PESTICIDES IN INTENSIVE CULTIVATION: EFFECTS ON WORKING CONDITIONS AND WORKERS' HEALTH[1]

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INTRODUCTION

Because Argentina is a predominantly agricultural and stockraising country, its use of pesticides is very substantial. One measure of this is the dollar value of pesticide sales, which totaled US$180 million in 1983 *(1)*. Most of the products involved—including a wide range of insecticides, fungicides, and herbicides—are formulated from imported raw materials *(2)*.

Many studies have been published on the acute toxic effects of exposure to various individual pesticides. However, few studies deal with chronic effects occurring among population groups occupationally exposed to multiple pesticides *(3-5)*. It is known, of course, that diverse pesticides—including various organophosphates, organochlorines, carbamates, and others—can affect fertility, induce teratogenic and genetic defects, and cause cancer *(6-11)*. And it is known that workers engaging in the intensive cultivation of flowers and ornamental plants in greenhouses are regularly exposed to many different pesticides. Therefore, it seemed appropriate to study the occupational conditions, pesticide application procedures, state of health, and reproductive history of workers engaged in the intensive cultivation of greenhouse-grown flowers and potted ornamental plants.

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MATERIALS AND METHODS

The Study Population

The two groups of workers studied belonged to families of predominantly Oriental stock. These people usually lived in the places where they worked, and all household members typically participated in the work. The plants involved were grown in closed plastic greenhouses. In general, production of the cut flowers required more frequent use of pesticides than did production of the ornamental plants.

One of the two groups studied consisted of 154 individuals living in the community of La Capilla, Buenos Aires Province, 20 kilometers to the south of the city of Buenos Aires. The group's principal activity was growing flowers, especially carnations and chrysanthemums, for cutting. The other group consisted of 188 individuals belonging to the Japanese Tsubomi Association. The members of this group also resided in Buenos Aires Province, in an area extending from 15 to 40 kilometers north of the city of Buenos Aires. Their principal activity was growing ornamental plants in pots.

Data Collection

An interview survey of the flower growers was conducted at a community facility in April–December 1983 by three Japanese volunteers belonging to the study community. Survey interviews with the Tsubomi Association members were conducted at the members' households in July–December 1984 by five students from the University of Buenos Aires School of Public Health. In both cases, all family members except children were interviewed. Questions relating to children were answered by the children's parents. Information was requested on demographics, personal habits, the length of time in the line of work being studied, the types of tasks being done, pesticides used over the past 20 years, their period of use, and the types of protection normally used while applying pesticides. In addition, questions were asked (1) concerning the presence of acute and chronic intoxication symptoms that might have resulted from exposure to pesticides and (2) concerning the presence of malignant tumors. The information obtained was processed by the Data Computation Service of the National Institute of Agricultural Technology.

Retrospective information was collected about pregnancies and whether either of the parents was working or had been working at the onset of pregnancy. Information on spontaneous abortions, premature live births, and births of malformed infants was recorded.

The following definitions were adopted for purposes of the survey: An involuntary termination of pregnancy before the end of the sixth month of gestation was classified as a spontaneous abortion; a live birth in which the infant weighed less than 2,500 grams at birth, as well as one in which the mother made a direct reference to prematurity, was classified as a premature birth; and babies described by their mothers as having one or more congenital organic or functional defects were classified as malformed.

Three categories of individuals, presumed to have different levels of exposure to pesticides, were established for purposes of the analysis:

- *Applicators:* Individuals who were applying pesticides at the time of the

survey or had applied them in the past, in addition to doing other kinds of work.

- *Nonapplicators:* Individuals who were engaged in growing the plants but were not applying pesticides and had never done so.
- *Nonworkers:* Individuals who lived in the work area but were not involved in the growing operations.

