AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 31:587–599 (1997)

Back to the Future: Sweatshop Conditions on the Mexico–U.S. Border. II. Occupational Health Impact of Maquiladora Industrial Activity

Rafael Moure–Eraso, PhD, CIH,* Meg Wilcox, SM, Laura Punnett, ScD, Leslie MacDonald, MSc, and Charles Levenstein, PhD

Present working conditions in one of the most active areas of the maquiladora system along the Mexico—U.S. border are reminiscent of nineteenth–century U.S. sweatshops. The organization of production is Tayloristic and authoritarian, with detailed division of labor, repetitive simple tasks, and piecework wages. Modern participative management styles are not apparent in the maquiladora setting. This study consists of two separate but interrelated surveys conducted in 1992, one of community leaders and this one of workers in maquiladora enterprises in the towns of Matamoros and Reynosa, Mexico. The community survey evaluated the economic and psychosocial impact of the maquiladora enterprise and was conducted simultaneously to the workers' survey and in the same Mexican towns where the workers lived and worked. The community leaders acknowledged the employment opportunities that maquiladora factories had brought to the region but believed them to have high environmental and psychosocial costs. For the occupational component, a community-based survey of 267 maquiladora workers was conducted. Participants were chosen with more than a year seniority in the industry and living in the two Mexican cities surveyed. They responded to an extensive questionnaire given by trained canvassers. The workers' survey found evidence that maquiladora workers (81% female) report symptoms from musculoskeletal disorders related to working conditions. Acute health effects compatible with chemical exposures were also identified. Prevalence of symptoms was correlated with increasing duration of exposure to ergonomic risk factors and qualitative chemical exposure indexes. Other chronic disease was not apparent. The survey demonstrated inequalities in salary, working hours, and safety training between the two communities. Matamoros workers are substantially better paid and work fewer hours per week than Reynosa workers. Most hazards reported in the worker's survey have been well studied in the general occupational health literature with respect to adverse health effects. Therefore, it is recommended that hazard surveillance studies would be more useful towards the goal of prevention than further etiologic studies. Specific recommendations on policy and remediation interventions are also made. Am. J. Ind. Med. 31:587–599, 1997. © *1997 Wiley-Liss, Inc.*

KEY WORDS: maquiladoras; occupational health; ergonomics; risk perception

INTRODUCTION

Maquiladoras are manufacturing plants owned by transnational corporations and located in an industrial zone in Mexico, on the border with the United States, under an agreement that permits duty–free export of their products to the United States. Although a North American Free Trade Agreement (NAFTA) between the United States, Mexico,

University of Massachusetts Lowell, Work Environment Program, Lowell, MA.

Contract Grant sponsor: American Federation of Labor-Congress of Industrial Organizations (AFL-CIO).

*Correspondence to: Dr. Rafael Moure-Eraso, Work Environment Department, One University Avenue, Lowell, MA 01854.

Accepted for publication 16 September 1996

and Canada is already in effect, the maquiladora industry continues its expansion. However, substantial questions have been raised in the United States and in Mexico concerning the working and environmental conditions of these facilities.

The explosive growth of the maquiladoras has depended on substantial migration from the southern areas of Mexico and has resulted in unplanned, sprawling growth of squatter villages around the border towns [Abrams, 1979]. A large proportion of the workers are female, 65% in the maquiladoras as compared to 28% of the non–maquila labor force [Baker et al., 1990]. Many workers have had little or no previous industrial experience. The labor turnover rates are extremely high, ranging from 180% per year in Nogales to a low of 14% in Guadalajara (far from the U.S. border). In Reynosa and Matamoros the rates are 48% and 36%, respectively [Baker et al., 1990].

Few studies have been conducted on occupational hazards due to the difficulties in gaining access to the plants [Hovell et al., 1988]. Several papers, based primarily on anecdotal reports, have reported adverse working conditions such as inadequate ventilation, unsafe machinery, long hours of microscopic assembly, few work breaks, and toxic chemical exposure [e.g., Fuentes and Ehrenreich, 1983; Fernandez–Kelly 1983; Sanchez, 1989; Salazar 1991].

Several studies have been conducted on reproductive outcomes. Eskenazi et al. [1993] studied reproductive outcomes among 241 maquiladora workers in the electronics and garment industries in comparison to 119 service workers in Tijuana. After adjusting for confounding factors, they found that infants born to the garment workers had significantly lower birthweight (653 g lighter) than the infants born to the service workers. Infants born to the electronics workers were 337 grams lighter than the service worker infants, but this difference was not statistically significant. Denman also found lower birthweights among maquiladora women, as compared with commercial and service sector workers [1990, 1991]; however, there was no controlling for factors such as age, parity, and education. Guendelman and Silberg [1993] studied the general health status of 480 workers in Tijuana, comparing women in the electronics and garment industries to women in the service sector and women with no work history outside the home. They found that although women employed by the maquiladoras were less educated, earned less, worked longer hours, and had less control at work than service workers, they did not score worse on the tests of well–being. Similar levels of depression and lack of control over life were observed in all workers, but electronics workers reported lower incidence of nervousness and functional impairments than service workers. Using data from a larger evaluation of Project Concern, Hovell et al. [1988] studied the general health profile of maquiladora workers, assessing mental health, respiratory health, musculoskeletal symptoms, and gastrointestinal symptoms. Their results showed essentially no difference in symptoms of illness comparing maquiladora workers with non–maquiladora workers and housewives. Both surveys may have underestimated the burden of illness in maquiladora workers due to selection bias, the ''healthy–worker effect,'' and an unclear definition of service workers. Furthermore, neither survey was able to examine whether actual levels of exposure to occupational health hazards differed within the groups of maquiladora workers or were linked to morbidity. On the other hand, some maquiladora workers may in fact experience positive effects of employment, related to increased earning power or social support, simultaneous with adverse effects of chemical or physical exposures [Moure–Eraso et al., 1994].

This study advances further our understanding of occupational health and safety conditions in the Mexican maquiladora factories. It complements a survey of community leaders that evaluated the economic and psychosocial impacts of the maquiladora industry in two Mexican border towns, Matamoros and Reynosa [Moure–Eraso et al., 1994]. This article reports on the results of the worker survey, conducted simultaneously with the community survey and in the same two communities. The worker survey was designed to assess general working conditions (e.g., wages and overtime), ergonomic stressors, chemical exposures, musculoskeletal symptoms and other health outcomes, and issues related to health and safety training.

METHODS

Data were collected in a population of maquiladora workers who lived in the cities of Matamoros and Reynosa. Two hundred sixty–seven (267) maquiladora workers were interviewed in their homes by a group of 12 trained interviewers from a church-sponsored community–worker organization (11 Mexican nationals and one U.S.–born fluent in Spanish). Training of interviewers by two of the investigators (R.M.–E. and M.W.) covered interviewing techniques, specific information sought in the questionnaire, and confidentiality issues. The interviewers were instructed that names and personal identifiers of the participants should be protected from all sources. The original questionnaire responses were mailed back to the University in Lowell immediately after completion.

