: 1991 July-Dec; 4(2): 1-4.
32. Personal communication. Lindsay McClelland, Smithsonian Institution, Washington, D.C. August 3, 1992.
33. Walker GPL. Volcanic hazards. Interdisciplinary Science Reviews 1982; 7(2): 148-57.
34. Tomblin J. Management of volcanic emergencies. UNDRO News, 1987 Jul-Aug: 14-7.
35. Gordon D. What to do when trouble erupts: EMS and volcanoes. EMS Today 1987 March: 67-72.
36. Centro Regional de Sismología para América del Sur. Riesgo volcánico: evaluación y mitigación en América Latina. Lima, Peru: CERESIS, June 1989.

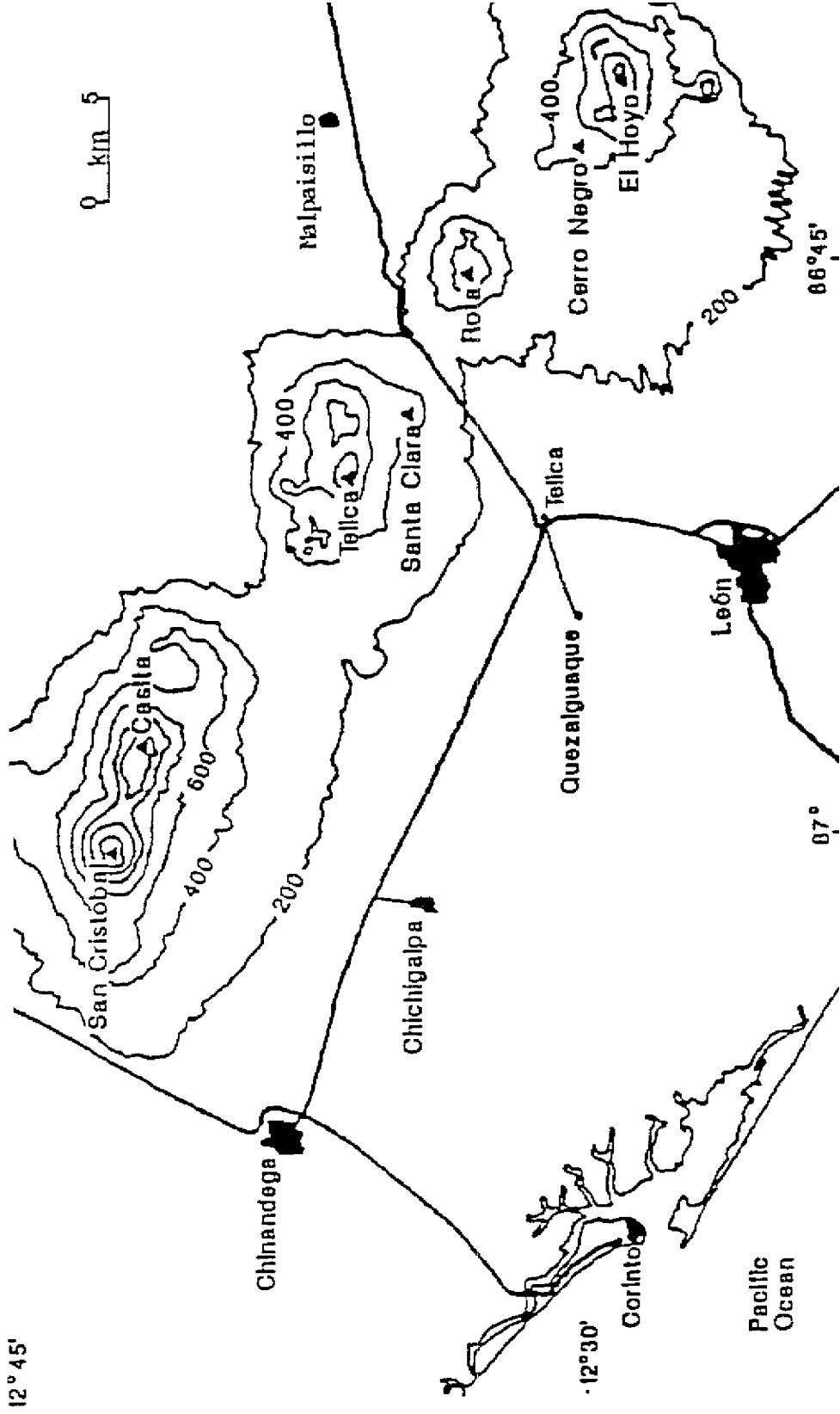
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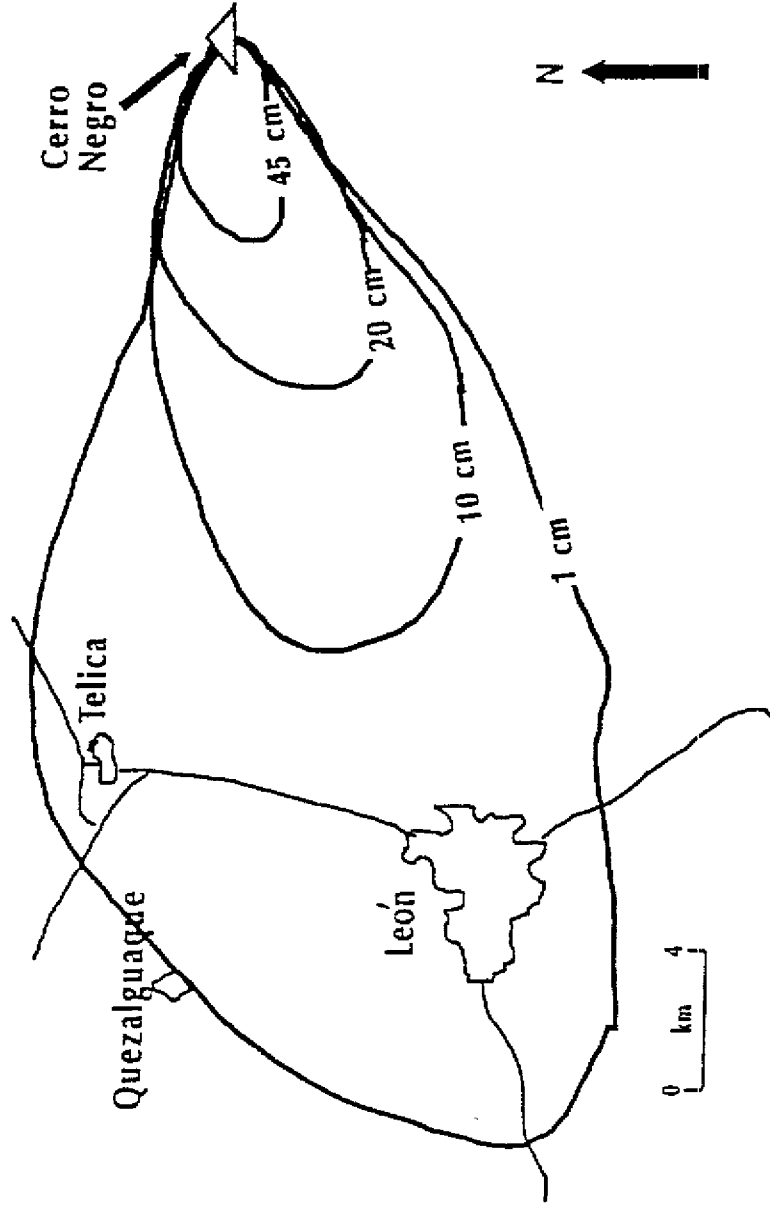
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Figure 1
Map with locations of Cerro Negro and neighboring volcanoes,
with nearby cities and towns affected by the eruption.



