

**CHRONIC HAZARDS: HEALTH IMPACTS ASSOCIATED WITH ON-GOING
ASH-FALLS AROUND MT. TUNGURAHUA IN ECUADOR**

Graham A. Tobin
Department of Geography
University of South Florida
Tampa, Florida 33620-8100

Linda M. Whiteford
Department of Anthropology
University of South Florida
Tampa, Florida 33620-8100

1. INTRODUCTION

This research examines some of the health consequences of and the responses to ongoing volcanic activity in three Ecuadorian communities, Penipe, Baños and Pelileo. The primary aim of the research is to understand more fully the human consequences of natural disasters, particularly the resultant stressors caused by ash falls and enforced evacuation. The research builds on previous research in Ecuador that investigated the role of women in determining the health of household members affected by the volcano (Tobin and Whiteford 2001, 2002a; Whiteford et al. 2002) and factors influencing community resilience (Lane et al. 2004, Tobin and Whiteford 2002b; Whiteford and Tobin 2004).

After approximately eighty years of quiescence, Mount Tungurahua entered a new phase of activity in the fall of 1999. Major eruptions occurred in October 1999, August 2001, and August 2002, along with many smaller events that have created an unsafe human environment. The volcano has remained active throughout this period and has frequently deposited ash on the surrounding landscape and constantly threatens neighboring communities. There persists a distinct possibility that the volcano will yet erupt more violently leading to widespread death and destruction. A large-scale evacuation in October 1999, and another in August 2001 have further disrupted several communities. With this in mind, the research focused on two main themes; the impacts of evacuation and the effects of continuing ash fall on the health of local residents.

1.1 Ongoing Hazards

While all natural hazards represent ongoing threats, in the sense that an area is hazard prone, most are not considered *active* for long periods. The actual flood or earthquake, for instance, occurs and is then over, leaving the community to deal with the post-disaster event. The *threat* remains because the flood or earthquake will inevitably occur again. The hazards literature, then, is replete with studies examining immediate post-disaster impacts, but long-term concerns have received less attention (Mileti, 1999). Volcanoes, especially those associated with strato-volcanoes that have a potential for major eruptions, often present on-going hazard problems. Certainly a major eruption would be devastating for adjacent areas, as witnessed by the explosion of Mt St. Helens in 1980, which destroyed thousands of hectares of forest (Cook, 1981). However, more pervasive is the (often) smaller scale, secondary activity, in the form of minor eruptions, gas venting, ash falls,

pyroclastic flows, lahars, lava flows, mud flows, landslides, and flooding. Events such as these can continue intermittently for months or even years and hence present on-going problems that cause damages and losses for long periods (Chester, 1993; Smith, 1996). For instance, ash falls destroy crops, harm livestock, contaminate water supplies, and are implicated in the increase in respiratory diseases (Searl et al. 2002; Tobin and Whiteford 2001a). Communities in such areas, therefore, face a continuing battle, and recovery efforts can be curtailed by further geo-physical activity. Unfortunately, studies of the impacts of these on-going events on local populations are not common and they rarely address the contextual, cultural, political, and economic conditions that help precipitate the disasters.

1.2 Health and Disasters

There is now a substantial literature on various hazards and health concerns (see for example Noji 1997; Whiteford and Tobin 2004). With regard to volcanic activity, studies have focused primarily on the health impacts of exposure to volcanic ash and its effects on the respiratory system. Children and individuals with a history of respiratory problems appear to be most at risk, particularly when exposed to moderate or high levels of ash fall over extended periods of time (Forbes *et al.*, 2003; Bernstein *et al.*, 1986; Vallyathan *et al.*, 1984; Baxter *et al.* 1983). One recent study suggests that certain respirable particles in volcanic ash may potentially cause silicosis in populations residing in areas where ash fall is ongoing for several years (Baxter *et al.*, 1999, Forbes et al. 2003). Individuals who have previously suffered from pulmonary tuberculosis are also at risk, as the disease could be reactivated (Montserrat Volcano Observatory with Baxter *et al.*, 1998). In addition to respiratory problems, one study of children five and under living in communities affected by ash fall showed an increase in acute diarrheal diseases (Malilay *et al.*, 1996). Similarly, children around Tungurahua have suffered higher incidences of respiratory problems (Tobin and Whiteford 2001b).