Questionnaire Development

The questionnaire was divided in three sections. The first obtained demographic information, job history, and current job exposures by proportion of the working day. The second section asked questions about symptoms of chemical and physical agent exposures, including ergonomic stressors. The third section included questions on general health and safety systems in the worksite, including questions to

evaluate the worker's knowledge of Mexican health and safety rights and regulations. The symptoms part of the questionnaire (part two) included a subset of seventeen (16) questions designed to identify neurotoxic symptoms. This subset was developed by the Occupational Medicine Clinic of the Karolinska Hospital [Axelson and Hogstedt, 1988]. The Spanish version used here was further modified and validated in two Latin American Spanish–speaking countries by the Medical School of the National Autonomous University of Leon, Nicaragua and the Occupational Health Clinic of the Karolinska Hospital in Stockholm, Sweden [Amador and Lunberg, 1990]. The questions on musculoskeletal symptoms were taken from a validated and standardized questionnaire [Silverstein et al., 1986] and were translated into Spanish. Translations of all instruments were pilot tested by the Mexican interviewers prior to implementation in the field.

Selection of Study Subjects

Workers were interviewed in their homes. To be selected for inclusion in the study, a person had to have worked a minimum of one year in a maquiladora plant in the area of Matamoros and Reynosa. We used the ''key– informant/ snowball approach'' to select the study subjects [Thorburn, 1977]. This method has been successfully applied in third world countries. Interviewers were instructed to go to a ''colonia'' or neighborhood where maquiladora workers were known (by the church–sponsored community–worker organization) to reside to select a house and to ask whether it was the residence of any maquiladora workers. If a worker lived there but was not at home, at least one additional attempt was made to contact that individual. Interviewers were instructed to continue approaching houses until they found a maquiladora worker at home who fit the selection criteria. Identified workers were interviewed and then asked for the names of other maquiladora workers in the colonia, who in turn were also asked for names of contacts. In some colonias, the process began by contacting individuals already known by the church–sponsored community organization. Since there was not always one family per house, and houses were not clearly demarcated, it was not a simple task to judge the population size of a given colonia or the representativeness of the sample. The same procedures were used in the two towns.

Using this approach, 267 workers were selected for interviews (141 in Matamoros and 126 in Reynosa) out of 270 originally contacted. The reported pool of maquiladora workers in the two towns was 28,000 in Matamoros and 6,500 in Reynosa, representing 8% of the total maquiladora workforce in Mexico [Sander and Mendoza, 1989]. The workers lived in 56 colonias in Matamoros, out of a total of 106, and 16 colonias in Reynosa out of a total of 57 at the time of the survey [Moure–Eraso et al., 1994].

TABLE I. Demographics and Living Conditions for 267 Maquiladora Workers, by Gender and City (mean ± SD): 1992

	Reynosa		Matamoros	
Respondent characteristics	**Female (n = 114)**	**Male (n = 27)**	**Female (n = 102)**	**Male (n = 24)**
Age	23.1 ± 5.9	23.7 ± 5.7	26.9 ± 9.3	28.5 ± 8.5
Dependents	0.8 ± 1.3	0.8 ± 1.3	1.5 ± 2.2	1.3 ± 1.3
Household residents	4.6 ± 2.3	4.8 ± 2.6	5.7 ± 2.6	5.7 ± 2.7

Data Analysis

Questionnaire responses were tabulated and percentages of positive and negative answers were recorded. Both ergonomic risk factors and chemical exposures were used as independent variables to compare symptom prevalences. For dichotomous exposure variables, a chi–square with one degree of freedom (1 df) was used to test the statistical significance of differences in prevalence. For exposures with three levels, linear trends in the prevalence of symptoms with increasing duration of exposure were examined with the Mantel test for trend (chi–square with 1 df). Results were considered statistically significant when the one-tailed p–value was <0.05. The Statistical Analysis System (SAS) was used for all calculations.

RESULTS

Respondent Demographics

Two hundred seventy questionnaires were completed: 142 (53%) from Reynosa and 128 (47%) from Matamoros (Table I). Two questionnaires from Matamoros and one from Reynosa had incomplete responses, so 267 could be used in the data analyses. Two hundred sixteen respondents (81%) were female, 61% of whom were single. Of the 51 men, 56% lived with a partner (primarily married). The proportions of male and female respondents were identical in the two cities. The average age of the respondents was 25 years (±7.8); the median age was 23 years. Respondents of Matamoros were somewhat older on average (27.2 years) than those of Reynosa (23.2 years). There was little difference in age between men and women (average 26 and 25 years, respectively). Most of the respondents (52% of men and 60% of women) had no dependents.

In comparison with the rest of Mexico, living conditions were generally good. The majority of the respondents (80%) reported that their household water source was indoor plumbing; just over three–fourths of the respondents had cement floors in their homes.

TABLE II. Educational Level for 264 Maquiladora Workers, by Gender

	Female (n = 213)		Male (n = 51)	
Schooling	n (%)	Completed	n (%)	Completed
Illiterate	6 (3%)	NA	2 (4%)	NA
Primary	102 (48%)	36 (17%)	19 (37%)	5 (10%)
Secondary	86 (40%)	30 (14%)	19 (37%)	4 (8%)
Tech/Univ.	19 (9%)	NA	11 (22%)	NA
No answer	3 (1.5%)	NA	1 (2%)	NA

NA, not applicable.

Nearly one-half of respondents (121, or 46%) reported having only a primary education or less. Forty percent (107) had partial or complete secondary schooling, and 30 (11%) had some technical or university education. Men generally had more education than women (Table II); 30 (59%) of the men had at least some secondary education or higher, compared with 105 (49%) of the women. The levels of education did not differ between Matamoros and Reynosa.

Working Conditions

The 267 respondents worked at 50 different companies. Ninety–eight were employed at Zenith (both Matamoros and Reynosa facilities). An average of 12 workers (range 10–14) worked at seven companies appearing in the survey, while not more than seven subjects were employed at any other single company.

Of the 267 survey respondents who identified the type of work in which they were employed, 252 (94%) worked in production activities, primarily in the electronics industry. Other industries represented included food processing, garment assembly, and automobile components manufacturing. Most workers did not provide specific job titles. Twenty–five (10% of 252) were employed in electrical/electronic assembly, 33 (13%) in inspection, 5 (2%) in packing, and 11 (5%) in warehousing, truck driving, or shipping and receiving. Nine respondents were employed in maintenance and repair work. In non–production jobs, there were 11 (4%) supervisors, 3 people (1%) in clerical or cashiering, and 2 (1%) in reception or security.

