The Prevalence of Musculoskeletal Complaints among Women in Tijuana, Mexico: Sociodemographic and Occupational Risk Factors

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The authors interviewed an age- and occupation-stratified sample of 466 women, aged 18–40, from 12 Tijuana neighborhoods, about sociodemographic characteristics, work and reproductive history, and musculoskeletal complaints. A total of 29.8% reported experiencing ache or pain in the low back, 88.3% in the upper back, 26.4% in the neck/shoulders, 18.2% in the hand/wrist, and 88.8% in the legs in the preceding year. Both sociodemographic and occupational factors were associated with these complaints. Very low educational attainment, having substandard housing, being the head of household, and being a migrant were each associated with an increased prevalence of one or more musculoskeletal complaints. In general, working outside the home increased the risk of musculoskeletal complaints. Compared with women who had not worked in the preceding 50-month period, those working in the maquiladora had 40–00% higher risks of upper back, neck/shoulder, and hand/wrist pain. Compared with women working outside the maquiladora, maquiladora women workers had 20% higher risks of low back, upper back, and neck/shoulder complaints. More detailed studies of the incidences of musculoskeletal disorders and of specific etiologic risk factors within the maquiladora industry are warranted. Future studies should concurrently evaluate sociodemographic risk factors. Key words: maquiladoras; occupational health; women; working; electronics workers; Mexico; low-back pain; musculoskeletal disorders; prevalence; epidemiology.


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The maquiladora industry is a sector of Mexico’s foreign-owned industry. The maquiladora program was initiated in 1965, experienced explosive growth during the 1980s and has become a leading source of Mexico’s foreign exchange.1 Prior to the signing of the North America Free Trade Agreement (NAFTA), maquiladoras enjoyed special tax status and produced goods for export. Historically, the maquilas were primarily assembly operations for the textile and electronics industries that utilized unskilled female labor. Recently, more complex production processes have been introduced, with a concomitant demand for more skilled labor. Several industrial sectors are now represented, the largest of which are electronics, automotive, and, more recently, plastics. In 1993, when this study was conducted, over 2,000 plants employed 486,210 workers, the majority of whom were female. Tijuana had more than 513 plants employing 71,490 workers.2

Despite the size and importance of the maquiladoras, little is known about occupational health risks in this industry.5–10 Sociologic and ethnographic studies suggest that women working in maquilas experience a wide variety of neuromuscular strains, including chronic lumbago.5,6 Repetitive motion injuries are of potential concern in any production-line process,7,11 and a recent report documented the presence of serious ergonomic hazards associated with repetitive motion processes and inappropriately designed workstations within various maquiladora plants.7 One of few population surveys published to date40 reported no difference between the prevalences of “functional impairments” in currently employed maquiladora workers and service workers. However, functional impairment was defined to include a wide range of unrelated symptoms, lumping backache and joint pains with problems such as earache and sore throat. Also, that study sampled only women who were currently working; thus, sampling bias due to the healthy-worker effect may have been present. The only other study to date that has examined musculoskeletal symptoms of workers in the maquilas10 was based on a sample of 108 respondents and reported an increased prevalence of general musculoskeletal complaints among elec-
Electronic maquiladora workers as compared with non-
maquiladora workers and homemakers. Studies of elec-
tronics workers in the United States have shown in-
creased prevalences of upper-extremity symptoms
associated with certain production processes.13

This pilot study was undertaken to obtain preliminary
data to define labor-force patterns in the maquiladora
industry to aid in the design of occupational studies.3 In
addition, we obtained preliminary estimates of the fre-
quencies of various health problems and occupational
exposures in a community sample of women living in Tijuana.
In the present paper, we estimated the expected one
year prevalences of specific musculoskeletal com-
plaints by occupational status. Because the women in
the study were all of low socioeconomic status, we also
evaluated the extents to which living conditions and
sociodemographic characteristics may act as important
confounders in this population.

