Long Term Relations between Earthquake Experiences and Coronary Heart Disease Risk Factors

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The authors analyzed the relations between a variety of earthquake-related experiences incurred in 1983–1984 (financial loss, evacuation, indices of disruption of social networks) and coronary heart disease risk factors (heart rate, blood pressure, total serum cholesterol) assessed in 1987 among 693 Italian male factory workers. Multivariate analyses (adjusting for age, body mass index, smoking, and educational level) revealed no long term relations between the quake-related experiences and blood pressure or cholesterol level. However, higher resting heart rates were observed for individuals who reported financial loss, increased distance from family/friends, or decreased visiting as a result of relocation after the quakes. Findings were unchanged after further adjustment for self-reported psychological distress (assessed using the global symptom index of the Symptom Checklist). These findings, while limited by the cross-sectional nature of the data, suggest that a number of psychosocial consequences of relocation due to a natural disaster are unrelated in the long term to coronary heart disease risk factors, except for small but significant differences in heart rate among individuals who have experienced financial loss and/or social network disruptions.


Coronary heart disease morbidity and mortality are well documented proximate sequelae of earthquakes (1–6). Earthquake exposure has also been found to be associated with temporary increases in many risk factors for coronary heart disease (7–9). The question of a possible relation between disaster exposure and long term increases in coronary heart disease morbidity and risk factors has important public health implications but has been infrequently studied (8, 10–13). Additionally, while there have been reports of relations between disaster experiences such as evacuation, financial loss, and social network disruptions and psychological distress (14–16), these experiences have rarely been examined in relation to morbidity and mortality (12, 13). Recently, Armenian et al. (13) reported results from a 4-year follow-up study of survivors of the 1988 earthquake in Armenia. Increased risks of heart disease, hypertension, diabetes mellitus, and arthritis were found with increasing levels of loss of material possessions and family members from the quake.

We previously reported long term (4 years) increased psychological distress among male factory workers who were evacuated and/or experienced financial loss due to a series of bradyseism earthquake swarms (14). Subsequently, we reported that the reporting of increased distress was limited mainly to those evacuated men who had experienced disruptions in their social networks (15). The present study addresses possible relations between those disaster experiences and risk factors for coronary heart disease in this population.

Pozzuoli, a coastal town in suburban Naples, Italy, is affected by bradyseism—the gradual upward or downward shifting of the land. Although these movements are usually slow and imperceptible, occasionally the movements accelerate and are accompanied by earthquake tremors, as occurred in 1983–1984. During this period, over 16,000 tremors (2–6 on the Mercalli scale) were recorded, with upward movement of the land reaching 184 cm (6.1 feet) above its original sea level. Pozzuoli was declared a national disaster area, and approximately 25,000 (of the 70,000) inhabitants were evacuated. These bradyseism quakes were confined to the Pozzuoli area, the location of the Olivetti factory and the residence for nearly half of its workers.
MATERIALS AND METHODS

Study participants

The Olivetti Heart Study is a longitudinal study of risk factors for coronary heart disease among employees of the Olivetti factory in Naples, Italy. Only the 1987–1988 follow-up included assessment of earthquake experiences and psychological distress. This report is based on data gathered in that follow-up, which screened 990 individuals (942 males and 48 females; 80 percent participation rate). Because of the small number of females, only male participants were considered. Participants who reported use of medications for lowering blood pressure and/or cholesterol levels (n = 176) were excluded, as were those with incomplete data (n = 73); this resulted in a total of 693 males for analysis.

Participants were seen in the early morning at the medical facilities of the Olivetti factory after an overnight fast. The medical examination included measurement of blood pressure, heart rate, serum lipid levels, and anthropometric characteristics. Participants also completed a self-administered questionnaire on lifestyle habits, psychological characteristics (including a 64-item reduced version of the Symptom Checklist (17)), and personal and family medical history.

Disaster experience measures

Participants were questioned about a wide variety of earthquake-related experiences, including whether or not they 1) had been evacuated from their homes, 2) had experienced financial loss due to the quakes, and/or 3) had experienced disruptions in their social networks (see Appendix).