The subjects had been employed an average of 44 months in their current jobs. Length of employment ranged from 1 to 20 years. One–fourth of the respondents had worked for less than 1 year in their current jobs but for at least 1 year in the maquiladora industry of the two towns; the median was 24 months. Although the ranges of length of employment overlapped considerably between the two cities, the average was significantly shorter in Reynosa (28.0 months) than in Matamoros (61.5 months). Women in Matamoros had been employed slightly longer than men (63 vs 55 months, respectively). The majority of the respondents worked a fixed shift (89%) and daytime work hours (74%). The average work week was 45.1 hr, with a median of 48 hr. Only three subjects worked less than 40 hr/week; 153 (59%) worked more than 40 hr, with 69 (26%) working 48 hr, and 71 (27%) working 50 hr on a regular basis. All but four respondents reported a regular lunch period, which lasted 30 min in almost all cases (241, or 89% of all subjects). All but nine subjects had at least one other break during the work day, usually lasting 15 min (62% of respondents); 224 workers also had a second scheduled break, usually lasting 10 min (63% of respondents). The total break times, including lunch, averaged 58 min/day; this was the same in the two cities.

When asked whether they regularly worked overtime hours, 113 (42%) responded that they did, and almost all of these (106) were production workers. One hundred seven workers reported an average of 9.6 hr of overtime work per week.

However, it appears that the term ''overtime'' was understood differently by different respondents. There was no difference in the usual number of hours worked between the self–defined overtime and non–overtime groups (44.5 + 4.9 vs 45.5 + 4.8 hr/week, respectively). Regular overtime was reported more often in Matamoros (47%) than in Reynosa (38%), although workers in Reynosa worked significantly longer hours on average (48.7 per week) than did workers in Matamoros (41.2 per week). Interview responses indicate that workers in Reynosa did not consider these additional work hours to be overtime. When usual weekly hours were compared between ''overtime'' and ''non–overtime'' within each of the two cities, it was again found that self–reported overtime did not correlate with the average number of hours worked per week. Four subjects reported they regularly worked overtime and were not paid overtime wages. All of these were employed in Matamoros. However, their usual weekly wages were about 30,000 pesos ($10 at the 1992 exchange rate) more than those workers who reported being paid overtime wages. Nevertheless, the workers who reported no usual overtime were paid about 10,000 pesos less than those workers who reported being paid for usual overtime.

The average weekly wages of the study subjects were 113,255 Mexican pesos, or U.S. $40.45 per week (1992 exchange rate). The hourly pay (weekly pay divided by hours worked per week) was 2,608 Mexican pesos on average, or about U.S. $0.93 per hour.

Despite the longer hours worked in Reynosa, the total weekly pay for respondents employed there was about 60% that in Matamoros (Table III). Thus, the mean hourly pay in Reynosa was less than one–half of that in Matamoros (1,714 vs 3,597, respectively).

TABLE III. Weekly Work Time and Pay Among Maquiladora Workers, by City (mean ± SD). Pay in 1992 Mexican Pesos

Weekly work time and pay	Reynosa		Matamoros	
	Female	Male	Female	Male
Hours/week	48.6 ± 3.3	49.2 ± 1.5	41.3 ± 3.4	40.7 ± 2.3
Pay/week	82,747 ± 24,839	89,571 ± 28,074	138,136 ± 20,625	179,768 ± 83,325
Pay/hr	1,705 ± 554	1,760 ± 473	3,398 ± 606	4,446 ± 2,117

TABLE IV. Frequency (%) of Chemical Exposures by Proportion of Shift With Daily Exposure Among 267 Surveyed Maquiladora Workers: 1992

Chemical type	None	Part of shift	All of shift
Dust	133 (49%)	26 (10%)	88 (33%)
Gas or vapor	107 (40%)	36 (13%)	86 (32%)
Poor ventilation	132 (49%)	34 (13%)	71 (26%)
Skin contact	135 (50%)	40 (15%)	70 (26%)

Women worked the same average number of hours per week (45) as men but were paid only about 83% of men's hourly wages (2,507 vs 3,021 pesos per hour). The hourly wage reported in production work did not vary between men and women, but men's wages were higher than women's in maintenance and service work. All of the gender differential occurred in Matamoros (Table III). The pay range for men in Matamoros was much greater than for men in Reynosa, or for women workers in both towns.

Hygienic facilities were generally available within the workplaces of the survey subjects. Eighty–eight to 98% of workers reported that washrooms, drinking water, and toilets were present in their workplaces. Reynosa workers were more likely to have access to a lunchroom separate from the production area (87% vs 76%), while workers in Matamoros were slightly more likely to have access to washing facilities. Seventeen Reynosa workers (12%) reported that a toilet was not available in their workplace. Showers were only rarely provided (34, or 13%), and their availability was not obviously linked to an occupational health rationale. For example, only one of 8 soldering workers, with probable lead exposure, had access to a shower.

Workplace Chemical Exposures

Chemical exposures in the workplace were relatively common, with more than one-half of workers reporting some noticeable airborne substance during at least part of the work day (Table IV). Almost 40% reported experiencing skin contact with a chemical substance or mixture for some part of the work day.

The chemical agents reported were classified according to apparent type of substance or mixture. Exposure to gases and vapors was reported by more than 122 (45%) of respondents to occur for at least part of the shift. Exposure to dust was reported by (43%) of respondents to occur at least for part of the shift.

Health Effects of Chemical Exposures

The most frequently reported symptoms included headache (56%), unusual fatigue (53%), depression for no specific reason (51%), forgetfulness (41%), chest pressure (41%), difficulty in falling asleep (39%), stomach pain (37%), dizziness (36%), and numbness or tingling in the extremities (33%).

In response to an open–ended question regarding other health problems not previously mentioned, 71 workers reported additional problems, of which 10 affected the ear, eye, nose, and throat region; 8 were gastrointestinal, and 4 were skin disorders.

Analysis of the association between reported exposures and health outcomes yielded some highly significant relationships. Nausea or vomiting, stomach pain, urinary and breathing problems were significantly related to the reported frequency of exposure to airborne contaminants (Table V). Eye and nose secretions and breathing problems were significantly associated with reported frequency of dust exposure (Table VI).

Almost all neurotoxic symptoms were associated with inhalation exposure to organic compounds such as solvents, glues, and gasoline. There was a statistically significant difference between exposed and unexposed workers in the prevalence of fatigue, chest pressure, and pins and needles sensations in the extremities (Table VII). Other symptoms significantly associated with the same exposures were heart palpitations, headache, stomach pain, and eye and nose secretions.

One hundred twenty–eight (47%) subjects stated that they believed themselves to be in good health. When the study group was asked to what extent they believed that any existing health problems might be related to work, 86 (32%) responded ''a little'' and 62 (23%) responded ''a lot.''

TABLE V. Frequency (%) of Symptoms to Any Airborne Contaminants Reported by 267 Maquiladora Workers: 1992

	Exposure to any airborne contaminants			
Symptoms	**None**	**Part of shift**	**All of shift**	**p[a]**
Nausea or vomiting	22 (27%)	9 (32%)	35 (43%)	0.03[b]
Stomach pain	26 (27%)	14 (38%)	53 (47%)	0.002[b]
Urinary problems	6 (6%)	2 (6%)	17 (15%)	0.02[b]
Coughing	22 (22%)	18 (49%)	30 (26%)	0.48
Eye or nose secretions	24 (23%)	9 (24%)	35 (31%)	0.20
Short of breath	19 (21%)	17 (50%)	50 (45%)	0.001[b]

[a]Test for linear trend (chi-square on 1 df).
[b]$p \leq 0.05$.