Contour interval, 200 m. Based on sheet ND 16-15 (Managua),
U.S. Defense Mapping Agency series 1501, Joint Operations Graphic (Ground).

Figure 2
Preliminary isopach map of ashfall deposits,
Cerro Negro, Nicaragua. April 9-14, 1992



Source: Instituto Nicaragüense de Estudios Territoriales

Figure 3

Weekly rates of reported health care visits for acute diarrheal diseases
Malpaisillo, Nicaragua, March 8 through April 18, 1992

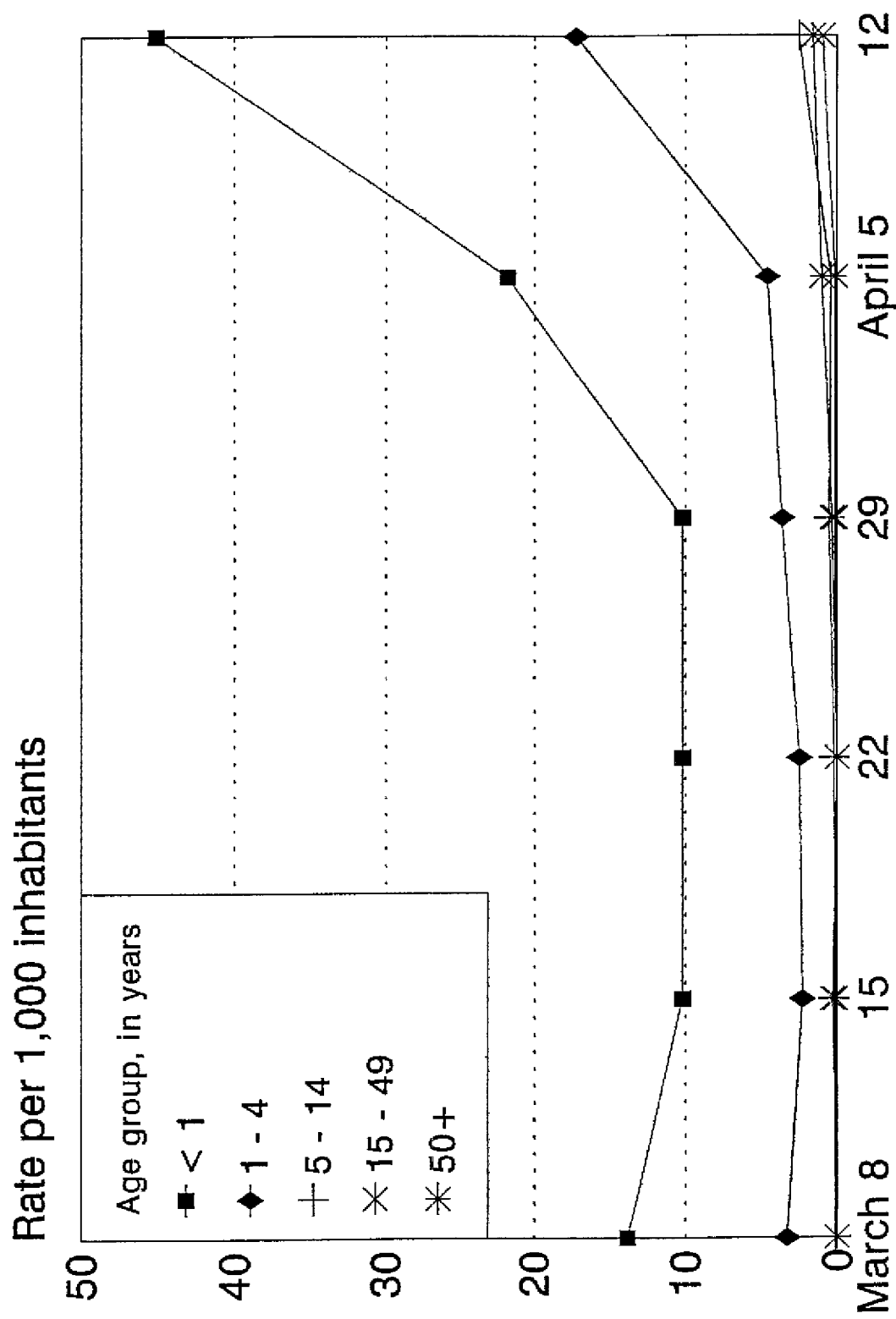


Figure 4

Weekly rates of reported health care visits for acute diarrheal diseases
Telica, Nicaragua, March 8 through April 18, 1992