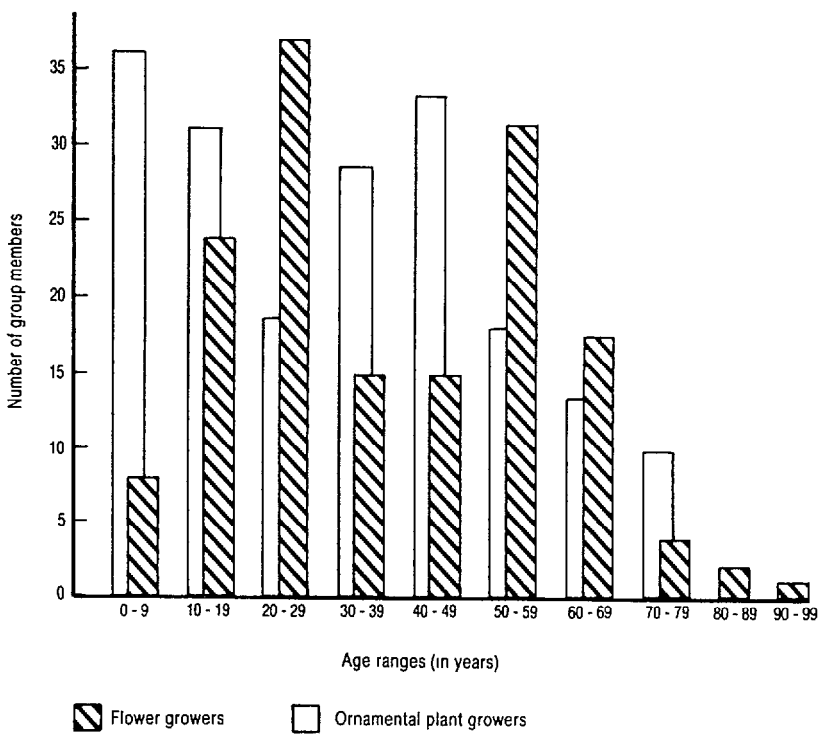
Results

The data collected from the two groups were analyzed in parallel. Figure 1 shows the age distributions of both groups. It will be noted that the ornamental plant growers tended to be younger than the flower growers, some 20% being youngsters less than 10 years old.

The educational levels of the two groups also differed. Specifically, 79% of the plant growers over 14 years of age had received at least some secondary schooling, whereas only 46% of the flower growers over age 14 had done so.

Over 90% of the members of both groups lived at their place of work and worked seven days a week without regard to any specified schedule of hours. Also, more than 70% of the workers in both groups had devoted 10 or more years of their lives to their particular line of work. The tasks performed by members of the two groups were similar. Among other things, both prepared the land, tilled the soil, applied pesticides,

FIGURE 1. Distribution of members of the two study groups by age.



and transplanted plant material. The flower growers performed a number of additional tasks that varied with the type of flower—tasks including the removal of excess buds, flower cutting, and flower packing.

Both groups of workers used broadly varied combinations of pesticides. The ornamental growers used more products but applied them less frequently, at most once a month, while the flower growers applied some type of pesticide at least once a week. Both groups applied pesticides anytime during the work day, and in many cases a reasonable length of time did not elapse before greenhouse work resumed.

Figure 2 shows the major pesticides used during the 20 years preceding the survey. These products are grouped into four general categories, these being the organochlorines, organophosphates, carbamates, and others ("miscellaneous"). Figure 3 indicates how the patterns of pesticide use have changed over the last 20 years, according to the recollections of those surveyed.

FIGURE 2. Pesticides said to have been used by members of the two study groups in the 20 years preceding the 1983 interviews, by pesticide categories (organophosphates, organochlorines, carbamates, and others), showing the percentages of study group members using the listed products.