1.3 Evacuation and Health

Other researchers have examined the impacts of evacuations on health (Inhorn and Brown, 2000). While evacuation strategies undoubtedly curtail loss of life from the particular geo-physical event, such as the volcanic eruption, they present their own potential health problems. Evacuation shelters are often overcrowded, sometimes unhygienic, and invariably provided with insufficient resources. Not surprisingly, these conditions are conducive to the rapid spread of infectious diseases. Furthermore, reduced food supplies may exacerbate the problems by compromising immune systems of many of those living in the shelters, especially those most vulnerable, such as young children and the elderly. Thus, it is not unusual to find higher than normal levels for such diseases in evacuation shelters.

1.4 Research Questions

Given the ongoing situation around Mt. Tungurahua, it was decided to examine the incidence of respiratory diseases among three different groups over several years. Four research questions were proposed as key to our understanding to what extent:

- does evacuation lead to higher levels respiratory disease when compared with non-evacuated populations?
- does exposure to ongoing, high levels of ash lead to higher levels of respiratory problems than those not living in high ash fall areas?
- do residents with evacuation and/or ash fall experience attribute their health problems to their personal experiences?
- have residents experiencing such difficulties done anything to mitigate any effects?

2. METHODOLOGY

To investigate the relationships between heavy ash fall and exposure patterns in enforced evacuations and the incidence of respiratory diseases a controlled comparison was developed using three communities adjacent to Tungurahua volcano in Ecuador. The first community, Penipe, has suffered heavy ash falls, but no forced evacuation; the second community, a barrio (neighborhood) in the town of Baños, has experienced forced evacuation but has had little ash fall; and the third community, a neighborhood in Pelileo, has suffered very little ash fall, no forced evacuation and hence constituted the control site. Information on ash exposure in each community was supplied by the Geophysical Institute in Quito. While an attempt was made when selecting research sites to control for critical social and economic differences, each of these communities was characterized by small differences in economic level and day-to-day living conditions. There were also differences in health and coping strategies for individuals from the three communities (Whiteford et al. 2002). Criteria used to select the research sites, apart from proximity to the volcano included: (i) Barrios had to be primarily residential and not highly commercial; (ii) Barrios had to be nucleated settlements and not spatially dispersed; (iii) population of the barrios had to be roughly comparable to that of Penipe; (iv) socioeconomic traits within the barrios had to be somewhat similar; and (v) houses in the barrios should have no cultivated lands or animal husbandry in relatively close proximity to the homes. This was accomplished by using the data from Penipe, the smallest site, as criteria for selecting the two barrios in Baños and Pelileo.

All sites share the experience of on-going risk, but they differ according to the degree of risk and exposures. Information from Penipe, therefore, provides insights into the effects of ash, while Baños data provide information on the effects of different evacuation strategies. Many Baños residents, it should be noted, broke down the military barricades and returned home before the emergency had been lifted. Indeed, the area around Tungurahua remains on orange alert except for the town of Baños. Both Baños and Penipe then address concerns of human health, as measured by infectious and respiratory diseases. The findings are then compared with the control group at Pelileo.

3.1 Health Data

Background data on health, specifically on acute respiratory infections (ARIs), were collected for every outpatient visit from 1995 through 2001 from archives in the health centers located in the three communities. Additional information was collected on infectious disease patterns for the same time-period. In both Baños and Pelileo, there is a canton hospital; these are small facilities with about 15 beds each. In Penipe there is only a small health sub-center.

3.2 Questionnaire Survey and Sample Strategy

A lengthy questionnaire survey was undertaken in each community. While the questions were wide ranging, covering social, economic and political concerns as well as health, only the results of those pertaining to some health and response activities are reported here. Participants had to meet certain criteria to be interviewed: being a parent of 18 years or older, living in the community for at least three years, and speaking Spanish fluently.