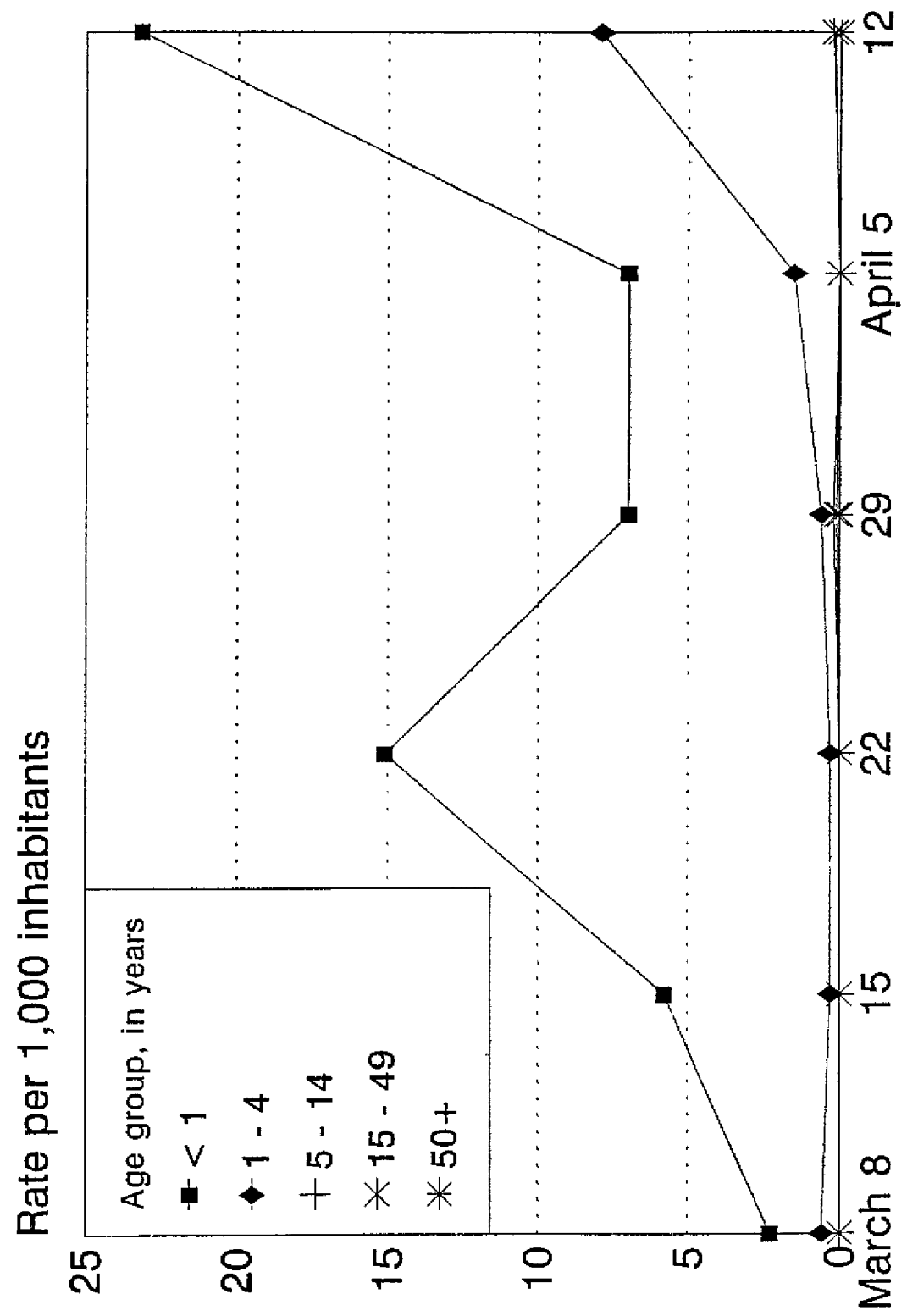


Figure 5
 Weekly rates of reported health care visits for acute respiratory diseases
 Malpaisillo, Nicaragua, March 8 through April 18, 1992