METHODS

This cross-sectional study was conducted in Tijuana,
Mexico, during a three-month period in 1993. Twelve
residential neighborhoods in which employees of spec-
ified electronics and plastic maquiladora plants were
known to reside were selected based on prior geo-
graphic analyses.14,15 In each neighborhood, a system-
atic, age-stratified sample of 40 women, ten from each of
four occupational groups, was obtained. The four oc-
cupational categories included electronic maquiladora,
other maquiladora, non-maquiladora work, and not
working. The two age strata were 18–24 and 25–40 years.
A house-to-house survey was conducted by female com-
munity health workers from the Patronato de Salud
Comunitaria, who moved sequentially through each
neighborhood until the targeted 40 women had been
interviewed. Three attempts were made to contact each
household. The health workers first determined
whether any women aged 18–40 lived in the household.
If so, after obtaining informed consent, a brief screen-
ing questionnaire was completed to obtain basic demo-
graphic information and to determine the occupational
status of every female member of the household. When
an eligible woman lived in the household, she was asked
to complete an hour-long interview after completing a
second informed consent procedure. This interview
obtained additional sociodemographic information, a
work history, detailed characteristics about her most re-
cent job, and a health history. Only one woman per
household was interviewed. All procedures were ap-
proved by the Institutional Review Board at the Univer-
sity of Michigan School of Public Health. A total of 479
women aged 18–40 were interviewed. Twelve women
were missing information regarding their current occu-
pational status, and one woman did not complete the
health status questionnaire, leaving 466 women eligible
for this analysis.

Musculoskeletal complaints. A simplified version of the
Nordic Trouble with Locomotive Organs question-
naire16 was used to assess the presence of any muscu-
loskeletal ache or pain in the preceding 12 months. A
shortened version of this instrument was used, as muscu-
loskeletal complaints were one of several health
outcomes examined in this pilot study. After viewing a
diagram of the human body, women were asked whether
they had ever had an ache or pain in a series of 11 body
parts, and, if so, whether they had experienced this prob-
lem within the preceding 12 months. In the analysis
reported here we examined whether a woman reported
having had an ache or pain in the preceding 12 months
in any of the following six sections of the body: 1) lower
back, 2) upper back, 3) neck or shoulders, 4) wrists or
hands, 5) legs (thighs or buttocks, knees, or lower leg),
and 6) ankles or feet. Information about frequency and
severity was not obtained with the short screening in-
strument.

Sociodemographic variables. Sociodemographic variables
included age, marital status, parity, migrant status
(whether or not the woman had been born in Tijuana),
level of education, whether or not the woman was the
head of the household, and whether or not the women
lived in substandard housing. Education was categorized
into primary education or less (0–6 years), some sec-
ondary education (7–9 years), and postsecondary edu-
cation (more than 9 years). Housing was considered to
be substandard if the walls or ceiling included cardboard
construction or if the house had any dirt floors. All the
women in this study were of low socioeconomic status
(SES), but the women with only a primary education or
who lived in substandard housing had the lowest status.

Occupational variables. Two measures of occupational
status, based on occupational profile over the past two
and a half years, were constructed. Each woman's oc-
cupation was defined by her most recent occupational
experience in the preceding two and a half years as 1)
not working, 2) electronics maquiladora, 3) other
maquiladora, 4) other employment. Other maquiladora
included plastics and textiles. A third variable was the to-
tal number of years ever worked. The women were also
categorized as to whether they were working at the time
of the interview, had worked in the preceding two and a
half years but were not currently working, or had not
worked in the preceding two and a half years. A third
variable measured total years ever worked (0, < 1, 1–2,
and > 2 years).

Analysis. The one-year prevalence and 95% confi-
dence interval (CI) were calculated for each type of
musculoskeletal complaint. Crude prevalence ratios
with 95% CIs were calculated to assess the effect of each
risk factor on each musculoskeletal outcome. Adjusted
odds ratios (ORs) and their 95% confidence limits
were then calculated using logistic regression, and all
odds ratios were converted to prevalence ratios (PRs).
Sociodemographic and reproductive history variables

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were modeled first to evaluate their independent contributions to the distribution of musculoskeletal complaints in this population.