The questionnaires, administered by a team of trained interviewers (students from the Universities of South Florida and San Francisco Quito) began in Penipe then proceeded to Pelileo, and Baños. Of the 480 houses identified, contact was made with households in 359, of which 333 met the research criteria for the survey. Some houses were found to be unoccupied and others had apparently been abandoned, and hence no contact was made.

The team successfully completed 314 interviews (94.3 percent of the viable households); 105 in Penipe, 103 in Pelileo, and 106 in Baños (Table 1). The overall rejection rate based on viable households was 5.7 percent, and there was a 48 to 52 ratio of males to females.

TABLE 1.
QUESTIONNAIRE SAMPLE AND SURVEY STATISTICS

	PENIPE		BAÑOS		PELILEO		TOTAL	
	N	%	N	%	N	%	N	%
Houses	137	-	173	-	170	-	480	-
Contacts Made	121	88.3	109	61.3	132	77.6	359	74.8
Viable Contacts	109	90.1	109	100	115	87.1	333	92.8
Rejections	4	3.7	3	2.8	12	10.4	19	5.7
Interviews	105	96.3	106	97.2	103	89.6	314	94.3
Males	52	49.5	47	44.3	51	49.5	150	47.8
Females	53	50.5	59	55.7	52	50.5	164	52.2

3. RESULTS

3.1 Health

Between 1998 and 1999, the health status of people living in the Tungurahua province had improved in nutritional status and reduced incidence of respiratory disease (Departamento de Saneamiento Ambiental – Penipe 2002; SIISE no date). However, following the evacuation in 1999, health status declined in the affected communities (Figure 1). In the first six months of 2000, Ministry of Health data showed an increase in both malnutrition and incidence of tuberculosis. Indeed, outpatient visits increased in all three communities with Baños data peaking in 2000. In 2001, there were higher rates in both Baños and Penipe. The higher rates of incidence are even more pronounced if just the acute respiratory infections are considered (Figure 2). For instance, in the ash-affected study site, the incidence of respiratory disease tripled, particularly affecting children and the elderly (Departamento de Saneamiento Ambiental – Penipe 2002; SIISE no date). Other epidemiological data showed that there were higher rates in Penipe for several other illnesses including pneumonia and diarrhea, as well as a higher mortality rate throughout the Penipe canton. (Whiteford et al. 2002). While these data are only suggestive of a causal link with levels of ash, the current study supports these negative health trends. Specifically:

- Overall disease rates increased in Penipe and Pelileo in 1999, but decreased in Baños
- Outpatient consultation rates in Penipe were 4 times greater in 1999 from 1998
- In Penipe ARI rates increased significantly after the eruption
- In 2000, ARI represented 44% of all medical consultations in Penipe

FIGURE 1.
OUTPATIENT CONSULTATION RATES: 1995 - 2001

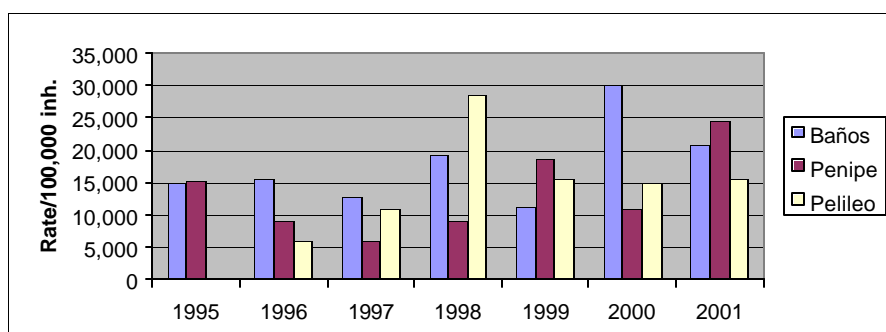
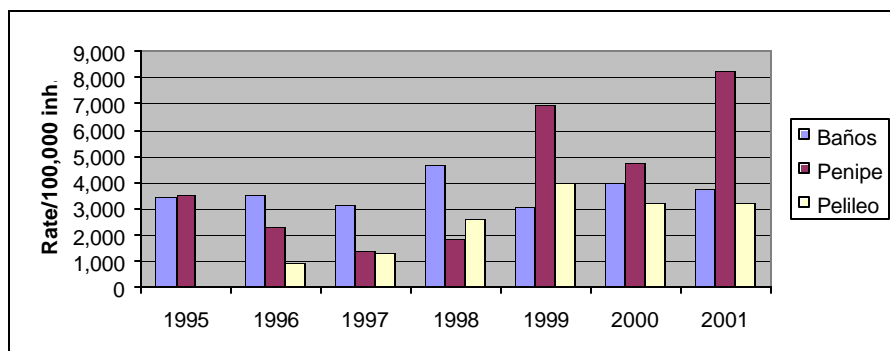