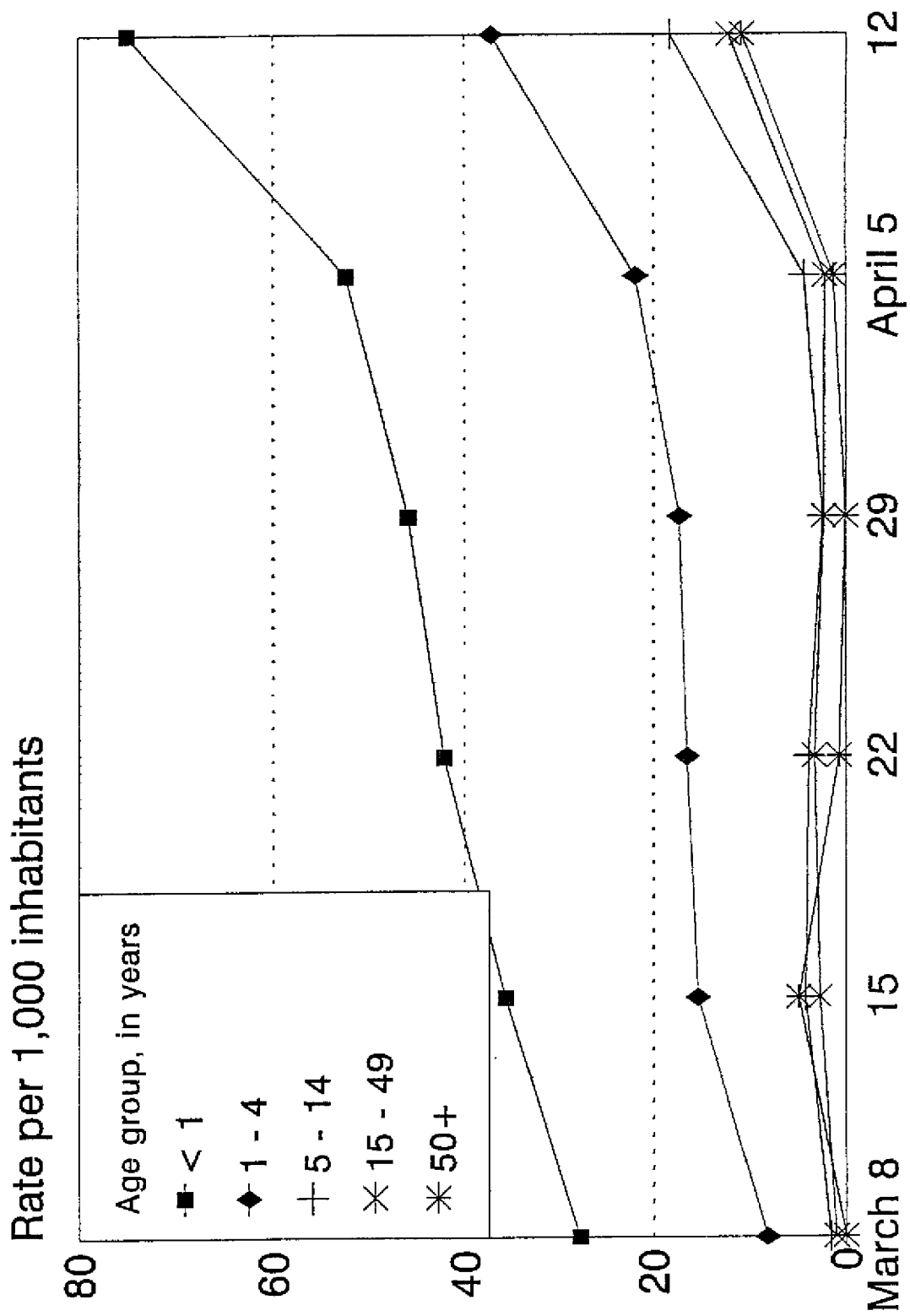


Figure 6

Weekly rates of reported health care visits for acute respiratory diseases
Telica, Nicaragua, March 8 through April 18, 1992

