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PUBLIC HEALTH SERVICE
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CDC--MOUNT ST. HELENS VOLCANO HEALTH REPORT #18 August 15, 1980

Clinical Aspects of Emergency Room Visits for Eye Problems, Yakima, Washington, May 18-June 14, 1980.

After the May 18, 1980, eruption, 2 types of ash fell in Yakima. Coarse granules resembling fine gray sand fell initially, followed by a fine gray powder similar to the ash that fell in the rest of central and eastern Washington.

Increased numbers of eye problems--foreign body, eye irritation or corneal abrasion, and conjunctivitis or "red eye"--were seen in the emergency room (ER) in 1 hospital in Yakima after the May 18 ashfall (CDC--Mount St. Helens Volcano Health Report #9, June 24, 1980). Another hospital reported the same pattern. The number of ER visits per week (excluding revisits) for eye conditions seen at the 2 hospitals for May 4-June 14, 1980, is shown in Table 1. The increase was especially marked the first 2 weeks (May 18-31, 1980) after the eruption.

Table 1. Eye Problems seen in 2 hospital emergency rooms in Yakima, Washington, May 4-June 14, 1980

Eye Problem	May 4-10	May 11-17	May 18-24	May 25-31	June 1-7	June 8-14
Foreign body	12	7	14	21	15	20
Irritation/abrasion	8	2	12	7	3	7
Conjunctivitis/"red eye"	3	5	6	7	3	3
Subtotal	23	14	32	35	21	30
Other Eye Conditions	9	4	4	4	7	11
Total	32	18	36	39	28	41

To determine whether any of these ER visits were related to the volcanic ash, the medical records for 129 (90%) patients with eye problems were reviewed for the 4-week period (May 18-June 14, 1980) after the ashfall. Patients who came to the emergency rooms with eye complaints were routinely examined with a slit lamp, and when indicated, fluorescein staining was done. A number of problems initially in the "other" category were diagnosed as chemical conjunctivitis.

A case was considered to be ash-related if "ash" or "sand" was mentioned in the history, the physical examination, or the diagnosis. The term "sand" was often used to describe the coarse ash particles.

Forty-two (33%) of the 129 patients had recorded histories indicating exposure to or physical findings attributable to (or diagnosed

as secondary to) volcanic ash (Table 2). Most (67%) of the patients were seen the first 2 weeks (May 18-31, 1980) after the ashfall.

Table 2. Ash-related eye diagnoses among ER records reviewed

Diagnosis	Number of Patients	Ash Related	Other
Foreign body	61	24 (39%)	37 (61%)
Corneal/abrasion	24	6 (25%)	18 (75%)
Conjunctivitis	35	12 (34%)	23 (66%)
Subtotal	120	42 (35%)	78 (65%)
Other Eye Conditions	9	0 (0%)	9 (100%)
Total	129	42 (33%)	87 (67%)

Ten (24%) of the patients were <15 years old (Table 3); 4 (40%) of them were playing with or throwing ash when the foreign bodies entered their eyes. Of the 32 patients ≥15 years old, 14 (44%) were outdoors; 11 (34%), 9 males and 2 females, were working in or cleaning ash at the time. Seven (17%) patients had onset of their symptoms while riding on or in their vehicles. Their activities included: riding on a motorcycle (1) or in the back of a pickup truck (1), driving (1) or riding as a passenger (1) in a car, and operating the car's ventilator (1) or air conditioner (2). The activities of 15 (36%) of the patients were not stated.

The 42 ash-related eye diagnoses included 24 (57%) of foreign body, 6 (14%) corneal abrasion, and 12 (29%) conjunctivitis. Of the 12 diagnoses of conjunctivitis, 4 (33%) were allergic (2 were "secondary to volcanic ash"), 2 (17%) irritative, 1 (8%) possibly infectious, and the rest (42%) unspecified.

The predominant complaint was foreign-body sensation (64%), irritation or redness (29%), pain (14%), tearing (5%), and swelling (5%). Other symptoms (10%) for patients with conjunctivitis included itching, burning, and photosensitivity.