FIGURE 2.
OUTPATIENT CONSULTATION RATES: ACUTE RESPIRATORY INFECTIONS



3.2 Survey Results

Results from the questionnaire survey, especially of the self-reported illnesses, revealed slightly different patterns than those presented by the epidemiological data.

3.2.1 Ash Experience

Over eighty percent of Baños respondents reported that they had been exposed to ash at some time, whereas 94 and 98 percent of respondents in Penipe and Pelileo respectively said they had been exposed (Table 2). Furthermore, there was a significant difference in responses to the frequency of exposure to ash based on a Chi Square test (Table 3). The highest frequencies were recorded for the Penipe respondents with lower levels in Pelileo and Baños. For Baños and Penipe these findings matched the actual geo-physical data on the three communities, whereas Pelileo residents reported higher levels than expected.

TABLE 2.
REPORTED EXPOSURE TO ASH

Community	Yes		No		Total	
	N	%	N	%	N	%
Penipe (Ash)	99	94.3	6	5.7	105	100
Baños (Evacuated)	87	82.1	19	17.9	106	100
Pelileo (Control)	101	98.1	2	1.9	103	100
Total	287	91.4	27	8.5	314	100

$$\chi^2 = 18.65; 2 \text{ df}; P = 0.000$$

Participants had mixed perceptions regarding the degree to which the ash had affected their families (Table 4). Baños residents had by far the lowest response (43 percent), which corresponds to the data from the Geophysical Institute. In contrast, Pelileo, which has received very little ash according to the institute, had the highest response (90 percent). When asked specifically about the perceived risk of the ash to their health, 71 percent of Penipe residents and 65 percent of Pelileo residents believed that the ash constituted a risk (Table 5). Significantly, only 26 percent in Baños were of the same opinion. The relative dismissal of ash as a major health problem is common to the Baños responses for a variety of questions;

residents in Baños perceived fewer problems with the volcano than others in spite of their close proximity to Mt. Tungurahua.

TABLE 3.
REPORTED FREQUENCY OF EXPOSURE

Community	Rarely or Infrequently		Regularly		Often or Very Frequently		Total	
	N	%	N	%	N	%	N	%
Penipe (Ash)	22	22.4	42	42.9	34	34.7	98	100
Baños (Evacuated)	64	73.6	7	8.0	16	18.4	87	100
Pelileo (Control)	65	64.4	18	17.8	18	17.8	101	100
Total	151	52.8	67	23.4	68	23.8	286	100

$\chi^2 = 60.17$; 4 df; P = 0.000

TABLE 4.
PERCEIVED EFFECT OF ASH ON RESPONDENT AND FAMILY

Community	Yes		No		Total	
	N	%	N	%	N	%
Penipe (Ash)	91	86.7	14	13.3	105	100
Baños (Evacuated)	45	42.5	61	57.5	106	100
Pelileo (Control)	93	90.3	10	9.7	103	100
Total	229	91.4	27	8.5	314	100