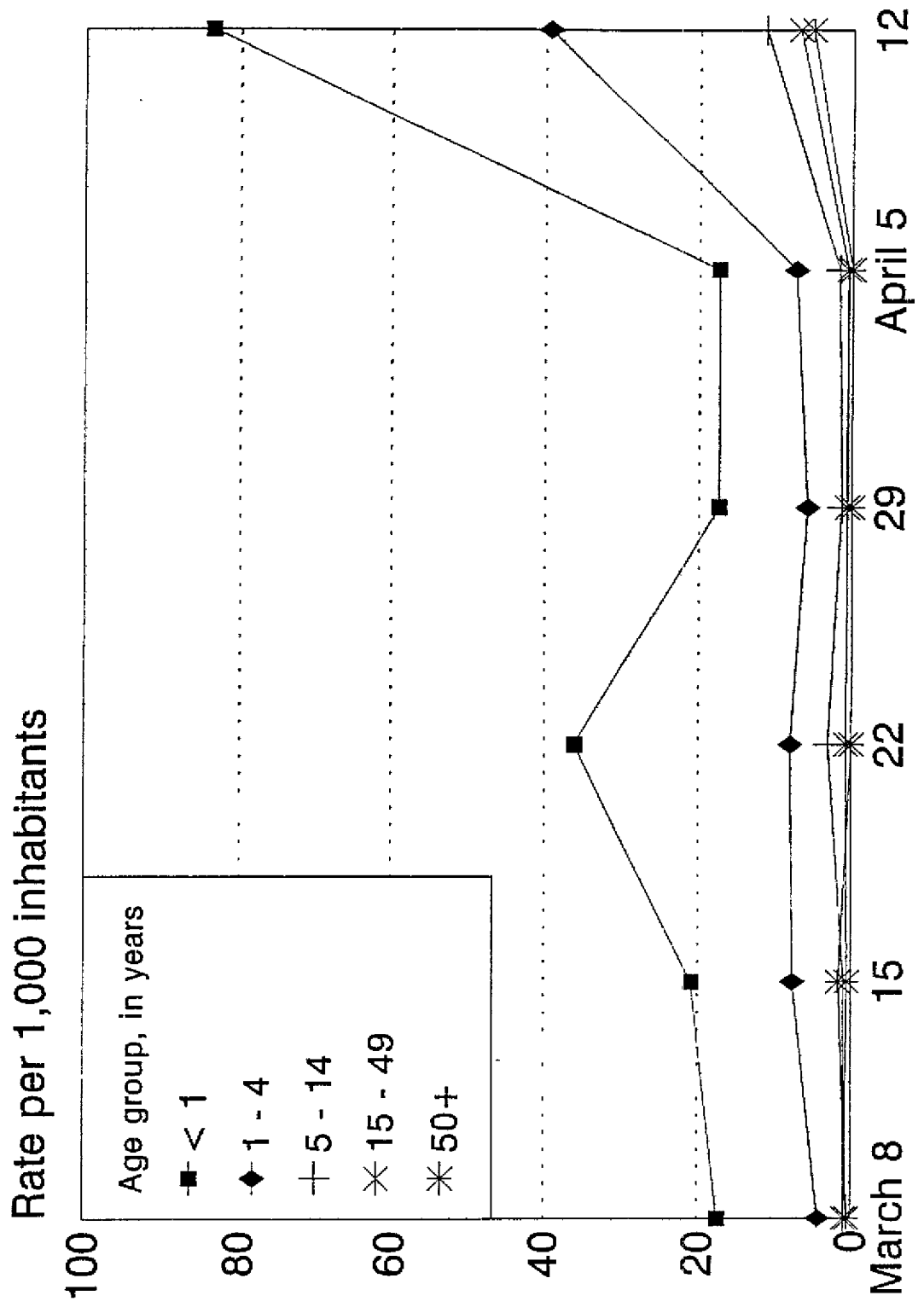
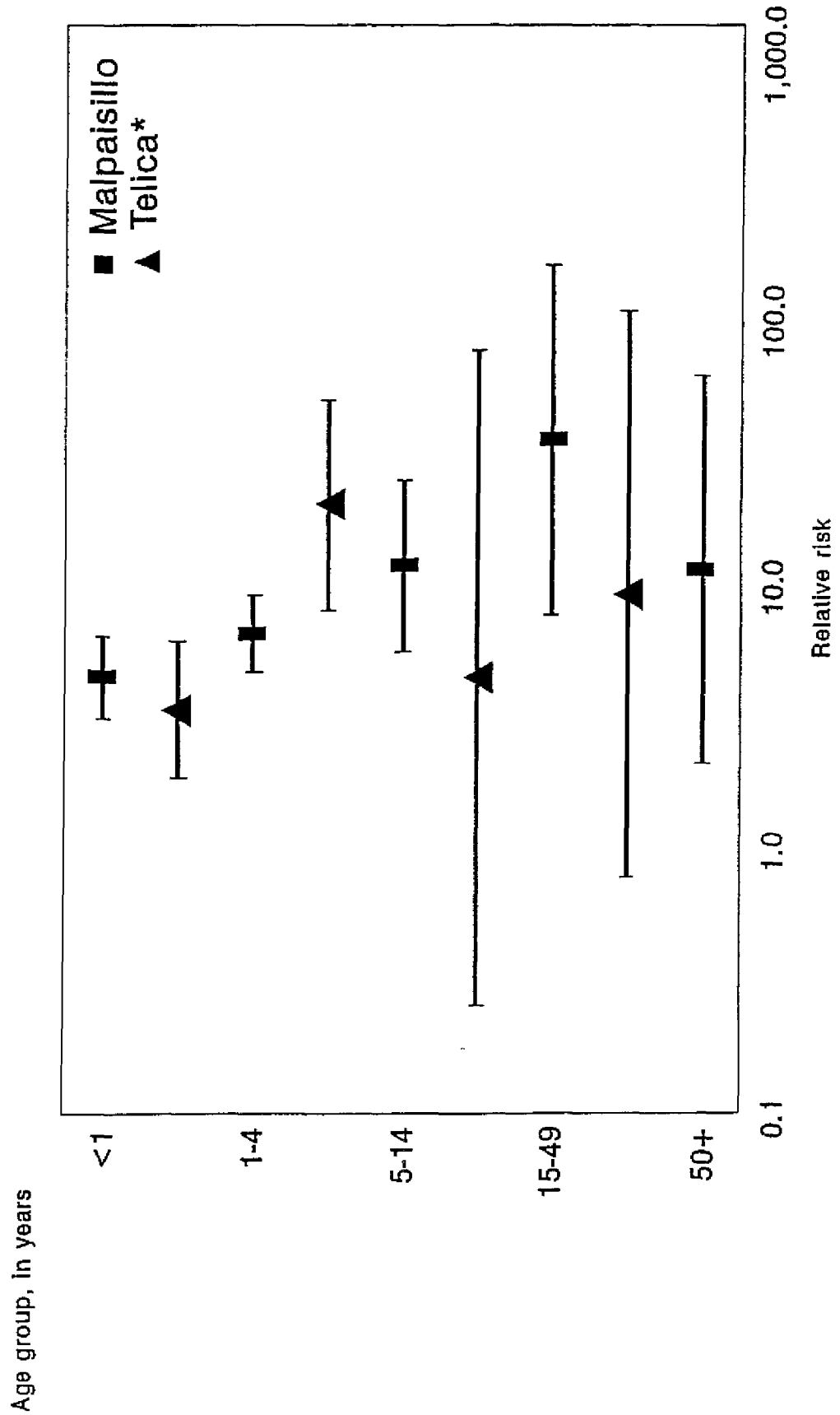


Figure 7. Relative risks and 95% confidence intervals for acute diarrheal diseases for pre- and posteruption periods, Cerro Negro, Nicaragua, 1992



*No cases observed posteruption for age group 50+ years in Telica

Figure 8. Relative risks and 95% confidence intervals for acute respiratory diseases for pre- and posteruption periods, Cerro Negro, Nicaragua, 1992