Risk factor measures

Blood pressure was measured by trained observers with a standard mercury sphygmomanometer according to a standardized protocol. The values reported are the average of two readings taken 2 minutes apart. Fasting blood samples were drawn by venipuncture for determination of serum lipid levels (18, 19). Heart rate was calculated from a 12-lead standard resting electrocardiogram (20).

Covariate measures

Height and weight were measured on a beam balance scale. Body mass index was calculated as weight in kilograms divided by the square of height in meters. Cigarette smoking was measured as the number of cigarettes smoked per day (19). Education was measured on a five-point scale (none through university).

Statistical analyses

One-way analyses of variance were used to assess differences in covariates (age, body mass index, educational level, and smoking) as a function of quake experiences. Separate multivariate analyses of covariance were used to assess the differences in heart rate, blood pressure, and serum total cholesterol between participants with varying disaster experiences, while controlling for the potentially confounding effects of age, body mass index, cigarette smoking, and educational level.

RESULTS

The Olivetti males studied averaged 44.4 years of age (range, 22.2-67.3), and most had less than a high school education (79.7 percent). Nearly all of the men (95.5 percent) were married.

Table 1 presents mean values for the covariates and the adjusted coronary heart disease risk factors as a function of evacuation status and reported financial loss. Evacuated men and those reporting financial loss were older and less educated than the nonevacuated and those reporting no financial loss. Evacuation status and reporting of financial loss were not related to body mass index, smoking, blood pressure, or cholesterol. Higher heart rates were observed for men who reported financial loss.

Table 2 presents differences in covariate measures and adjusted coronary heart disease risk factors between evacuated and nonevacuated men with varying social network disruptions. On average, evacuated men were older and less educated than nonevacuated men. In comparison with the nonevacuated men, mean adjusted heart rates were higher for the 118 evacuated men who reported subsequent increased distance from family and/or friends and for the 95 evacuated men who reported decreased visiting. The observed higher heart rate for evacuated men who did not return to the same houses they had lived in before the quake (n = 105) was of borderline statistical significance (p = 0.16). Blood pressure and cholesterol levels did not differ as a function of these indices of social network disruption. These findings were unchanged with further adjustment for self-reported psychological distress (data not presented).

DISCUSSION

In this group of employed factory workers, we found no relation between blood pressure and earthquake experiences at the 4-year follow-up. These findings are consistent with short term follow-up of earthquake victims in Italy and Japan (7, 9). At the 2-year follow-up,
TABLE 1. Mean values for covariate measures and adjusted coronary heart disease risk factors among males (n = 693) at the 1987 examination, by 1983–1984 earthquake experiences, Olivetti Heart Study, Italy

<table>
<thead>
<tr>
<th></th>
<th>Evacuated in 1983–1984</th>
<th>Financial loss due to earthquake</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No (n = 469)</td>
<td>Yes (n = 224)</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>SD†</td>
</tr>
<tr>
<td>Age (years)</td>
<td>45.40</td>
<td>3.75</td>
</tr>
<tr>
<td>Body mass index‡</td>
<td>26.15</td>
<td>3.50</td>
</tr>
<tr>
<td>Educational level§ (0–4)</td>
<td>3.01</td>
<td>0.79</td>
</tr>
<tr>
<td>Smoking (cigarettes/day)</td>
<td>10.86</td>
<td>0.79</td>
</tr>
<tr>
<td>Heart rate¶ (beats/minute)</td>
<td>71.52</td>
<td>7.30</td>
</tr>
<tr>
<td>Systolic blood pressure¶ (mmHg)</td>
<td>126.58</td>
<td>126.88</td>
</tr>
<tr>
<td>Diastolic blood pressure¶ (mmHg)</td>
<td>86.48</td>
<td>85.96</td>
</tr>
<tr>
<td>Total cholesterol level¶ (mg/dl)</td>
<td>217.39</td>
<td>218.97</td>
</tr>
</tbody>
</table>