Each of the three occupational variables was then examined in a separate model after adjusting for sociodemographic variables relevant to the specific musculoskeletal complaint. The small sample size did not permit us to include the three variables simultaneously in one model. For each variable, women who had not worked in the preceding two and a half years served as the reference group. Although substantial housing was associated with several musculoskeletal outcomes, 19 women were missing information about this variable. As housing quality did not confound the association between musculoskeletal complaints and the occupational variables, housing condition was not included in the adjusted models.

Finally, we restricted the sample to only those women who had worked during the preceding two and a half years, and modeled the association between occupation and musculoskeletal complaints. These models enabled us to compare the prevalences of musculoskeletal complaints in maquiladora workers with the prevalences of similar complaints in non-maquilladora workers.

Given the small sample size and the high prevalence of musculoskeletal complaints, our sample was generally insufficient to achieve statistical significance in the adjusted models. As the goal of this pilot study was to obtain preliminary risk estimates for use in future studies, we focus on identifying those variables for which meaningful increases in prevalence ratios are suggested. We judged a meaningful effect to be an increase or decrease in the prevalence ratio greater than or equal to 40%, which corresponds to approximately a 10% change in absolute risk for the most frequent complaints. As working women generally have higher prevalences of musculoskeletal complaints than the general population, for those models that compared risks in two groups of working women, we considered a meaningful effect to be a 20% increase or decrease in the prevalence ratio, which corresponds to about a 5% increase in the absolute risk.

RESULTS

The sociodemographic, reproductive, and occupational characteristics of the study population are presented in Table 1. The socioeconomic status of the population was quite low. A third of the population had received no secondary education, and only 9% had completed beyond secondary school. Sixteen percent of the participants lived in substandard housing. Ten percent of the women considered themselves to be the head of the household. Two thirds of the sample had migrated to Tijuana, and two thirds were parous.

By sample design, approximately one fourth of the women pertained to each occupational classification. For 23% (n = 109), their current or last job was in an electronics maquiladora; for 27% (n = 125) it was in another type of maquiladora, for 28% (n = 129) it was a non-maquiladora job; 22% (n = 103) had not worked in the preceding two and a half years. Fifty-six percent of the women were working at the time of the interview and 22% had worked during the reference period. Among the women who had not worked within the reference period, 8% had never worked. The women who did not work and the women who worked in the non-maquiladora sector were older than the women who worked in the maquilas (Table 1). The women who worked in the non-maquiladora sector also tended to have more education, while the women who did not work were less likely to be single, head of the household, or nulliparous.

Table 2 presents the estimated one-year prevalences of self-reported aches or pains in the back, upper extremities, and lower extremities. Complaints of upper-back trouble were the most common, with 38.4% of the women reporting upper-back pain. Slightly fewer women (29.8%) reported low-back complaints. Similar proportions reported having neck or shoulder pain (26.4%) and leg pain (28.3%). Complaints related to the hand or wrist (18.2%) and the feet or ankles (50.0%) were the least common. The majority of women (59%) reported at least one musculoskeletal problem in the preceding 12 months, while 20 women (4.3%) reported pain in every part of the body. Low-back and upper-back pain, neck/shoulder complaints, and leg pain were most common in maquila workers, although differences in prevalence by occupation were statistically significant for upper back pain (p < 0.01) only.

Low-back pain. Very low SES was associated with an increased risk of having a low-back complaint. Women with no secondary education were almost 50% more likely to report low-back pain (prevalence ratio \( PR = 1.48, 95\% \text{ confidence interval} [CI] = 1.13, 1.88 \)). The prevalence ratio for women living in substandard housing was 1.4 (95% CI = 0.99, 1.06). Age, parity, marital status, migrant status, and head of household were not associated with the frequency of low-back complaints (data not shown).

After adjusting for education, the risk of self reported low-back pain was increased about 40% among women whose current or last job was in the electronics maquiladora, compared with women who had not worked, as well as among women who had worked for more than two years, in comparison with other women (Table 3).

When the analysis was restricted to only those women who had worked in the preceding two and a half years, electronics maquila and other maquila workers had about a 20-35% higher likelihood of reporting low-back pain as compared with non-maquila workers \( PR = 1.36, 95\% CI = 0.89, 1.92 \) and \( PR = 1.19, 95\% CI = 0.77, 1.72, \) respectively).