$\chi^2 = 75.63$; 2 df; P = 0.000

TABLE 5.
PERCEIVED RISK OF ASH TO FAMILY HEALTH

Community	Yes		No		Total	
	N	%	N	%	N	%
Penipe (Ash)	75	71.4	30	28.6	105	100
Baños (Evacuated)	28	26.4	78	73.6	106	100
Pelileo (Control)	67	65.0	36	35.0	103	100
Total	170	54.1	144	45.9	314	100

$\chi^2 = 50.39$; 2 df; P = 0.000

3.2.2 Response to Ash Falls

An assessment was made to try and determine the extent to which residents tried to mitigate the effects of the ash. The data in Table 6 indicate the percentage of respondents who undertook actions such as washing vegetables more carefully, covering water, sweeping roofs and using masks. As was expected given the lower overall concern expressed by Baños residents, they

undertook less action than residents of the other two communities. Penipe recorded the highest levels for all categories except “other.”

TABLE 6.
ACTIVITIES UNDERTAKEN TO COUNTER EFFECTS OF ASH

Community	Wash Vegetables		Cover Water		Sweep Roof		Use Face Mask		Other		Nothing	
	N	%	N	%	N	%	N	%	N	%	N	%
Penipe (Ash)	75	71.4	71	67.6	62	59.0	63	60.0	30	28.6	5	4.8
Baños (Evacuated)	30	28.3	35	33.0	28	26.4	31	29.2	23	21.7	5	4.7
Pelileo (Control)	65	63.1	68	66.0	57	55.3	58	56.3	34	33.0	5	4.9
Total	170	54.1	174	55.4	145	46.2	152	48.4	87	27.7	15	4.8

3.2.3 Reported Health Problems

Finally, respondents were asked about illnesses that had occurred in their families over the preceding six months. As shown in Table 7, the highest figures were recorded in Penipe reflecting the most health problems, but noticeably there was a majority of respondents in Baños and Pelileo also experienced respiratory problems. Those illnesses linked to ash and evacuation, such as respiratory, eye, skin and throat problems, therefore, showed high levels throughout the surveys.

TABLE 7.
REPORTED ILLNESSES OF RESPONDENTS OVER
PRECEDING SIX MONTHS

Community	Respiratory Problems		Gastro-Intestinal		Eye, Skin and Throat	
	N	%	N	%	N	%
Penipe (Ash)	82	78.1	44	41.9	68	64.8
Baños (Evacuated)	60	56.6	25	23.6	29	27.4
Pelileo (Control)	71	68.9	35	34.0	53	51.5
Total	213	67.8	104	33.1	150	47.8

4. CONCLUSIONS

Both the epidemiological and the questionnaire studies revealed some interesting patterns of illness in the three communities that were correlated with the eruptive activity of Mt. Tungurahua. In all cases, conditions in Penipe, where ash fall was heaviest and no evacuation has occurred, were the worst. However, outpatient consultation rates also increased in Baños after the initial eruption. What needs to be established more clearly, therefore, is if there is a causal relationship between ash and illnesses in this area. Similarly, those study participants from Baños, all of whom had been evacuated, exhibited higher levels of illnesses initially, but

then demonstrated a strong recovery, suggesting that home life is more healthy than that in evacuation shelters.

In answer to the first research question, therefore, Baños demonstrated a degree of resilience after the evacuation of 1999. Outpatient visits increased in 2000 and then fell in 2001. However, these levels may be compromised by incomplete data, since the hospital in Baños was effectively closed for over two months at the end of 1999 and for the first six months in 2000. Nevertheless, the rates for acute respiratory infections were low in comparison with Penipe, suggesting that the ash may be the causal agent. On the other hand, it appears that the evacuation did not have long-term consequences on respiratory illness in Baños. The epidemiological data did not indicate an increase in ARI outpatient consultation rates in Baños after 1999, and consequently, did not support the first research question for an association between evacuation experience and respiratory illness. The figures for Baños compared to the other two communities suggested that the health of the community rebounded relatively quickly after participants returned home in 2000. In addition, while economic conditions were difficult in Baños, exposure to ash fall was minimal which may be reflected in the lower rates for respiratory illness medical consultations.