Physical findings included foreign body (57%), corneal abrasion or scratches (36%), conjunctival injection/edema (33%) or hemorrhage (2%), conjunctivitis (17%), swollen eyelid or periorbital edema (2%), and exudate (2%).

Many of the clinical findings were associated with more than 1 diagnosis. For a few patients, the diagnosis was made by history alone--4 (17%) of the 24 patients who had a diagnosis of foreign body had no foreign body visible at the time of examination, but 3 (75%) of the 4 had some other finding such as corneal abrasion or conjunctival injection. For these reasons it is more useful to consider these conditions as a group.

Twenty-four patients were reported to have foreign bodies in locations including under the upper lid (8), in the lower conjunctival sac (3), in the medial canthus (2), and on the cornea (2). The exact locations of the foreign bodies were not stated for 8 (35%) patients. At least 11 (46%) patients had multiple foreign bodies (4), i.e., fine

Table 3. Characteristics of ER Patients Ash-Related Eye Problems, Yakima, Washington, May 18-June 14, 1980

	Foreign Body	Corneal Abrasion	Conjunctivitis	Total
Number of patients	24	6	12	42
Initial ER visit on:				
May 18-24	8	2	3	13
May 25-31	9	2	4	15
June 1-7	4	1	3	8
June 8-14	3	1	4	6
Age - range	2-59	7-58	2-61	2-61
- median	21	27	29	23
Sex - <15 yrs. (M/F)	2/3*	0/1	1/2	3/6*
≥15 yrs. (M/F)	13/5	1/4	5/4	19/13
all ages (M/F)	15/8*	1/5	6/6	22/19*
Activity:				
Outdoors	2	0	1	3
Throwing, playing with ash	4	0	0	4
Working (cleaning up ash)	7	1	3	11
On or in vehicle	3	2	2	7
Other	0	1	2	3
Not stated	8	2	5	15
Symptoms:				
Right eye	9	2	3	14
Left eye	14	2	3	19
Both eyes	1	1	4	6
Not stated	0	1	1	2
Tearing	2	0	0	2
Irritated/redness	4	1	7	12
Foreign body sensation	19	2	6	27
Pain	1	3	2	6
Swelling	1	0	1	2
Other	1	0	4	5
Physical examination:				
Visual acuity, >20/30 in 1 eye	16	4	8	28
<20/50 in both eyes	2	0	1	3
not stated	6	2	3	11
Patients - wearing glasses	2	0	0	2
- wearing contacts	0	0	1	1
- not stated	22	6	11	39
Foreign body	21	2	1	24
Corneal abrasion/scratches	5	6	4	15
Conjunctival injection	5	4	5	14
Conjunctivitis	1	2	4	7
Other	3	0	4	7
No abnormalities found	1	0	1	2
Diagnosis, "secondary to ash"	5	1	2	8

*Sex of 1 child unknown

particles described as "ash," "sand," or "grit," (7). All of these foreign bodies were removed without difficulty and without sequelae.

Visual acuity was recorded for 32 (74%) of the 42 patients. Most (90%) of those tested had good vision (better than 20/30 in 1 eye). Only 2 (5%) of the patients were reported to be wearing glasses, and only 1 (2%) was reported to be wearing contact lenses.

Discussion

The increased number of ER visits for eye problems after the May 18 ashfall in Yakima can be largely attributed to volcanic ash. The larger ash granules can enter the eyes as foreign bodies and cause corneal abrasion and scratches, and the finer ash particles can cause irritation and inflammation of the conjunctivae.

Persons living in high ashfall areas should stay indoors if possible during windy or dusty conditions. Children should not play with the ash, and especially should not throw it at each other. Persons wearing contact lenses should remove them and wear corrective eyeglasses if their eyes are irritated when dust levels are high. Persons who must work or travel in dusty areas should consider protecting their eyes in addition to wearing face masks. CDC/NIOSH recommends the use of goggles in fine-dust environments, especially for persons suffering eye irritation (CDC--Mount St. Helens Volcano Health Report #11, July 2, 1980).