Upper-back pain. The only demographic risk factor for upper back pain was being the head of the household.
| TABLE 1 Sociodemographic and Reproductive Characteristics by Occupation of 466 Women, Tijuana, Baja California, 1993 |
|-------------------------------------------------|-----|-----|-----|-----|-----|-----|
| Total                                          | No. | %   | No. | %   | No. | %   | No. | %   | No. | %   | Χ² (p-value) |
| Age                                            |     |     |     |     |     |     |     |     |     |     |             |
| 18-24 years                                    | 208 | 45  | 54  | 50  | 68  | 54  | 54  | 42  | 32  | 31  | 13.96 (0.003) |
| 25-40 years                                    | 258 | 55  | 55  | 51  | 57  | 46  | 75  | 53  | 71  | 69  |             |
| Education (years)                              |     |     |     |     |     |     |     |     |     |     |             |
| 0-6                                            | 164 | 35  | 41  | 38  | 55  | 44  | 29  | 23  | 39  | 38  | 14.37 (0.022) |
| 7 or more                                      | 300 | 65  | 68  | 62  | 69  | 56  | 100 | 78  | 62  | 90  |             |
| Missing                                        | 2   |     |     |     |     |     |     |     |     |     |             |
| Substandard housing                            |     |     |     |     |     |     |     |     |     |     |             |
| Yes                                            | 74  | 16  | 17  | 16  | 24  | 20  | 23  | 19  | 12  | 10  | 4.02 (0.25)  |
| No                                             | 373 | 80  | 88  | 84  | 98  | 80  | 100 | 81  | 87  | 90  |             |
| Missing                                        | 19  | 4   |     |     |     |     |     |     |     |     |             |
| Marital status                                 |     |     |     |     |     |     |     |     |     |     |             |
| Single                                         | 143 | 31  | 35  | 32  | 47  | 38  | 51  | 40  | 10  | 10  | 28.97 (<0.001) |
| Other                                          | 323 | 69  | 74  | 68  | 78  | 62  | 78  | 61  | 93  | 90  |             |
| Head of household                              |     |     |     |     |     |     |     |     |     |     |             |
| Self                                           | 49  | 11  | 15  | 14  | 19  | 15  | 14  | 11  | 1   | 1   | 14.26 (0.003) |
| Other                                          | 444 | 89  | 93  | 86  | 105 | 85  | 114 | 89  | 92  | 99  |             |
| Missing                                        | 3   |     |     |     |     |     |     |     |     |     |             |
| Migrant                                        |     |     |     |     |     |     |     |     |     |     |             |
| Yes                                            | 305 | 66  | 71  | 55  | 91  | 73  | 79  | 62  | 64  | 62  | 4.08 (0.25)  |
| No                                             | 159 | 34  | 38  | 35  | 34  | 27  | 48  | 38  | 35  | 38  |             |
| Missing                                        | 2   |     |     |     |     |     |     |     |     |     |             |
| Parity                                         |     |     |     |     |     |     |     |     |     |     |             |
| 0                                              | 153 | 33  | 41  | 38  | 41  | 33  | 53  | 41  | 16  | 18  | 16.13 (0.001) |
| 1 or more                                      | 313 | 67  | 63  | 62  | 84  | 67  | 76  | 69  | 85  | 63  |             |

*Percentage may not sum to 100 due to rounding error.*

*Chi-square and p-value for comparison of distributions of sociodemographic and reproductive characteristics across occupations.*
### TABLE 2  Estimated One-year Prevalences of Musculoskeletal Complaints by Occupational Status in 466 Women, Tijuana, Baja California, 1993