TABLE VI. Frequency of Respiratory Symptoms by Proportion of Shift With Daily Exposure to Dust Among 267 Maquiladora Workers: 1992

	Exposure to dust			
Symptoms	**None**	**Part of shift**	**All of shift**	**p[a]**
Coughing	32 (25%)	10 (38%)	26 (30%)	0.38
Eye or nose secretions	28 (21%)	8 (31%)	29 (33%)	0.05[b]
Short of breath	29 (24%)	12 (52%)	40 (47%)	0.001[b]

[a]Test for linear trend (chi-square on 1 df).
[b]$p \leq 0.05$.

Physical and Ergonomic Hazards and Musculoskeletal Symptoms

Several physical agents and ergonomic stressors were extremely widespread in their workplaces. Both noise and repetitive manual work were reported to be present for the entire work day by two–thirds of the workers. Constant, machine–paced work was reported by more than one-half of subjects. Heat, vibration, and high visual demands were reported for at least part of the shift by over half the subjects. Given the opportunity to comment about work pace, the majority (56%) described the work as ''normal,'' while 26% reported their usual work pace as ''rapid.'' Sixty–one percent reported that their work was machine paced.

Forty–three percent of the respondents reported working in uncomfortable positions during part or all of the shift. Sixty–six percent reported repetitive movements throughout the shift, while an additional 10% reported such movements part of the shift. Monotonous work was reported by 47%. Thirty–two percent reported that they were doing forceful manual work during the shift, and 26% of the workers reported heavy whole–body physical work load (Table VIII).

Subjects were asked whether they had experienced musculoskeletal symptoms during the past year. By body region, 56 (21%) reported pain, numbness, or tingling in one or both hands; 31 (12%) reported elbow or forearm pain; and 38 (14%) reported shoulder pain. For each body region, more than one-half of respondents with pain indicated that it decreased when they were away from work for a week or more.

TABLE VII. Frequency (%) of Reported Symptoms, by Airborne Exposure to Organic Compounds in Survey of 267 Maquiladora Workers: 1992

	Airborne organics		
Symptoms (numbers NTQ)[c]	**Yes (n = 101)**	**No (n = 169)**	**p[a]**
1. Forgetful	47%	38%	0.14
2. Forgetful (view of family)	35%	27%	0.15
3. Forgetful (responsibilities)	42%	32%	0.09
5. Poor concentration	32%	42%	0.10
6. Angry	52%	46%	0.42
7. Depressed	51%	52%	0.96
9. Fatigue	65%	46%	0.004[b]
10. Chest pressure	51%	36%	0.02[b]
11. Loss of balance	42%	33%	0.11
12. Pins and needles	42%	29%	0.03[b]
13. Difficulty buttoning	13%	8%	0.16
15. Loss of sensation	29%	19%	0.09
16. Difficulty sleeping	44%	36%	0.20
Heart palpitations	34%	20%	0.01[b]
Headache	67%	52%	0.01[b]
Nausea or vomiting	43%	30%	0.06
Stomach pain	51%	32%	0.003[b]
Eye or nose secretions	34%	22%	0.04[b]
Excess saliva	19%	16%	0.57

[a]Test for difference in proportions (chi-square on 1 df).
[b]$p \leq 0.05$.
[c]Questions from pool of 16 of the Neurotoxic Questionnaire verified in three countries. From Amador (1990).

Shoulder pain was at least twice as prevalent among workers reporting exposure for the entire work day to uncomfortable postures, repetitive movements, forceful manual work, and heavy physical effort, compared to workers without such exposures (Table IX). Hand and wrist pain showed associations of similar magnitude with uncomfortable postures, repetitive movements, and forceful manual work (Table X).

The reported prevalence of exposure to ergonomic stressors was generally either the same or higher in Reynosa than in Matamoros (with the exception of better illumination and fewer heat problems in Reynosa). However, workers in Reynosa reported from one–half to one–third fewer musculoskeletal disorders than workers in Matamoros.

Machine–paced work, as compared with self–paced tasks, was reported slightly more often in Reynosa. Subjects

TABLE VIII. Exposure to Physical Agents and Ergonomic Stressors, by Proportion of Shift With Daily Exposure

Type of exposure	None	Part of shift	All of shift
Noise	41 (15%)	44 (16%)	181 (67%)
Heat	135 (50%)	45 (17%)	74 (27%)
Vibration	90 (33%)	29 (11%)	130 (48%)
Bad illumination	163 (60%)	20 (7%)	74 (27%)
Intense visual demands	120 (44%)	44 (16%)	100 (37%)
Uncomfortable position	146 (54%)	30 (11%)	86 (32%)
Repetitive movements	54 (20%)	27 (10%)	177 (66%)
Monotonous	134 (50%)	54 (20%)	74 (27%)
Machine pacing	79 (29%)	12 (4%)	155 (57%)
Forceful manual work	136 (50%)	33 (12%)	86 (32%)
Heavy physical work load	182 (67%)	24 (9%)	47 (17%)

TABLE IX. Prevalence of Shoulder Pain, by Proportion of Shift With Daily Exposure to Specific Ergonomic Risk Factors Among 267 Maquiladora Workers: 1992

	Shoulder pain			
Risk factor	None	Part of shift	All of shift	p[a]
Uncomfortable position	15 (11%)	2 (7%)	21 (25%)	0.005[b]
Repetitive	3 (6%)	1 (4%)	32 (19%)	0.009[b]
Monotonous	21 (16%)	8 (15%)	9 (12%)	0.48
Machine pacing	10 (13%)	1 (8%)	23 (15%)	0.63
Forceful manual work	15 (11%)	2 (6%)	19 (23%)	0.03[b]
Heavy work	19 (11%)	1 (4%)	13 (29%)	0.005[b]

[a]Test for linear trend (chi-square on 1 df).
[b]$p \leq 0.05$.

in Matamoros were also more likely to rate their work pace as too rapid. Increasing work pace (Matamoros) was also found to be correlated with an increasing prevalence of headaches.

Company Medical Services

More than 90% (253) of the survey subjects worked at facilities with in–plant medical clinics. The majority of these clinics were staffed by nurses (185, or 73%); the remainder by a doctor or a combination of a doctor and a nurse. Roughly two–thirds (167) reported that their clinics were open through all the shifts of the plant's operation.

The survey permitted the workers to register their satisfaction or dissatisfaction with company clinics. Only about one–fourth (67) reported the quality of the clinic services to be ''good,'' a little more than one–half (140) rated them as ''fair,'' and the remainder (43) as ''poor.'' The Matamoros clinics were reported to be somewhat better (33% good, 67% fair or poor) than those in Reynosa (22% good, 78% fair or poor).