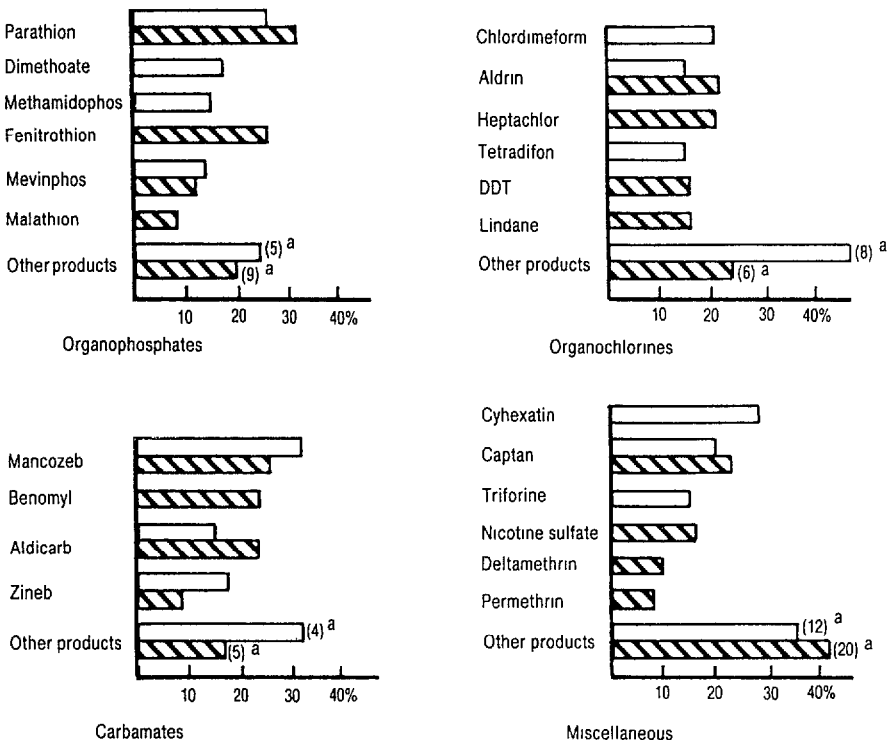
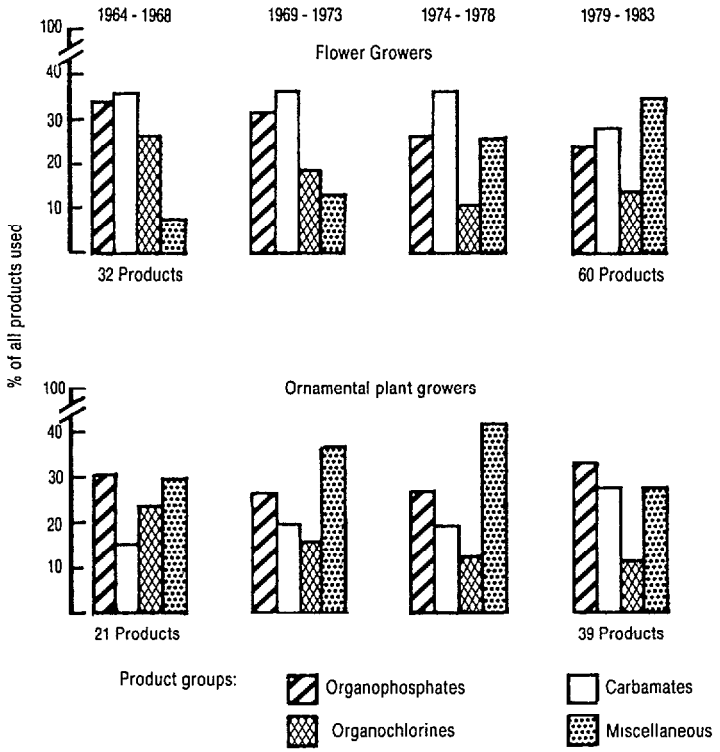


FIGURE 3. Evolution of pesticide use by members of the two study groups, 1964-1983.



These data suggest that the use of organochlorines declined among both groups of workers. Also, the flower growers appeared to make increasing use of products in the miscellaneous category and somewhat less use of organophosphates, while the growers of ornamentals continued to make extensive use of organophosphates and increased their use of carbamates.

Table 1 groups the study subjects by sex and according to whether they applied pesticides, worked in the nursery but did not apply pesticides, or did not work in the nursery. These data indicate that most of the pesticide applicators were men and that most of the women engaged in nursery work but did not apply pesticides.

Table 2 groups the pesticide applicators according to the protective measures they reported taking, the frequency with which they changed work clothes, and the frequency with which they smoked, drank, or ate food while working. The data gathered indicate that most of the applicators took some protective measures but not all of those specified in the table. Also, while most applicators did not smoke, drink, or eat while they worked, few changed their work clothes daily. No correlation was found between the workers' educational levels and their use of protective gear.

TABLE 1. Distribution of the two study groups according to sex and their presumed degree of exposure to pesticides (as applicators, workers who did not apply pesticides, and nonworkers), Buenos Aires, 1983.