<table>
<thead>
<tr>
<th></th>
<th>All Women</th>
<th>Maquila Electronic (n = 109)</th>
<th>Maquila Other (n = 125)</th>
<th>Non-Maquila (n = 129)</th>
<th>Did Not Work (n = 103)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>95% CI</td>
<td>%</td>
<td>95% CI</td>
</tr>
<tr>
<td>Pain or ache in</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower back</td>
<td>139</td>
<td>29.8</td>
<td>(25.7, 33.2)</td>
<td>35.3</td>
<td>(26.8, 45.7)</td>
</tr>
<tr>
<td>Upper back</td>
<td>179</td>
<td>38.4</td>
<td>(34.0, 43.0)</td>
<td>42.2</td>
<td>(33.2, 52.9)</td>
</tr>
<tr>
<td>Neck or shoulder</td>
<td>123</td>
<td>26.4</td>
<td>(22.4, 30.6)</td>
<td>31.3</td>
<td>(23.1, 41.5)</td>
</tr>
<tr>
<td>Hand or wrist</td>
<td>85</td>
<td>18.2</td>
<td>(14.8, 22.1)</td>
<td>17.4</td>
<td>(10.8, 25.9)</td>
</tr>
<tr>
<td>Leg</td>
<td>132</td>
<td>28.3</td>
<td>(24.3, 32.7)</td>
<td>31.4</td>
<td>(22.7, 41.2)</td>
</tr>
<tr>
<td>Ankle or foot</td>
<td>70</td>
<td>15.0</td>
<td>(11.9, 18.6)</td>
<td>14.3</td>
<td>(8.2, 22.5)</td>
</tr>
</tbody>
</table>

### TABLE 3  Prevalence Ratios (PRs) for Musculoskeletal Complaints by Work Status Adjusted for Sociodemographic Characteristics for Women Living in Tijuana, Baja California, 1993

<table>
<thead>
<tr>
<th>Back</th>
<th>Neck and Shoulder</th>
<th>Hand and Wrist</th>
<th>Leg</th>
<th>Foot and Ankle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Back*</td>
<td>Upper Back†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maquila—electronic</td>
<td>1.38</td>
<td>0.88, 2.00</td>
<td>1.70</td>
<td>1.14, 2.31</td>
</tr>
<tr>
<td>Maquila—other</td>
<td>1.20</td>
<td>0.82, 1.78</td>
<td>1.65</td>
<td>1.32, 2.47</td>
</tr>
<tr>
<td>Non-Maquila</td>
<td>1.02</td>
<td>0.66, 1.57</td>
<td>1.57</td>
<td>1.06, 2.51</td>
</tr>
<tr>
<td>Not working</td>
<td>Reference</td>
<td>Reference</td>
<td></td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work status n past 25 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Currently working</td>
<td>1.20</td>
<td>0.79, 1.71</td>
<td>1.86</td>
<td>1.30, 2.54</td>
</tr>
<tr>
<td>Worked</td>
<td>1.18</td>
<td>0.72, 1.83</td>
<td>1.51</td>
<td>0.99, 2.12</td>
</tr>
<tr>
<td>Did not work</td>
<td>Reference</td>
<td>Reference</td>
<td></td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years ever worked</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>Reference</td>
<td>Reference</td>
<td></td>
<td>Reference</td>
</tr>
<tr>
<td>&lt; 1 year</td>
<td>1.60</td>
<td>1.06, 2.22</td>
<td>2.67</td>
<td>1.39, 4.78</td>
</tr>
<tr>
<td>1–2 years</td>
<td>1.39</td>
<td>1.33, 1.81</td>
<td>2.40</td>
<td>1.36, 4.01</td>
</tr>
<tr>
<td>&gt; 2 years</td>
<td>1.71</td>
<td>Reference</td>
<td></td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Adjusted for years of education; PRs are calculated for the reference population of women with > 6 years of education.
†Adjusted for head of household; PRs are calculated for the reference population of women who are not head of household.
‡Adjusted for parity and head of household; PRs are calculated for the reference population of non-married women who are not head of household.
§Adjusted for marital status, migrant status, and years of education; PRs are calculated for the reference population of non-migrant married women with > 6 years of education.
‖Adjusted for migrant status; PRs are calculated for the reference population of non-migrant women.
(PR = 1.48, 95% CI = 1.07, 1.87). Age, education, housing quality, parity, marital status, and migrant status were not associated with frequency of upper-back complaints.