When asked where they went if they experienced health problems, 156 subjects (58%) reported that they usually went to the plant clinic, 42 (16%) went to a Social Security clinic, and 23 would go to either facility. About 40 (15%) responded that they would not leave work to seek medical care, generally either because they were not allowed to or because they were afraid of losing their jobs.

TABLE X. Prevalence of Hand/Wrist Pain by Proportion of Shift With Daily Exposure to Specific Ergonomic Risk Factors

	Hand/wrist pain			
Risk factor	None	Part of shift	All of shift	p[a]
Uncomfortable position	23 (16%)	8 (27%)	25 (29%)	0.015[b]
Repetitive movements	6 (11%)	4 (15%)	44 (25%)	0.02[b]
Monotonous	30 (23%)	13 (25%)	13 (18%)	0.48
Machine pacing	18 (23%)	2 (17%)	28 (18%)	0.40
Forceful manual work	22 (16%)	5 (16%)	27 (32%)	0.008[b]
Heavy work	37 (21%)	3 (13%)	11 (24%)	0.79
Vibration	16 (18%)	8 (29%)	28 (22%)	0.55

[a]$p \leq 0.05$.
[b]Test for linear trend (chi-square on 1 df).

Labeling

About 45% of the workers in each city reported that containers of chemical substances in their places of employment were labeled. These labels were slightly more likely to be in Spanish in Reynosa workplaces compared with those in Matamoros (33% vs 27% always or usually, 5% vs 23% rarely or never).

Less than 20% reported each of these types of information to be generally present on the labels: the substance's trade name, the generic chemical name, possible health effects and how to prevent them, and possible safety hazards (e.g., fire or explosion) and how to prevent them. Literacy (in Spanish) was reported above 96% in the study group (see Table II).

Worker Health and Safety Training

One hundred twenty–seven (47%) of the respondents said that they had received training from their employers ''on the risks of the job and the means to prevent them.'' Of those who had been formally trained, 94 (74%) judged that the training had been adequate ''to protect themselves.'' Those employed in Reynosa were slightly more likely than Matamoros workers to have been trained (52% vs 42%). This difference between the two cities was larger among

TABLE XI. Maquiladora Workers' Perceptions of Degree of Occupational Health Risk, by City (Number and Percentage of Workers in Each Category)*

Degree of hazard	Reynosa	Matamoros
None	65 (47%)	25 (20%)
Little	49 (36%)	54 (43%)
Medium	18 (13%)	22 (18%)
Great	6 (4%)	24 (19%)

*Test for difference in proportions: chi-square on 3 df, $p < 0.001$.

Zenith workers than among those employed by other companies.

Those subjects who had been trained by their employers were somewhat more likely to believe that they were in good health than those who had not (66% vs 51%).

To assess the nature of the training received, subjects were asked whether they had been taught eight specific types of information, as well as whether they believed their training to be adequate to protect themselves. Less than one-half the study group had received training in each specific area. In general, this was about equally true for those employed in each city, even though workers in Reynosa were more likely to believe that their training had been adequate (45% vs 28%).

One hundred fifty–three (57%) workers stated that they had received the most credible health and safety information from their union or from meetings in their neighborhoods, rather than from their employers. This included 32 (25%) of the 127 workers who had received formal training in their workplaces. The proportion of respondents whose knowledge had primarily come from outside the workplace was almost the same in the two cities (58% in Matamoros, 55% in Reynosa). Among those who had not been formally trained in the workplace, some had nevertheless obtained some information from plant management; 22 (15%) gave the company as their primary source of information.

The survey questionnaire included a series of six items designed to test the subjects' knowledge of occupational health and safety, including key elements of the Mexican laws [Instructivos, 1985]. Roughly 60% of the workers answered each question correctly. However, on most questions there was a highly significant difference between Reynosa and Matamoros on the proportion answering correctly; more correct responses were given by Matamoros workers for two–thirds of the items, while Reynosa workers were more likely to answer ''don't know'' for every question (Table XI).

On all four items concerning health effects, workers who had received their information from sources outside the company were more likely to answer correctly (Table XII). Training by employers did not improve the likelihood that a worker would answer the same four questions (rather than responding ''don't know''), compared with those who had not been trained. For the two items on health and safety legislation, workers trained by their employers were more likely to respond; they were also more likely to answer the question on elected representatives correctly than subjects whose information came from other sources.

Hazardous Work and Perception of Risk

Fifty–five (20%) respondents reported that they had experienced at least one ''near miss'' at work during the previous two months; 21 of them (8%) reported two or more. Among all subjects, about one–fourth (71) believed that their work was ''moderately'' or ''highly'' dangerous. Workers in Matamoros were significantly more likely to believe that their jobs were hazardous (Table XIII).

There was only a negligible difference in the perception of hazards between those who had and had not received company training. In general, perceived hazardousness was more strongly associated with reported exposure to chemical and physical agents than to potential ergonomic stressors. For example, perceived hazardousness was linearly associated with three of four indicators of chemical exposure (excluding bad ventilation), noise, and vibration, but showed only a weak linear association with ergonomic stressors except for repetitive work and intense visual demands (Table XIV).

Personal Protective Equipment

More than one-half of respondents (150) said that they regularly used personal protective equipment such as dust masks, safety goggles, gloves, ear plugs, or muffs; 104 (69%) reported that they did so ''always.'' Among the 114 who did not routinely use personal protective equipment, 47 (41%) stated that it was not required in their jobs; 36 (32%) stated that it was not available; and 10 (9%) found it bothersome to wear. Workers who had received any formal training in safety and health were twice as likely to use personal protective equipment as those who had not (76% vs. 38%). When asked to whom they would turn for help with health and safety problems at work, 145 (53%) of the workers interviewed indicated that they would always go to a supervisor, and 53 (20%) stated that they would sometimes turn to a supervisor. These proportions were markedly higher for workers in Reynosa than in Matamoros (62% vs 45% always, 24% vs 15% sometimes).

DISCUSSION

In this study, data were collected on the prevalence of occupational exposures to various chemical, physical, and ergonomic agents and potentially related health effects, in addition to data on general working conditions and issues related to health and safety training in maquiladora plants in two Mexican border towns.

Some socioeconomic conditions for the respondents of this study were fairly good. For example, they reported the

TABLE XII. Workers' Knowledge of Occupational Health and Safety, by City (Number and Percentage of Workers Answering Each Item as Shown): 1992

	Correct[b]		Don't know[b]		
Knowledge item	**Reynosa**	**Matamoros**	**Reynosa**	**Matamoros**	**p[a]**
Chemicals never have chronic effects without acute effects	32%	45%	59%	29%	<0.001
Chemicals absorbed through the skin may affect internal organs	13%	45%	71%	34%	<0.001
There is always a warning period before fainting from a chemical exposure	34%	32%	54%	27%	<0.001
Noise-induced hearing loss is not always reversible	18%	54%	54%	22%	<0.001
Workers may elect plant health and safety representatives	10%	52%	48%	27%	<0.001
Plant health and safety commission has no decision-making authority	25%	15%	53%	23%	<0.001

[a]Chi-square on 2 df, test for differences in proportions (correct/incorrect/don't know) by city.
[b]All percentages for the fatal number of workers in the specified city who gave any answer, including ''don't know.''