Exposure category	Flower growers			Ornamental plant growers		
	M	F	Total	M	F	Total
Applicators	61	12	73[a]	68	12	80[a]
Nonapplicator workers	13	52	65	10	45	55
Nonworkers	9	7	16[b]	23	30	53[c]
Total	83	71	154	101	87	188

[a] None less than 15 years old.
[b] Twelve less than 15 years old.
[c] Forty-three less than 15 years old.

TABLE 2. Classification of the applicators in the two study groups by the completeness of protective measures taken, the frequency of work clothing changes, and the frequency of smoking, eating, or drinking on the job.

	Flower growers		Ornamental plant growers	
	No.	%[a]	No.	%[a]
Protective measures taken:				
Complete[b]	15	20.5	5	6.3
Incomplete[c]	51	69.9	51	63.8
None	6	8.2	23	28.8
Work clothes changed:				
Daily	10	13.7	21	26.3
2–3 times per week	57	78.1	40	50.0
Once a week	5	6.8	17	21.3
Smoke, drink, or eat during work:				
Never	49	67.1	51	63.8
Occasionally	21	28.8	16	20.0
Always	1	1.4	12	15.0

[a] Less than 100% in most cases because of a few applicators for whom specific information was not available.
[b] Complete protection: simultaneous use of at least a mask, gloves, and special clothing while applying pesticides.
[c] Incomplete protection: any protective measures that do not include all those specified above

Despite proximity between the workers' homes and the greenhouses, no cases were found in which household utensils or areas of the home were used for preparing pesticide mixtures.

Table 3 shows the symptoms of acute intoxication encountered in each population group. Among the flower growers, two individuals suffered convulsions as a result of intoxication by Captafol (an organic fungicide), and one person went into a coma because of exposure to Temik (a carbamate whose active principle is Aldicarb). No particular group of symptoms was found to be more frequent than any other. Ten individuals among the flower growers and 29 among the ornamental growers were found to have suffered isolated symptoms.

Table 4 shows data on individuals experiencing symptoms of acute and chronic intoxication, grouping them by their presumed levels of exposure (i.e., whether they were applicators, nonapplicator workers, or nonworkers). With regard to symptoms of acute intoxication, the percentage of applicators experiencing such symptoms exceeded the percentage of nonapplicators experiencing them—among both ornamental growers and flower growers—but these differ-

TABLE 3. Symptoms of acute intoxication reported for members of the two study groups, in order of frequency.

	Flower growers		Ornamental plant growers	
	No. with symptoms	% with symptoms	No. with symptoms	% with symptoms
Cough and sputum	7	18.9	10	12.0
Tears	6	16.2	20	24.2
Runny nose	5	13.5	16	19.3
Blurred vision	6	16.2	12	14.5
Vomiting	5	13.5	10	12.0
Diarrhea	4	10.8	9	10.8
Convulsions	2	5.4	0	0.0
Salivation	1	2.7	6	7.2
Coma	1	2.7	0	0.0
Total symptoms reported	37	100	83	100
Total no. of subjects with symptoms	19		38	
% of study group with symptoms		12.3		20.2

TABLE 4. Distribution of individuals experiencing acute and chronic symptoms in the two study groups, by pesticide-related activities (pesticide application and greenhouse work).

	Individuals with reported symptoms of intoxication							
	Acute symptoms				Chronic symptoms			
	Flower growers		Ornamental plant growers		Flower growers		Ornamental plant growers	
	No. with symptoms	% with symptoms	No. with symptoms	% with symptoms	No. with symptoms	% with symptoms	No. with symptoms	% with symptoms
Applicators	13	17.8	21	30.0	52[a]	71.2	69	86.3
Nonapplicators	6	9.2	12	21.8	34[a]	52.3	41	74.5
Nonworkers	0	0.0	2	3.8	1	6.3	25	47.0
Total	19	12.3	35	18.6	87	56.5	135	71.8

[a] Difference statistically significant by Chi^2 test ($p<0.01$).

ences were not statistically significant. Among the nonworkers, only two of those in the ornamentals group reported having symptoms of acute intoxication.

Regarding symptoms of chronic intoxication, applicators among both the flower and ornamental groups appeared more likely than other workers to show chronic symptoms suspected of being caused by exposure to pesticides. The observed differences in these numbers were not statistically significant for the ornamental growers but were statistically significant ($p<0.01$) for the flower growers. It also appears that the high percentage of nonworkers in the ornamental plant group who were reported to

have possible pesticide-related symptoms merits further investigation.