Working proved a moderately strong risk factor for upper-back complaints, with working women having about a 60–90% higher probability of having such complaints compared with women who had not worked (Table 3). The risk of having an upper-back complaint was highest among women working in the maquilas, currently working women, and women who had been in the labor force for more than two years.

When the analysis was restricted to only those women who had worked in the preceding two and a half years, younger maquila workers had a 20% higher risk of self-reported upper-back complaints (PR = 1.20, 95% CI = 0.89, 1.50) compared with non-maquilla workers, while the risk in the electronics maquiladora differed little from that observed in the non-maquiladora sector (PR = 1.08).

Neck and shoulder pain. Being the head of the household was also strongly associated with reporting a neck/shoulder complaint, while parous women were less likely to report such complaints (PR = 1.61, 95% CI = 1.13, 2.08 and PR = 0.69, 95% CI = 0.48, 0.95, respectively, when both variables are included in the same model). Living in substandard housing increased the PR slightly (PR = 1.42, 95% CI = 0.98, 1.94). Age, education, marital status, and migrant status were not associated with this outcome.

After adjusting for head of household and parity, working in the maquiladoras was associated with an increase of about 10% in the risk of having self-reported neck or shoulder pain, as compared with women who did not work (Table 3). Such complaints were also more likely among women who had recently stopped working as compared with women who did not work during the reference period.

After restricting the sample to only those women with recent work experience, both electronics and other maquiladora workers had about a 20% higher risk of having neck/shoulder complaints as compared with women who worked outside the maquiladora (PR = 1.24, 95% CI = 0.84, 1.71 and PR = 1.20, 95% CI = 0.81, 1.65, respectively).

Hand or wrist pain. Very little education was associated with a 50% increase in the risk of self-reported aches or pains in the hand or wrist. In addition, single women and migrants were also 50–60% more likely to report hand/wrist complaints than were other women (PR = 1.50, 95% CI = 0.97, 2.25; PR = 1.64, 95% CI = 1.05, 2.46; and PR = 1.48, 95% CI = 0.92, 2.29, respectively, when all three variables are included in the same model). Age, parity, head of household, and housing quality were not associated with this outcome.

After adjusting for education and marital and migrant status, hand/wrist complaints were 40% more likely to be reported by electronics maquiladora workers, 65% more likely to be reported by non-maquiladora workers, and 80% more likely to be reported by other maquiladora workers as compared with non-working women (Table 3). Such complaints were also more than twice as common among women who had ever worked at least one year as compared with women with little or no work experience.

After restricting the analysis to women who had worked during the reference period, electronics maquila workers had a 20% lower probability of reporting hand and wrist complaints, while the likelihood in other maquila workers did not differ as compared with women who worked outside the maquiladora industry (PR = 0.84, 95% CI = 0.45, 1.51, and PR = 1.11, 95% CI = 0.63, 1.86, respectively).

Leg pain. Women who had migrated to Tijuana were more likely than were non-migrants to report experiencing aches or pains in the legs within the preceding year (PR = 1.45, 95% CI = 1.05, 1.91). No other sociodemographic variable was associated with this outcome.

After adjusting for migrant status, working was again associated with an increase in the likelihood of having a complaint, with women working in the maquilas having a 40–50% higher probability of such complaints (Table 3). The likelihood of reporting leg pain was also elevated among women who had ever worked for more than two years.

When the analysis was restricted to women who had worked within the preceding two and a half years, electronics maquiladora workers were about 20% more likely and other maquiladora workers were about 35% more likely to report leg complaints than were non-maquiladora workers (PR = 1.24, 95% CI = 0.79, 1.85, and PR = 1.35, 95% CI = 0.88, 1.95, respectively).

Ankle or foot pain. Having less than a secondary education and being head of the household were associated with the prevalence of self-reported aches or pain in the ankle or foot (PR = 1.56, 95% CI = 0.99, 2.55, and PR = 1.57, 95% CI = 0.84, 2.70, respectively, when both variables are included in the same model). After adjusting for these two variables, the frequency of reporting ankle/foot pain was elevated more than twofold among working women as compared with non-working women, while women with more than two years of work experience had more than a three-fold increase in risk (Table 3).