NOTE - Community surveys in ashfall areas show eye and upper respiratory tract irritations to be common symptoms produced by the ash. In the Moses Lake Survey (CDC--Mount St. Helens Volcano Health Report #7, June 17, 1980), 144 (37%) of 385 respondents reported eye irritation the week a the May 18 eruption. A similar proportion also reported nose and and throat irritation.

In a random telephone survey conducted by the Washington Department of Social and Health Services in late June 1980, 5% of residents Yakima and 8% of residents in Centralia complained of eye irritation a the ashfalls in the areas (Table 4). In Olympia, 4% of the respondent reported eye irritation following a light dusting of ash after the May eruption. In all 3 areas, about 10%-11% of these persons visited a physician for their eye problems.

Table 4. Telephone Survey Respondents Describing Eye Irritations Following Ashfall in Yakima, Centralia, and Olympia, Washington

City	Number of Respondents	Number with Eye Irritations	Number Who Sought Medical Care
Yakima	312	17 (5%)	2
Centralia	358	28 (8%)	3
Olympia	257	11 (4%)	1

Eye irritation was the most prevalent symptom attributable to the volcanic eruption of Mount Usu in Hokkaido, Japan. The health studies performed after the August 1977 eruption will be discussed briefly in the following section.

The Health Effects of the August 1980 Eruptions of Mount Usu Volcano, Hokkaido, Japan

The following was abstracted from a chapter on health effects in the report "Usu Eruption and Its Impact on the Environment," edited by Professor K. Seki, Graduate School of Environmental Science, Hokkaido University, December 1978. An English translation of this chapter by Mr. John Hada was provided to us through the courtesy of Mr. Robert Stevens, Regional Director, Region IX, FEMA.

On April 7, 1977, Mount Usu in Hokkaido, Japan, erupted after 33 years of dormancy. Ash clouds completely blackened the sky, and altogether 18 eruptions occurred during the week August 7-14, 1977. Some of the ashfalls were accompanied with rain. About two-thirds of all towns and cities in Hokkaido were affected by ashfall, with as much as 30-50 cm around the volcano and averaging 2-17 cm in various cities. Within a few days of the eruption, 6,500 inhabitants of 8 towns and cities were ordered to evacuate. There were no deaths or injuries from the eruptions.

Ash Analysis

The pumice and ash which fell ranged in diameter from 40 um to 10 mm, with a most common size of 2 mm. Over 85% of sedimented parti- greater than 15 um in Toyako Spa of Abuta. Air samples taken from road workers were reported to have dust concentrations of 0.018-0.435 mg/m^3. Ash samples were reported to contain 61%-67% SiO_2. There was no mention of the free (crystalline) silica content of the respirable-size ash particles.

Health Studies

Several studies were conducted 2-3 months after the eruptions in areas affected by ashfall and where evacuation had taken place.

In one early study, questionnaires were designed to collect information on not only the extent of property damage caused by the ash, but also the level of anxiety experienced by the residents during the eruptions and evacuation.

In a study aimed at identifying illnesses associated with the eruptions, over 400 residents of various areas were given a physical examination, chest x-ray, urinalysis, and questions on past illnesses and new symptoms. Many health problems were reported or discovered, but the investigators only regarded the 10%-20% complaints of cough and eye irritations ("eyes feel flicker or as if foreign body was being stuck in the eyes," "sticky secretion from the eyes or lacrimation," and "eyes ached, itchy, or red") to be attributable to the volcanic ash. Very few patients gave a history or were diagnosed to have asthma or chronic bronchitis.

In another study of eye and respiratory symptoms after the ashfall, similar complaints of eye, nose, and throat irritations were reported by residents and to a greater degree by outdoor construction workers and drivers. Unfortunately, the interpretation of the prevalence of respiratory symptoms is difficult for lack of previous medical histories and a suitable comparison group.