The distribution of chronic symptoms suspected of being pesticide-related, by study group and site of the symptoms, is shown in Table 5. This distribution was similar for the two study groups, most commonly involving the central nervous system or limbs (arms and legs).

For the applicators, use of complete protective measures appeared to have a major impact upon development of chronic symptoms. Specifically, only 20% of those among the flower growers and 17% of those among the ornamental plant growers who adopted complete protective measures reported chronic symptoms, as compared to 84% of the flower growers and 93% of the ornamental plant growers who applied pesticides but adopted incomplete protective measures or none at all. Two individuals with previously diagnosed malignant tumors were found in each of the two study groups.

Table 6 shows the number of pregnancies that terminated with spontaneous abortions or premature births in both groups. The estimated relative risk (RR) of spontaneous abortion showed no clear-cut trend, the percentage of such abortions being greater among flower group members when neither parent worked and greater among ornamental group members when at least one parent worked. The percentage of premature live births was somewhat higher among the ornamental growers when at least one parent worked. In the case of premature live births among the flower growers the data are meaningless, because all of the premature live births recorded pertained to the same mother.

Malformations were observed in two children, both of whom belonged to the ornamentals group.

Discussion

The main purpose of the study reported here was to assess the working conditions and pesticide use procedures of workers engaged in two types of intensive plant cultivation in the

TABLE 5. Symptoms of chronic intoxication reported for members of the two study groups, classified according to the bodily system or area affected.

System or area affected	Flower growers with symptoms		Ornamental plant growers with symptoms	
	No.	%	No.	%
Central nervous system	123	39.5	215	43.3
Arms and/or legs	81	26.1	109	22.0
Digestive system	41	13.2	49	9.9
Respiratory system	33	10.6	66	13.1
Skin	24	7.7	45	11.0
Reproductive system	9	2.9	12	2.4
Total symptoms reported	311	100	496	100
Total No. of subjects with symptoms	87		135	
% of study group with symptoms		56.5		71.8

TABLE 6. Spontaneous abortions and premature births experienced by women in the two study groups, classified according to whether or not they were doing plant work during pregnancy.

	Flower growers			Ornamental plant growers		
	Working during pregnancy	Not working during pregnancy	Total	Working during pregnancy	Not working during pregnancy	Total
Spontaneous abortions:						
No. of pregnancies	87	47	134	107	39	146
No. of spontaneous abortions	4	6	10	15	3	18
% abortions	4.6%	12.8%	7.7%	14.2%	7.7%	15.2%
Est. relative risk	0.32			1.96		
Premature births:						
No. of live births	83	41	124	89	35	124
No. of premature births	1[a]	7[a]	8[a]	9	2	11
% premature	1.2%	17.1%	6.5%	10.0%	5.7%	8.9%
Est. relative risk	—[a]			1.86		

[a] All delivered by the same woman. Relative risk calculation not meaningful.

province of Buenos Aires. The study also sought to determine whether any health effects related to pesticide exposure could be found in the two groups. In addition, it served as a pilot project for testing the feasibility of conducting a larger study on the country's whole population of flower and ornamental plant growers, which is estimated at roughly 10,000 persons.

It was demonstrated that intensive plant-growing operations in closed plastic greenhouses involved a high level of exposure to pesticides, especially in the case of flower growers. This level was lower among ornamental plant growers, even though (probably because of their higher purchasing power) they used a wider variety of products. The survey also found that the number of products used appeared to nearly double between 1964–1968 and 1979–1983. This could reflect an actual increase in the number of products available, a memory bias that rendered the interview subjects' recollection of events in the more distant past less accurate, or both of these circumstances.

It is interesting to note that the ornamental plant growers' higher average educational level failed to improve their attitudes toward personal protection. This shows a need for programs that call attention to the hazardous nature of the products being handled, as well as for clear warning of that danger on container labels.

In most cases it was not possible to compare workers with nonworkers because the age structure of these two groups was very different, the latter consisting mainly of children. Neither was it possible to compare reproductive events among pesticide applicators and nonapplicators, since the former were predominantly men and the latter were predominantly women belonging to the same families.

The two groups (flower and ornamental growers) were interviewed by different survey workers because it was not possible to do otherwise; it is principally for this reason that the data from the two groups were not combined for purposes of analysis.