**DISCUSSION**

This cross-sectional study estimated the one-year prevalences of self-reported musculoskeletal aches or pains, identified relevant demographic risk factors to evaluate as potential confounders in occupational studies of this population, and estimated the expected magnitude of risk associated with occupational status among women.
living in Tijuana. The one-year prevalences of having any musculoskeletal ache or pain ranged from 15% to 38% for different body parts, with the highest prevalence reported for the back. These data suggest that in Mexico, as in the United States, musculoskeletal disorders may be an important public health concern. Women with recent work experience had a higher prevalence of self-reported musculoskeletal complaints as compared with women who had not worked in the preceding two and a half years or had never worked. Among working women, maquila workers were somewhat more likely to report having had aches or pains in the lower and upper back, in the neck or shoulder, and in the legs in the preceding year than were workers in the non-maquilladora sectors.

Over the past two decades, sociologic studies have suggested that work in the maquiladoras may increase a woman's risk for having musculoskeletal problems. Recently, Guendelman and Jasis argued that no real cause for concern existed. Although the sample size in this pilot study was not adequate to rule out chance, our data suggest that women currently or recently employed in the maquiladora may be at increased risk of having musculoskeletal complaints. Work in the maquiladora sector was associated with an increase in the prevalences of self-reported musculoskeletal problems above background levels for the population, and the prevalences were also elevated for women working in the maquiladora sector as compared with other working women. Although the increase in risk among women in the maquiladoras as compared with other working women is small, given the high prevalence of musculoskeletal complaints, a 20% increase in risk represents an important addition to the public health burden. Jobs in the maquiladora industry have many of the ergonomic characteristics that have been identified as important risk factors for musculoskeletal complaints, including high force and frequent repetition, long hours of standing, and improperly designed workstations.

Other investigators have also found increases in musculoskeletal symptoms among women and men working in semiconductor manufacturing. Although the maquiladora population is relatively young, they are at the age during which musculoskeletal complaints generally present for the first time, and the prevalences reported in this study are consistent with findings from other studies. Most studies from industrialized countries report that 60–80% of the populations experience low-back pain at some point in their lives, with the first episode usually occurring between the ages of 20 and 40. The one-year self-reported prevalence of low-back pain among 30-year-old women workers in Denmark was 41.1/100, with higher risks associated with low SES and heavy manual labor. Industrial workers have been found to be at increased risk of back pain and problems of the upper extremities, while high-force repetitive jobs have been found to be a risk factor for hand and wrist cumulative-trauma disorders. The prevalences reported here are also consistent with the few occupational studies of musculoskeletal problems in Mexico.

In addition to providing preliminary data on the prevalences of musculoskeletal problems among working women in Tijuana, these data also point to the importance of evaluating specific complaints and of using large samples when assessing potential occupational risks for musculoskeletal disorders. The sample size of this pilot study was too small to achieve statistical significance for the magnitude of risks identified. For example, we observed a 10% difference in the prevalences of low-back pain and a 6% difference in the prevalences of neck and shoulder pain, but no difference in the frequencies of hand/wrist complaints, between electronics maquiladora workers and non-maquilladora workers. The prevalence ratios, when elevated, were in the range of 1.2–1.4. The sample sizes required per occupational group to detect a prevalence ratio of 1.2 range from about 650 to 1,290 for the range of prevalences observed in this study. No study undertaken in the maquiladoras to date has had a sample size adequate to detect statistically significant risks of this magnitude.

Given the high job turnover rate and the short employment history of the typical maquiladora worker, the findings that neck and shoulder complaints were alone common among women who had stopped working within the preceding two and a half years and that hand/wrist and upper-back problems were more common in women who had worked for at least a year emphasize the importance of considering the healthy-worker effect in future study designs. As we have reported elsewhere, approximately 15% of these women had left their last jobs because of hazardous working conditions, and maquiladora workers were much more likely to state that poor working conditions had led to changes in job status. The findings of an increased risk of musculoskeletal complaints even given the short employment histories is consistent with previous findings that, among workers who perform heavy manual labor, low-back pain often begins within the first few years of starting work.