The questionnaire data show that Baños residents do not perceive the volcano as a major threat to their health; this contrasts with the epidemiological record. The epidemiological data support the second research question, that exposure to high levels of ash fall is associated with people experiencing higher levels of respiratory problems compared to those not living in high ash fall areas. The data showed significant increases in outpatient consultation rates for ARI in Penipe in 1999 and 2001, both years characterized by high ash fall. The questionnaire data produced similar results, with high levels of illnesses reported in all categories.

Pelileo, the control site that has not experienced evacuation or heavy ash falls was characterized by relatively stable medical consultation rates throughout the time period. Therefore, the epidemiological data also supported the third research question. In 2000, Pelileo had the lowest ARI rate of the three sites, suggesting an association between lack of exposure to ash fall and evacuation experience with fewer respiratory problems.

The question remaining, therefore, is how to deal with communities' ongoing exposures to health risks. Continuing ash falls present serious problems that may have long-term consequences on the health of affected populations. Constant irritation of the lining of the lungs may predispose suffers to other, more serious pulmonary diseases such as TB. The elderly and young children, already the most vulnerable portions of any population, may be less able to fight off co-morbid illnesses than they would otherwise. And the young adult population who are actively engaged in income generation, often through hard, physical labor such as agriculture, may lose days to illness they would not have otherwise.

National Ministry of Health officials should be encouraged to work with local communities to develop mechanisms to reduce exposure, or otherwise mitigate the consequences. Local residents should be encouraged to adopt more aggressive strategies to combat the effects of the ash such as washing vegetables and covering water supplies, although living in a condition of chronic and ongoing exposure may require still more aggressive strategies. Economic, emotional, and cultural forces conspire to reduce the likelihood that people may easily move out of the ash exposed zones, thereby requiring increased governmental support in terms of epidemiological surveillance of ARIs and the development of health campaigns to assist people with early identification of ARIs before they become serious threats to health. It should be noted that Ecuador has experienced severe economic straits during the study period (Tobin and Whiteford 2002a)

The preliminary evidence from those evacuated also suggests that residents are more healthy when allowed to stay home rather than forced to flee. A strategy such as this, of course, must be balanced against the threat of a major eruption. Displacement is always a life-challenging experience. Evacuation policies too often are designed to advantage policy-makers and not necessarily those evacuated (Whiteford and Tobin 2004). These data suggest it is time for a close analysis of international and national disaster mitigation policies and their short and long-term health consequences. As the Tungurahua data suggest, populations evacuated once may not evacuate again. Given these findings, it may well be time for health and hazard mitigation professionals to turn their attention to alleviating health risks associated with either evacuation or prolonged exposures to risks. This challenge will not be easily met. It requires active cooperation among applied geographers and hazard specialists with health and policy professionals, and with those who study local and national cultural norms. But it is a challenge whose time has come.