TABLE XIII. Workers' Knowledge of Health Effects of Occupational Exposures, by Whether Trained by Employer* (Number and Percentage of Workers Answering Each Item as Shown)

	Correct		Don't know		
Knowledge item	**Trained**	**Not trained**	**Trained**	**Not trained**	**p[a]**
Chemicals never have chronic effects without acute effects	34%	42%	43%	45%	0.07
Chemicals absorbed through the skin may affect internal organs	22%	34%	54%	52%	<0.04[b]
There is always a sufficient warning period before being affected by airborne chemical	28%	37%	41%	41%	0.16
Noise-induced hearing loss is not always reversible	33%	37%	42%	37%	0.74

*''Not trained'' by employer; subjects may have been trained at neighborhood meetings, union educational sessions, etc.
[a]Chi-square on 2 df, test for differences in proportions.
[b]$p \leq 0.05$.

same frequency of indoor plumbing, 80%, as the overall percentage of Mexican population with water supply services [PAHO/WHO, 1994]. Their level of education was comparable to what has been reported for all of Mexico by the Instituto Nacional de Estadistica, Geografia e Informatica [Equipo de Estudios Sociales, 1991]. Their hourly wages were about twice as high as the 1992 Mexican legal minimum wage of 1,366 pesos, or U.S. $0.45 (1992 exchange rate). Lastly, contrary to previous reports, the vast majority of workers received a 30–min lunch period and two 15–min breaks.

These findings not withstanding, our study confirms some of the previous reports of problems with general working conditions in the maquiladoras. For example, nearly one-half of respondents reported low levels of education (primary education or less), and large proportions of the workers reported machine–paced work, exposure to toxic chemicals, and poor ventilation. In addition to collecting new information on the prevalence of exposure to chemicals and ergonomic stressors, we demonstrated significant associations between these exposures and specific health symptoms. These findings are detailed below.

Interesting differences were also observed between the worker populations in the two towns, particularly inequalities in salary and working hours between the two communities and with regard to health and safety training issues. Matamoros workers were substantially better paid and worked fewer hours per week than Reynosa workers. Respondents employed in Reynosa were younger on average and received mean hourly wages less than one–half of those in Matamoros. Within Matamoros, women had been employed 8 months longer than men, on average, but were paid only 76% of their hourly wages. Furthermore, although the average pay in both communities was double the minimum wage, it was 30% less than the average pay for service workers as reported by Guendelman and Silberg [1993]. While Reynosa workers worked 48 hr/week on average, Matamoros workers worked approximately the same number of hours per week (42 hr) as non–maquila service workers [Guendelman and Silberg, 1993].

TABLE XIV. Frequency of Reported Exposure to Selected Occupational Hazards, by Degree of Perceived Hazardousness of Work (''None'' vs ''Great'') (Number and Percentage of Workers in Each Category) Among 267 Maquiladora Workers: 1992

		Hazardousness		
Exposure	**n**	**None**	**Great**	**p[a]**
Any airborne dust, vapor, etc.				
No	102	54 (53%)	2 (2%)	<0.001
All shift	111	19 (17%)	25 (23%)	
Organics, airborne				
No	165	73 (44%)	10 (6%)	<0.001
Yes[b]	99	17 (17%)	20 (20%)	
Bad ventilation				
No	130	50 (38%)	9 (7%)	0.38
All shift	69	29 (42%)	10 (14%)	
Any substance, skin contact				
No	132	65 (49%)	5 (4%)	<0.001
All shift	68	13 (19%)	16 (24%)	
Noise				
No	40	21 (53%)	3 (8%)	0.02
All shift	178	52 (29%)	25 (14%)	
Vibration				
No	87	36 (41%)	5 (6%)	0.02
All shift	128	35 (27%)	21 (16%)	
Heat				
No	131	46 (35%)	12 (9%)	0.85
All shift	72	30 (42%)	8 (11%)	
High visual demands				
No	118	49 (42%)	9 (8%)	0.01
All shift	97	26 (27%)	15 (15%)	
Uncomfortable body position				
No	143	52 (36%)	13 (9%)	0.07
All shift	85	27 (32%)	14 (16%)	
Repetitive work				
No	53	25 (47%)	5 (9%)	0.01
All shift	175	49 (28%)	25 (14%)	
Heavy lifting/whole body work				
No	177	56 (32%)	19 (11%)	0.33
All shift	47	22 (47%)	7 (15%)	
Forceful manual work				
No	132	45 (34%)	15 (11%)	0.75
All shift	85	26 (31%)	10 (12%)	

[a]Test for linear association between two variables (chi-square on one d.o.f.).
[b]During either part or all of the workshift.

Chemical and Ergonomic Hazards

Substantial proportions of the population reported exposure to toxic chemicals. Forty–three percent of respondents reported dust exposure during part of the shift; 45% reported gas or vapor exposure; 41% reported chemical–to–skin contact hazards; and 39% reported bad ventilation.

The section in the questionnaire designed to identify neurotoxic symptoms used 16 questions verified and validated for international use in three countries (Nicaragua, Venezuela, and Sweden) [Amador, 1990]. In this study, the associations of these symptoms with reported inhalation exposure to organic compounds confirmed the ability of the questionnaire items to discriminate between exposed and nonexposed workers. The items most significantly associated with exposure were the presence or absence of fatigue, chest pressure, and pins-and-needles sensations in the extremities.

The maquiladora workers interviewed were young and highly mobile, making it unlikely that diseases with long latency would be observed; however, our survey data appear to demonstrate acute health symptoms compatible with chemical exposure to worker exposure reports (e.g., the associations between frequency of exposure to airborne contaminants and shortness of breath, nose and eye secretions, and nausea). This suggests that there could be substantial chronic health effects in the future.

Study respondents reported high levels of exposure to physical agents with well–established health effects, such as noise, heat, and vibration. Ergonomic stressors were also reported at high rates. Nearly two–thirds reported repetitive movements or machine–paced work throughout the shift. Most strikingly, there is clear evidence that the musculoskeletal symptoms experienced by these maquiladora workers were related to such ergonomic exposures as rapid pace of work, poor workplace design and other ergonomic hazards.

Health and Safety Training and Programs

Most of the workers reported they had received health and safety training. When health and safety knowledge was tested, however, company–trained workers performed poorly compared with workers who had received independent training. Although a greater proportion of workers from Reynosa than from Matamoros reported receiving training, Reynosa workers were more likely to have received company training and performed less well than Matamoros workers.