Future occupational studies in this population should include more precise delineation of the nature of each woman's work, including factors such as job title, specific tasks, and hours worked per week. Future studies should also consider the joint risks of women's living conditions and the non-work environment. Very low SES, as measured by education and housing conditions, was associated with higher risks of low-back pain and of hand/wrist pain. Previous studies have also reported an association between low SES and low-back pain. Women who were the head of household were more likely to report upper-back and neck/shoulder pain. Single women, who tended to be younger and were more likely to be working, were more likely to report...
aches or pains in the hand/wrist. Being a migrant is often considered an indicator of increased vulnerability, and migrants had higher prevalences of hand/wrist and leg complaints. In Tijuana, women of very low SES are likely to live under strenuous conditions, where they are frequently required to carry heavy loads, including drinking water, because of a lack of basic services and transportation. They also have few amenities to reduce back strain stemming from daily household tasks. It is less obvious how low SES, being a migrant, or being single affects the risk of hand/wrist problems. Additional research is needed to identify specific risk factors for wrist pain in these demographic subgroups. Being the head of household appears to identify a particularly vulnerable group of women, and examination of the role of stress, particularly the double burden of work and household roles, may clarify the association between this variable and musculoskeletal problems. Further evaluation of reproductive history characteristics such as number of young children in the home, birth spacing, and recent pregnancy should also be evaluated.27

Since this was a cross-sectional pilot study that depended on self-reports, several limitations must be acknowledged. Although we included both currently employed and unemployed women in the sample, financial and time constraints limited our ability to make numerous repeat visits to sampled households. Consequently, unemployed women may be overrepresented. Nonetheless, these data demonstrate the importance of including representative samples of recently employed as well as currently employed women in occupational studies of this population. Self-reports of aches or pains in the last 12 months may lead to overestimation of actual disorders as well as to recall bias. In the short health screening questionnaire, we did not include measures of frequency or severity; thus, prevalences observed in this study may overestimate the true prevalences of musculoskeletal disorders. However, this pilot study does provide preliminary estimates of both prevalences of musculoskeletal complaints and the magnitudes of risk associated with specific sociodemographic and occupational factors, to facilitate estimation of sample-size requirements for future studies. Such studies should include measures of frequency, severity, and actual disability. Future studies should also characterize high-risk jobs versus lower-risk jobs within a given occupational sector. Finally, obesity has been identified as an important covariate in studies of carpal tunnel syndrome.28 and we did not have data on body size.

CONCLUSION

Chronic musculoskeletal disorders were identified as a major contributor to disability worldwide in the 1993 World Bank report on health.29 In the United States, chronic musculoskeletal impairments affect about 10% of the population and are a primary reason for limita-

tion of daily activity.30 In contrast to the conclusion of Guendelman et al.,9 that work in the maquiladoras "does not seem to add an extra occupational health burden" related to functional impediments, data from this study suggest that women working in the maquiladoras may have up to a 20% higher risk of musculoskeletal pain of the lower and upper back and neck/shoulders as compared with other working women. This elevated risk was apparent even though the maquiladora workers were younger and had entered the workforce more recently. As others have stated,13 even small reductions in risks through preventive interventions can yield large benefits in a population when the health outcome is prevalent, as is the case with musculoskeletal complaints.

Although in epidemiologic studies we often seek a comparable occupational group to serve as a control, the goal of a preventive public health program is to reduce risk to background levels. Thus, the fact that women maquiladora workers have a 40–90% higher risk of musculoskeletal disorders as compared with nonworking women suggests that any intervention program should aim to reduce musculoskeletal complaints by this magnitude. The labor force in the Mexican maquiladora industry has now risen to approximately one million employees.31 Given the paucity of data and the enormous public health consequences of musculoskeletal disability, additional studies of the incidence and prevalence of musculoskeletal pain as well as of frank musculoskeletal disorders should be conducted. The data presented here provide preliminary estimates for use in the design of such studies.

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