Primary school children in 2 areas were followed for the month of September 1977. The daily prevalence of cough (4%-15%), red eye (0-2%), nose irritation (1%-5%), and sore throat (3%-8%) were, with few exceptions, higher in the area with heavier ashfall (percentages shown are for heavier ashfall area). The proportion of children reporting insomnia decreased from 7%-8% at the beginning of September to 0-2% at the end of the month.

Discussion

If the physical and chemical characteristics of the sedimented ash reported are representative for the Mount Usu eruptions, it is unlikely that harmful quantities of ash particles would penetrate or persist in the lower respiratory tract. However, more accurate assessment of the potential respiratory risk can only be made with information on free crystalline silica in the respirable (<10 um) fraction of the dust. (CDC--Mount St. Helens Volcano Health Report #7, June 17, 1980).

The only health effects attributed to the eruptions were anxiety and irritations of the eye and upper respiratory tract based on surveys and examinations of residents in ashfall areas. The number of persons with chronic respiratory diseases (such as asthma and chronic bronchitis) were small in these studies and it is difficult to evaluate whether such high-risk individuals were more severely affected by the ash than the general population.

Follow-up of Migrant Agricultural Workers

Fruit-picking is well under way in the Yakima Valley, with peaches, pears, and nectarines being the main crop at present. Fruit trees are regularly watered along the ground and by spraying, and as a result, the ash lying around the trees is becoming incorporated into the soil or overgrown by new grass. A film of fine volcanic dust can be seen on most leaves and fruit, but it is firmly adherent and little becomes airborne when the branches are shaken. However, the dust can be easily rubbed off. Fruit-picking was not observed to be an especially dusty job, so exposure could vary with the speed at which different crops were picked. Apple-picking begins in a weeks, but it does not appear likely that exposures will be markedly different.

NIOSH performed personal monitoring on 11 migrant peach-pickers. On August 12-13 in an orchard close to Yakima where 1 inch of ash fell on May 18, the range for respirable dust was 0.01-0.39 mg/m^3 and the mean was 0.21 mg/m^3 (8-hour average). Assuming a free silica of 6%, these levels do not indicate the need for respiratory protection for the prevention of silicosis. However, it may be advisable for those workers who develop respiratory tract irritation or who have chronic lung disease to wear masks to prevent acute effects.

Total Suspended Particulates (TSP) Following the August 7, 1980 Eruption

Preliminary (elevated) TSP for August 8, 1980, at Wenatchee, Washington, reflects the trace ashfall at this location after the

August 7 eruption (CDC--Mount St. Helens Volcano Health Report #17, August 8, 1980). Seattle and Spokane did not receive any appreciable amount of ash from this eruption (Table 5).

Table 5. Preliminary Total Suspended Particulates (TSP) for Seattle, Wenatchee, and Spokane, August 7-8, 1980

	August 7,1980		August 8, 1980	
	Time Frame	TSP (ug/m^3)	Time Frame	TSP (ug/m^3)
Seattle	0-2400	74	1000-1530	15
Wenatchee	0-2400	290	0800-1600	830
Spokane	0-2400	132	0-2400	221

ERRATUM: CDC--Mount St. Helens Volcano Health Report #17, August 8, 1980, page 11, Table 6, the correct table is as follows:

Table 6
Total and Respirable Dust Concentrations
in Harvester Combines and Truck Cabins (8-Hour Sampling)

	Number of Samples	Total Sample		Respirable Sample	
		Average ($mg/^3$)	Range (mg/m^3)	Average (mg/m^3)	Range (mg/m^3)
Combines					
With A/C Cabs*	4	5.82	4.24-8.2	0.4	0.17-0.74
Without A/C Cabs	2	191.	32.6-349.	2.24	2.2-2.38
Trucks	5	2.1	1.7-2.75	0.35	0.21-0.5

*Air-conditioned

CDC--Mount St. Helens Volcano Health Reports will be published once a week until further notice. Information in these reports represents the latest data reported to CDC; much of the information is preliminary in nature and subject to confirmation and change. It is distributed for the purpose of providing up-to-date health data from CDC and the many other groups involved in public health assessment. We hope to continue to receive relevant reports and data from others working on this problem.

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