Workers in Reynosa were more likely to believe that their training had been adequate, although they were not more likely to have been taught specific types of information, and were less likely to know substantive information about the potential health effects of occupational exposures. Workers in Reynosa were also less likely to attribute any health problems to work or to believe that their jobs were hazardous. They reported fewer musculoskeletal disorders than workers in Matamoros, although the prevalence of reported exposure to ergonomic stressors was generally either the same or higher in Reynosa (with the exception of better illumination and fewer heat problems).

The community leader survey [Moure–Eraso et al., 1994]) had previously indicated that the maquiladora work

environments were Tayloristic and authoritarian, with a noticeable lack of worker participation at all levels of work organization. The reports on how workers were treated when chemical incidents occurred in the plants provide the most striking evidence for this. Contact with the outside (e.g., Red Cross and firefighters) was reportedly cut off, and workers were initially not allowed to leave to seek medical care.

Methodology Issues

The methodology employed in this study conveys some inherent weaknesses in the data collected. A discussion of these weaknesses follows.

Cross–sectional surveys

Cross–sectional surveys obtain information on current exposures and current symptoms. Most of the workers were young and with low seniority. Turnover in these workplaces was fairly high. To the extent that those with work–related health problems leave work or change jobs more frequently, this would lead to underestimation of the health effects of previous exposures [Eisen, 1995; Punnett, 1996]. This would mean that the true effects of the working conditions in the maquiladora could be more severe than those identified in this survey.

Selection of subjects

The procedure to select subjects was based on well–established sociological methods. Nevertheless, the population may not be representative of all the maquiladora workers in the communities of Matamoros and Reynosa with respect to working conditions or health and safety knowledge. Thus, the findings reported here should be verified with larger studies, including a larger proportion of the population of interest.

Self–reports

All the data are self–reported, which raises the issue of possible information selection bias. These self–reports cannot be checked for accuracy or evaluated for error, whether random missclassification or systematic bias. Random error is more likely, however, which would lead to dilution of the estimated associations between workplace exposures and health effects. Although the canvassers did not tell subjects about any of the specific hypotheses of the study, recall or information bias could have occurred in situations where the presence of symptoms made subjects more aware of aggravating occupational exposures (or vice versa). One finding, at least, suggests that such bias was not a large problem, in that symptoms of musculoskeletal disorders were only weakly correlated with respondents' perceptions of the general hazardousness of their workplaces.

CONCLUSIONS AND RECOMMENDATIONS

This paper concludes our findings on two separate but interrelated surveys, one of community leaders that was open–ended and exploratory, and one of community residents who worked in maquiladoras in the area. The community leaders acknowledged the employment opportunities that maquiladora factories had brought to their region but believed them to have high environmental and psychosocial costs. The survey of workers identified health hazards well studied in the occupational health literature and symptoms not expected in such a young workforce (average age under 28.5 years). Although these two surveys could both be interpreted as ''hypothesis–generating,'' the evidence of widespread exposures with known health effects is sufficient to justify intervention without further etiologic studies. The areas of concern identified are obvious targets for immediate preventive and remedial action, as suggested below.

Conclusions

General conclusions

1. Current working conditions in the Matamoros–Reynosa maquiladoras are reminiscent of nineteenth–century U.S. sweatshops. The organization of production is Tayloristic and authoritarian, with detailed division of labor, repetitive simple tasks, and piecework wages. Modern participatory management styles were not in evidence in any of the companies in the study. The very high turnover rates reported elsewhere are indicative of the deep dissatisfaction of Mexican workers in this type of industry.
2. Many of the methodological flaws of the study were the result of investigators not having the ''right of entry.'' The Mexican government should ensure that an expanded scientific investigation of reported health hazards occurs—either by undertaking such studies itself or ensuring that the companies cooperate with investigators. The Mexican labor movement should demand such investigations and monitor their conduct. Although further investigation is warranted, public health action must not wait on further investigation.
3. It is apparent that ''voluntary compliance'' with internationally established occupational and environmental health standards and procedures is not being practiced by the owners of the maquiladoras. This demonstrated failure of transnational firms to operate responsibly—and the apparent failure of the host country to regulate effectively—raises serious questions about the health impact on workers of the expanding maquiladora sector. The Labor Side–Agreement to NAFTA attached to the body of the treaty provides that in–country complaints can be made concerning violations of recognized labor standards. National and cross–national efforts involved trade unions and concerned citizens are both essential if economic

''development'' is not to exact an awful price in human health.

4. It seems clear that the Mexican government is not to blame for the existing hazards; those problems are caused by poor management of the companies involved. Since the Mexican government is convinced of the economic benefit of maquiladora development, it must be prepared to tap some of the benefits to ensure compliance with its own health and safety regulations by companies benefiting from the free market. Enforcement agencies require well–trained and ample staffing and a mandate from the government to protect workers' health endangered by irresponsible corporate behavior.
5. Given the long history of the maquiladora production system, neither multinational corporations nor the Mexican government could alone by themselves protect workers' health. A cooperative approach in which workers, management, and government interact is the method of choice. However, the meaningful participation of workers has to be promoted and developed as a serious endeavor. A fundamental role of the Mexican trade unions should be the protection of worker health—even if the official trade unions support the broad economic development objectives of the maquiladora program.
6. It is beyond the scope of this study to review compliance by maquiladora owner companies with occupational and environmental health standards in their own countries. The problems observed in maquiladora industry cannot be the result of corporate ignorance. Multinational companies simply have to act responsibly, based on well-established professional practice.

Specific conclusions

Occupational safety risks and symptoms. *Ergonomics.* The most striking finding of this survey was the clear evidence that the reported muskoloskeletal symptoms were thoroughly related to such ergonomic exposures indices as reported rapid pace of work, poor workplace design and other ergonomic hazards. Shoulder pain and hand or wrist pain showed associations with reported uncomfortable postures repetitive movements and forceful manual work. This is specially remarkable in a young worker population, e.g., $<$28.5 years average.

Chemical exposures. There was strong correlation between reported frequency of exposure to airborne contaminants (i.e., dust, gases, and vapors) and reported symptoms (i.e., nausea, stomach pain, urinary and breathing problems). Workers reporting exposures to organic chemicals (described as solvents, glues and gasoline) reported symptoms of fatigue, chest pressure, and pins-and-needles sensations in the extremities. No such symptoms were reported by workers not using these substances. This finding of apparent chronic effects is remarkable in a young working population.

Wages and overtime. Workers in Reynosa earn less than one-half the wages of the Matamoros workers despite the fact that they work longer average hours per week (48.7 hr/week in Reynosa vs 41.2 hr/week in Matamoros). It is remarkable that workers represented by similar unions do not make a basic demand of equal pay for equal work. This is a reflection of the weakness on the collective bargaining representation of Reynosa workers, as compared with Matamoros.

Health and safety training. Workers who had received their information outside the company were more likely to answer correctly health and safety questions. Training by employers did not improve the number of ''don't know'' answers when compared with those who had not received any training. This demonstrates low training effectiveness when employers provided the training.