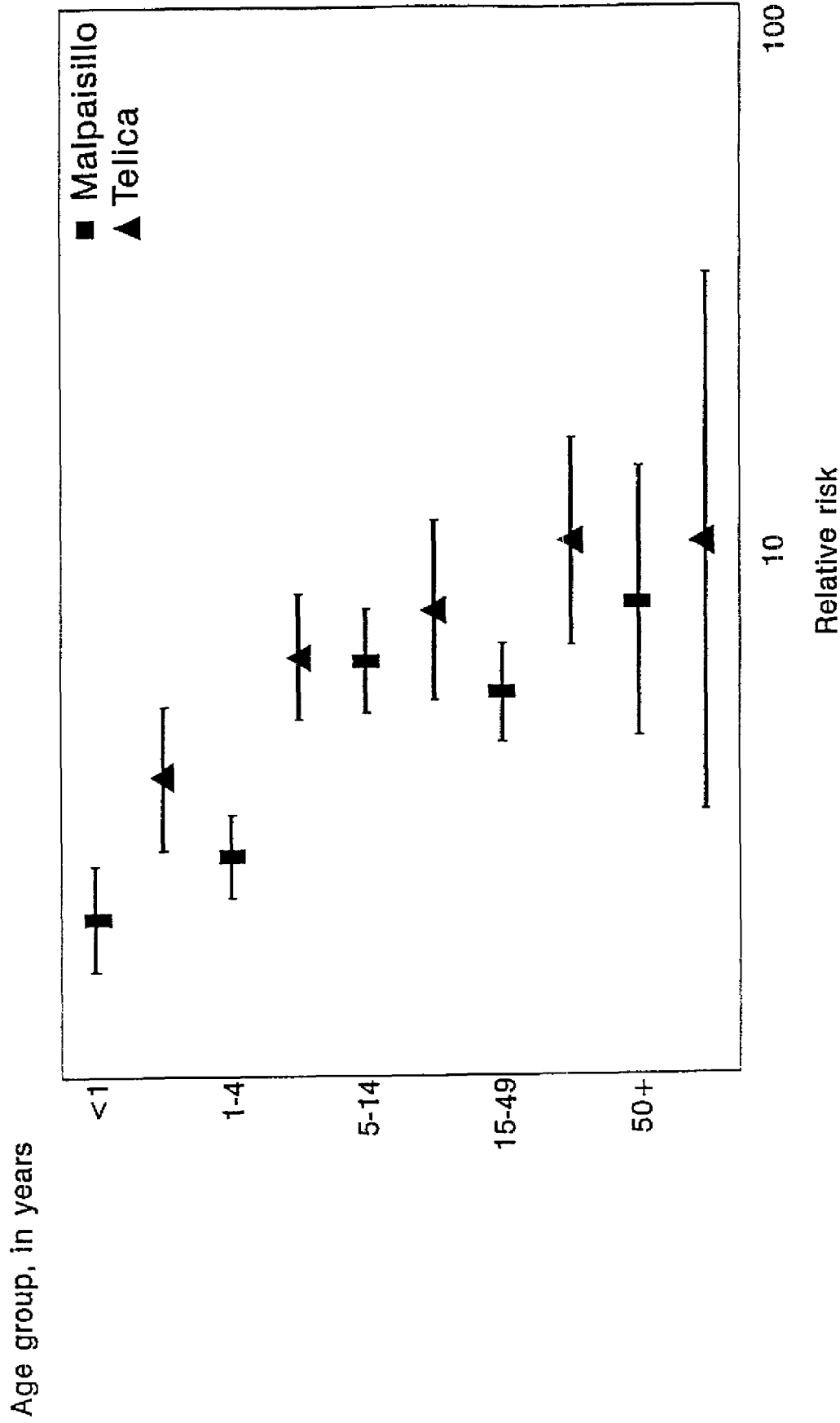


Table 1

Standardized morbidity ratio (SMR) for acute diarrheal diseases,
pre- and posteruption periods, Malpaisillo, Nicaragua

Age group, in years	Population projection, 1992	Pre-eruption morbidity rate per 1,000	* Expected no. of cases	** Observed no. of cases
<1	1,374	11.10	15.25	62
1-4	5,218	2.92	15.25	90
5-14	10,240	0.24	2.50	26
15-49	15,797	0.03	0.50	15
50+	3,063	0.16	0.50	5
TOTAL			34.00	198
SMR [95% confidence interval]			5.82	[5.04, 6.66]

Table 2

Standardized morbidity ratio (SMR) for acute diarrheal diseases,
pre- and posteruption periods, Telica, Nicaragua

Age group, in years	Population projection, 1992	Pre-eruption morbidity rate per 1,000	*Expected no. of cases	**Observed no. of cases
<1	861	7.55	6.50	20
1-4	3,272	0.46	1.50	26
5-14	6,420	0.04	0.25	1
15-49	9,905	0.03	0.25	2
50+	1,905	0.00	0.00	0
TOTAL			8.50	49
SMR [95% confidence interval]			5.76	[4.26, 7.49]