5. REFERENCES

- Baxter, P.J., Bonadonna, C., Dupree, R., Hards, V.L., Kohn, S.C., Murphy, M.D., Nichols, A., Nicholson, R.A., Norton, G., Searl, A., Sparks, R.S.J., Vickers, B.P. 1999. Cristobalite in Volcanic Ash of the Soufriere Hills Volcano, Montserrat, British West Indies. Science 283:1142-1145.
- Baxter, P.J., Ing, R., Falk, H., Plikaytis, B. 1983. Mount St. Helens Eruptions: The Acute Respiratory Effects of Volcanic Ash in a North American Community. Archives of Environmental Health 38(3):138-43.
- Bernstein, R.S., Baxter, P.J., Falk, H., Ing, R., Foster, L., Frost, F. 1986. Immediate Public Health Concerns and Actions in Volcanic Eruptions: Lessons from the Mount St. Helens Eruptions, May 18-October 18, 1980. American Journal of Public Health 76(3) Suppl: 25-37.
- Chester, D. 1993. Volcanoes and Society. Edward Arnold: London.
- Cook, R.J. 1981. Impact on Agriculture of Mt. St. Helen's Eruption. Science 211:16-22.
- Departamento de Saneamiento Ambiental – Penipe 2002. Diagnóstico Rápido de Saneamiento del Cantón Penipe. Ing. Sandro Haro. Unpublished Report.
- Forbes, L., Jarvis, D., Potts, J., Baxter, P. 2003. Volcanic Ash and Respiratory Symptoms in Children on the Island of Montserrat, British West Indies. Occupational Environmental Medicine 60:207-211.
- Inhorn, M.C. and Brown, P.J. 2000. The Anthropology of Infectious Disease. In The Anthropology of Infectious Disease: International Health Perspectives. ed. M.C. Inhorn and P.J. Brown, Gordon and Breach Publishers: Amsterdam, The Netherlands.
- Lane, L.R., Tobin, G.A. and Whiteford, L.M. (2004) Volcanic Hazard or Economic Destitution: Hard Choices in Baños, Ecuador. Environmental Hazards: Human and Policy Dimensions, Global Environmental Change, Part B. 5:23-34.
- Malilay, J., Real, M.G., Ramirez Vanegas, A., Noji E., Sinks, T. 1996. Public Health Surveillance After a Volcanic Eruption: Lessons from Cerro Negro, Nicaragua, 1992. Bulletin of the Pan American Health Organization 30(3):218-26.
- Mileti, D.S. (ed.) 1999. Disasters by Design: A Reassessment of Natural Hazards in the United States. Joseph Henry Press: Washington, D.C.

- Noji, E. K. 1997. The Nature of Disaster: General Characteristics and Public Health Effects. In The Public Health Consequences of Disasters. E.K. Noji ed. Oxford University Press: New York and Oxford.
- SIISE, n.d. Datos territoriales – Indicadores básicos. Sistema Integrado de Indicadores Sociales del Ecuador. Statistical database of the Ecuadorian Government, <http://www.gov.ec/>. Accessed various dates 2000-2002.
- Smith, K. 1996. Environmental Hazards: Assessing Risk and Reducing Disaster. Routledge Press: New York.
- Tobin, G.A. and Whiteford, L.M. 2001a. The Role of Women in Post-Disaster Environments: Health and Community Sustainability. Technical Report prepared for The Center for Disaster Management and Humanitarian Assistance.
- Tobin, G.A. and Whiteford, L.M. 2001b. Children's Health Characteristics Under Different Evacuation Strategies: The Eruption of Mount Tungurahua, Ecuador. Papers and Proceedings of the Applied Geography Conferences 24:183-191.
- Tobin, G.A. and Whiteford, L.M. (2002a) Community Resilience and Volcano Hazard: The Eruption of Tungurahua and Evacuation of the Faldas in Ecuador. Disasters: The Journal of Disaster Studies, Policy and Management 26(1):28-48.
- Tobin, G.A. and Whiteford, L.M. 2002b. Economic Ramifications of Disaster: Experiences of Displaced Persons on the Slopes of Mount Tungurahua, Ecuador. Papers and Proceedings of the Applied Geography Conferences 25:316-324.
- Vallyathan, V., Robinson, V., Reasor, Mr., Stettler, L., Bernstein, R. 1984. Comparative in Vitro Cytotoxicity of Volcanic Ashes from Mount St., Helens, El Chichon, and Galunggung. Journal of Toxicology and Environmental Health. 14(5-6):641-54.
- Whiteford, L.M., Tobin, G.A., Laspina, C. and Yepes, H. 2002. In the Shadow of the Volcano: Human Health and Community Resilience Following Forced Evacuation. Technical Report prepared for The Center for Disaster Management and Humanitarian Assistance.
- Whiteford, L.M. and Tobin, G.A. 2004. Saving Lives, Destroying Livelihoods: Emergency Evacuation and Resettlement Policies. In Unhealthy Health Policies: A Critical Anthropological Examination. A. Castro and M. Springer, ed. AltaMira Press: Walnut Creek, California. Chapter 11.