* p ≤ 0.05; ** p ≤ 0.01; *** p ≤ 0.001 (significant F ratio).
† SD, standard deviation.
‡ Weight (kg)/height (m²).
§ None through university.
¶ Adjusted for age, body mass index, smoking, and educational level.

survivors of the Buffalo Creek dam disaster exhibited increased prevalence of hypertension and increased diastolic blood pressure (10). However, these findings were most notable for Blacks (of both sexes) and White females. In a case-control study of female flood victims, financial loss and property loss were identified as risk factors for self-reported hypertension 5 years after exposure (12). Among these women, however, disruption of social contacts did not differentiate the hypertensive cases from controls. Comparisons with these two studies are problematic, since our sample was limited to White males. The increased reporting of new hypertension among Armenian earthquake survivors with increased levels of loss and damage at the 4-year follow-up (13) is important, and probably illustrates some of the differences between the Armenian population and the Olivetti population. While the Armenian survivors' loss scores included earthquake-induced death and injury in the family, the Olivetti workers were far more fortunate: No deaths occurred, and there were only 18 reported injuries. Additionally, our participants were a working population, and our sample did not include females or the elderly.

We found no relation between earthquake experiences and cholesterol level. This is consistent with a previous report from our group that focused on the 7-year follow-up of Olivetti males following the 1980 quake (8).

The lack of observed differences as a function of earthquake experience calls into question the validity of our indices of quake experience. However, these indices were shown to identify significant differences in self-reported psychological distress for these men at the 1987 follow-up (13, 14).

We found heart rate differences in relation to 1983–1984 bradyseism quake experience at the 1987 follow-up. Heart rates were elevated for the Olivetti workers screened during the weeks immediately following a major earthquake in 1980, but were normal at the 7-year follow-up (8). However, relations to specific quake experiences in 1980 were not considered. The study of Armenian earthquake survivors' increased risk of heart disease with increased loss does not address the possible role of increased heart rate as a mediator of the disaster-disease relation. While there is evidence that elevation in resting heart rate is a risk factor for coronary heart disease (21–23), the differences found in the present study were small (~3 beats/minute) and thus were unlikely to be the only factor in a relation between disaster exposure and coronary heart disease morbidity and mortality.

Our findings were cross-sectional, and thus we cannot say for certain that differences in heart rate were not present before the quakes. While the 1980 follow-up of these workers included measurement of heart rate, the differences in techniques used between the two follow-ups, as well as the reduced number of men observed at both times, make a longitudinal view inappropriate. Findings may differ for other segments of
the population and/or for disaster victims who experience more devastation and loss.

In summary, our cross-sectional analysis of working men did not suggest that disaster experiences, such as financial loss and relocation, are related in the long term to coronary heart disease risk factors, with the exception of small differences in heart rates.

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REFERENCES

APPENDIX

Questions Posed to Olivetti Heart Study Participants Regarding Their 1983–1984 Bradyseism Earthquake Experiences

1. Between 1980 and today, did you ever live in Pozzuoli (the area affected by the 1983–1984 bradyseism quakes)?

2. Were you evacuated because of the bradyseism quakes? (Yes/No)

3. Where do you live now? In the same house as before the bradyseism? (Yes/No)

4. Did you move into a new house because of the bradyseism quakes? (Yes/No)

5. As a result of the bradyseism quakes, did the distance from family:
   1. increase;
   2. decrease;
   3. remain the same? [Combined with the “decrease” group because of the small number of participants choosing this response.]

6. As a result of the bradyseism quakes, did the distance from friends:
   1. increase;
   2. decrease;
   3. remain the same? [Combined with the “decrease” group because of the small number of participants choosing this response.]

7. After the bradyseism, did the number of visits with family:
   1. increase;
   2. decrease;
   3. remain the same? [Combined with the “increase” group because of the small number of participants choosing this response.]

8. After the bradyseism, did the number of visits with friends:
   1. increase;
   2. decrease;
   3. remain the same? [Combined with the “increase” group because of the small number of participants choosing this response.]

9. Was your property damaged because of the bradyseism quakes? (Yes/No)

10. Did your finances suffer because of the bradyseism quakes? (Yes/No)