With respect to other biases, these probably existed among both the observers (interviewers) and the observed. The principal observer bias probably arose from the fact that the interviewers knew all of the individuals interviewed had been exposed to pesticides in one way or another. (There were no controls, since this was a prevalence study.) Such bias was probably of special significance for the ornamentals group, because those interviewing this group were students at the University of Buenos Aires School of Public Health, who were probably able to elicit desired replies and detect appropriate symptoms more readily than the other interviewers.

Bias on the part of interview subjects appears especially likely to have influenced the results for flower growers, since the need to have a knowledge of Japanese made it necessary to use members of the study community as interviewers. This circumstance may have led some flower growers to falsify certain types of information, and that could have contributed to making the incidence of acute and chronic symptoms seem higher among ornamental growers than flower growers (see Tables 4 and 5).

The effect of both kinds of bias, to the extent they existed, was probably smaller in the case of "closed" questions such as those dealing with demography and reproductive history.

With respect to the acute and chronic symptoms reported, two points deserve special attention. These are, first, the high frequency of acute intoxication symptoms reported by individuals in both study groups and, second, the significantly higher level of chronic symptoms reported by applicators (as compared to nonapplicators) among the flower growers. While there is little information about the frequency of acute and chronic intoxication symptoms in the general population, and it is clear that the reporting of those symptoms was subjective, our observations are consistent with the large number of pesticide products used and the deficient protection in evidence. A similar symptomatology has been described by Lings among farmers using pesticides *(5)*.

With respect to spontaneous abortion, the values found are within the normal range reported by other authors for the population at large *(4, 12, 13)*. Superficially, the data suggest different relative risks for each of the two study groups. However, the small number of events involved makes it impossible to assess whether this difference was significant or whether it was the result of various extraneous factors.

The rates of reported premature births are close to those encountered by other researchers among flower growers exposed to pesticides in Colombia *(4)*. In this case, working with a much larger group, the investigators found a greater risk of prematurity when either the wife or the husband worked in flower growing. No correlation was found, however, between this risk and variables considered to be exposure indicators *(4)*.

In conclusion, the results of our survey indicate that both study groups made indiscriminate and damaging use of a wide range of pesticides with different active principles, and that they took insufficient protective measures.

To lessen the risks being run, it is suggested (1) that the workers in-

volved be encouraged to improve their working conditions, and (2) that technology designed to prevent health-threatening exposures be promoted.

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Summary

A survey was made of greenhouse workers in the province of Buenos Aires, Argentina, in order to assess the safety of pesticide application procedures and their possible effects on health. This work also served as a pilot project that helped to determine the feasibility of doing a similar nationwide survey.

Two population groups were studied, these being 154 people growing flowers for cutting and another 188 raising ornamental potted plants. Members of both groups generally lived in the places where they worked and were predominantly Oriental. Interviews conducted with group members sought information about demography, personal habits, the types of tasks performed, pesticides used, protective measures taken, and possible pesticide-related health effects.

The results confirmed that the work done by both study groups involved extensive exposure to a wide range of pesticides and suggested that the number of products used had increased substantially since 1964. The data also indicated that both study groups made indiscriminate use of a wide range of pesticides, took inadequate protective measures, and experienced a wide range of acute and chronic intoxication symptoms. Such symptoms were far less common among those applicators who took adequate protective measures than among those who did not.

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XIII World Conference on Health Education

The XIII World Conference on Health Education is scheduled to be held from 28 August to 2 September 1988 in Houston, Texas, USA. The conference is being sponsored jointly by the World Health Organization and the International Union for Health Education, in cooperation with the US Centers for Disease Control and the United States Host Committee, an entity representing over 40 public health organizations including the American Public Health Association, the American Medical Association, and the American Red Cross.

"Participation for all in health" is the theme for the event, which is geared to encourage participants from all over the world to exchange information, skills, knowledge, and experience in the field of health education. In addition, a number of special topics—AIDS health education, maternal and infant health, helping children to learn about health, and smoking and health—will receive special attention.

Inquiries related to the conference should be directed to the United States Host Committee, Inc., P.O. Box 20186, Suite 902, Houston, Texas 77225, USA.

Source: World Health Organization, *Weekly Epidemiological Record* 62(36).268, 1987.