Recommendations

General recommendations

1. The findings of this survey should invoke conservative public health principles concerning public health action in the face of scientific uncertainty. Worker and community leaders' accounts of hazards that were validated by significant association with health effect reports warrant action by government, by companies, by unions, by citizen organizations. It is not advisable to wait for an epidemic of chronic disease or a Bhopal–type disaster to take precautionary action. Action should be taken even though the findings of the survey have the acknowledged flaws of community–based and cross–sectional studies.
2. To the extent that Mexican workers' unions need assistance in performing their function of workers' health defense, it is recommended that the international labor and the international public health movements should provide Mexican workers organizations with moral and material support. On the other hand, if leading Mexican unions are unwilling to demand better working conditions, the international community should consider support for the development of independent trade unions and other organizations that will serve Mexican workers' health and safety needs.
3. Already in the United States and Canada, coalitions of trade unionists, church groups, community organizations, environmentalists and public health advocates have formed coalitions to support improvement in maquiladora working conditions. A Maquiladora Code of Conduct has been developed to pressure U.S. companies at home to behave responsibly when they invest abroad. Exchanges have occurred between Canadian, U.S., and Mexican trade unionists, health and safety advocates, and environmentalists. Perhaps one of the few benefits for workers and community health of NAFTA has been the emerging labor and environmental solidarity movements developing across the continent. To the extent that such broad movements can put pressure on governments and corporations to improve their practices, those efforts

should be encouraged. Ultimately, Mexican worker's organizations, supporting public health officials and advocates in Mexico bear the burden of improving maquiladora working conditions. The tasks of the other two North American countries is to support such developments.

Specific health and safety conclusions

Most hazards reported in this study have been well studied in the general occupational health literature with respect to adverse health effects. Therefore, it is recommended that surveillance studies, i.e., hazard surveillance and if necessary medical surveillance with strong worker participation, would be more useful toward the goal of prevention than further etiologic studies. At the same time, the evidence presented here should trigger quick remediation of the conditions in the plants. Remediation should focus on the prevention of chemical, physical, and ergonomic hazards through permanent engineering controls, with supplementary appropriate personal protective equipment where necessary. Adequate health and safety administrative programs are also needed, especially including hazard communication and emergency response measures. Compliance with legal requirements for plant health and safety committees with elected worker representatives and decision–making authority is also necessary. Meaningful worker representation in all of these activities is essential both to ensure their success and as a fundamental right.

ACKNOWLEDGMENTS

This study was partially funded by the American Federation of Labor–Congress of Industrial Organizations (AFL–CIO). Special thanks are also given to Edward Krueger and the American Field Service Committee (AFSC) for advice and assistance for the field research activities in Mexico.

REFERENCES

Abrams HK (1979): Occupational and environmental health problems along the U.S.–Mexico border. Southwest Econ Soc 43:20.

Amador RR, Lundberg I (1990): Development of a neurobehavioral symptoms questionnaire in Spanish. Department Prev. Med. University Report. School of Medicine, National Autonomous University of Leon, Nicaragua.

Axelson O, Hogstedt C (1988): On the health effects of solvents. In Zenz C (ed): ''Occupational Medicine. Principles and Practical Applications,'' 2nd Ed. Chicago: Year Book Medical Publishers, pp 775–785.

Baker S, Weiner E, Borrus A (1990): Mexico: A New Economic Era. Business Week. 11:105.

Denman CA (1991): Las repercusiones de la industria maquiladora de exportacion en la salva: El peso al nacer de hijos de obreras en Nogales. Masters thesis: El Colegio de Sonora, Hermosilla, Mexico.

Denman CA (1990): Industrializacion y maternidad en el noroeste de Mexico. Presentacion en IV Reunion Nacional de Investigacion Demografica en Mexico, April 23–27.

Eisen EA (1995): Healthy worker effect in morbidity studies. Med Lavoro 86:125–38.

Equipo de Estudios Sociales (1991). Banco Nacional de Mexico. Mexico Social 1990–1991. Indicadores Seleccionados. BANAMEX, 8*a* Edición, Perfección Impreso, Mexico, D.F. Mexico.

Eskenazi B, Guendelman S, Elkin E (1993): A preliminary study of reproductive outcomes of female maquiladora workers in Tijuana, Mexico. Am J Ind Med 24:667–676.

Fernandez-Kelly MP (1983): ''For We Are Sold, I and My People: Women and Industry in Mexico's Frontier.'' Albany, NY: State University of New York Press.

Fuentes A, Ehrenreich B (1983): ''Women in the Global Factory.'' Boston: South Ed Press.

Guendelman S, Silberg MJ (1993): Maquiladora work: women on the US–Mexican border. Am J Public Health 83:37–44.

Hovell MF, Sipan C, Hofstetter CR, DuBois BC, Krefft A, Conway J, Jasis M, Issacs HL (1988): Occupational health risks for Mexican women; The case of the maquiladora along the Mexican–United States Border. Int J Health Serv 186:616–626.

Instructivos (1985): ''Reglamento General de Seguridad e Higiene en el Trabajo.'' Secretaria de Trabajo y Prevision Social. Mexico D.F. Mexico.

Lewis SJ, Koltofen M, Ormsby G (1991): Border Trouble Rivers in Peril. National Toxic Campaign. Boston.

Moure-Eraso R, Wilcox M, Punnett L, McDonald L, Levenstein C (1994): Back to the Future: Sweatshop Conditions on the Mexico–U.S. Border. I. Community health impact of maquiladora industrial activity. Am J Ind Med 25:311–324.

Opalin L (1990): Banamex Predicts 15% Growth in Added Value this Year. Maquila Close-Up 11:3.

PAHO/WHO (1994): ''Health Conditions in the Americas.'' Scientific Publ No. 549.1. Washington, DC: PAHO/WHO.

Punnett L (1996): Adjusting for the healthy worker effect in cross-sectional studies. Int J Epidemiol 25:1068–76.

Salazar VA (1991): Present occupational health conditions in maquiladora industry: US–Mexico border. Masters thesis: San Diego University, San Diego, CA.

Sanchez R (1989): Health and environmental risks of the maquiladora in Mexicali. Trans-boundary Resources Rep 3:3–5.

Sander G, Mendoza F (1989): Maquila Land. Twin Plant News 236.

Secretaria de Agricultura y Recursos Hidraulicos (1980): ''Estudio Geohidrologico Preliminar de Prospeccion Geohidrologica y Evaluacion de Acuiferos en Diversas Zonas del Estado Tamaulipas.'' Ciudad Victoria Estado de Tamaulipas.

Silverstein B, Fine L, Armstrong T (1986): Hand wrist cumulative trauma disorders in industry. Br J Ind Med 43:779–784.

Thorburn MJ (1977): Long-term needs of mentally retarded children in Jamaica. Presented at the Twenty-third Scientific Meeting of Commonwealth Caribbean Medical Research Council, Belize, British Honduras.

U.S. Environmental Protection Agency (1991): EPA Chief: Clean and Competitive. Challenges. 4:6.