* March 8-April 4, 1992

** April 12-18, 1992

Table 3

Standardized morbidity ratio (SMR) for acute respiratory diseases,
pre- and post-eruption periods, Malpaisillo, Nicaragua

Age group, in years	Population projection, 1992	Pre-eruption morbidity rate per 1,000	* Expected no. of cases	** Observed no. of cases
<1	1,374	37.85	52.00	103
1-4	5,218	14.33	74.75	194
5-14	10,240	3.03	31.00	187
15-49	15,797	2.33	36.75	193
50+	3,063	1.39	4.25	33
TOTAL			198.75	710
SMR [95% confidence interval]			3.57	[3.31, 3.84]

* March 8-April 4, 1992

** April 12-18, 1992

Table 4

Standardized morbidity ratio (SMR) for acute respiratory diseases,
pre- and post-eruption periods, Telica, Nicaragua

Age group, in years	Population projection, 1992	Pre-eruption morbidity rate per 1,000	*Expected no. of cases	**Observed no. of cases
<1	861	22.94	19.75	72
1-4	3,272	6.42	21.00	129
5-14	6,420	1.52	9.75	73
15-49	9,905	0.68	6.75	68
50 +	1,920	0.52	1.00	10
TOTAL			58.25	352
SMR [95% confidence interval]			6.04	[5.43, 6.69]

* March 8-April 4, 1992

** April 12-18, 1992

Table 5

**Distribution and types of injuries treated in the emergency department,
Hospital Escuela Dr. Oscar Danilo Rosales A. (HEDRA), León, Nicaragua, April 10-14, 1992**

Type	Number	(%)
Roof-related	85	(54.1)
Non-intentional	33	(21.0)
Vehicular	17	(10.8)
Other	16	(10.2)
Violence	6	(3.9)
TOTAL	157	(100.0)

Source: Rocha, JC and Ordonez, AM. Accidentes del 10 al 14 de Abril emergencia, HEDRA, 1992. Ministerio de Salud, Oficina de Vigilancia Epidemiológica, Region 2, April 1992.

Table 6

Anatomic distribution of roof-related injuries treated in the emergency department, Hospital Escuela Dr. Oscar Danilo Rosales A. (HEDRA), León, Nicaragua, April 10-14, 1992

Type	Number	(%)
Multiple trauma	22	(25.9)
Upper extremities	20	(23.5)
Lower extremities	17	(20.0)
Thorax	16	(18.8)
Head	10	(11.8)
TOTAL	85	(100.0)

SOURCE: Rocha, JC and Ordonez, AM. Accidentes del 10 al 14 de Abril emergencia, HEDRA, 1992. Ministerio de Salud, Oficina de Vigilancia Epidemiológica, Region 2, April, 1992.

Table 7

Eruption-related injuries by sex treated in the emergency department, Hospital Escuela Dr. Oscar Danilo Rosales A. (HEDRA), León, Nicaragua, April 10-14, 1992

	Roof-related	Other	Total
Male	57	12	69 (68.3)
Female	28	4	32 (31.7)
Total (%)	85 (84.2)	16 (15.8)	101 (100.0)

Chi-square = 0.11
NS, p > 0.05

SOURCE: Rocha, JC and Ordonez, AM. Accidentes del 10 al 14 de Abril emergencia, HEDRA, 1992. Ministerio de Salud, Oficina de Vigilancia Epidemiológica, Region 2, April 1992.

Table 8

Distribution of injuries by age group.

Hospital Escuela Dr. Oscar Danilo Rosales A. (HEDRA), León, Nicaragua, April 10-14, 1992

Age group, in years	Roof-related	Other	Total	(%)
<1	0	1	1	(1.0)
1-4	0	3	3	(3.0)
5-14	19	5	24	(23.8)
15-49	55	5	60	(59.3)
50 +	11	2	13	(12.9)
Total (%)	85 (84.2)	16 (15.8)	101	(100.0)

SOURCE: Rocha, JC and Ordonez, AM. Accidentes del 10 al 14 Abril emergencia, HEDRA, 1992. Ministerio de Salud, Oficina de Vigilancia Epidemiológica, Region 2, April 1992.

Table 9

Anatomic distribution of injury by circumstance among hospitalized persons,
Hospital Escuela Dr. Oscar Danilo Rosales A. (HEDRA), León, Nicaragua, April 10-14, 1992

Circumstance	Head	Abdomen				Total	Total (%)
		Blunt	Penetrating	Spleen	Other		
Roof-related	4	2	1	1	9	(81.8)	
Motor vehicle incident	0	1	0	0	1	(9.1)	
Other	1	0	0	0	1	(9.1)	
Total	5	3	1	1	11		
(%)	(45.4)		(45.4)		(9.0)	(100.0)	