Letters to the Editor

Reduction in male births among workers exposed to metal fumes

From IRENE FIGÁ-TALAMANCA AND GRAZIA PETRELLI

Sir—A number of reports suggest that some occupational exposures of males may alter the gender ratio of their offspring. Reduction in male offspring has been observed after exposures to hyperbaric chambers¹ and among professional drivers,² applicators of dibromochloropropane,³ carbon setters⁴ and aluminum smelter workers.⁵ Weijin and Olsen⁶ have suggested that offspring gender ratio, because of its correlation with reduced fertility, may be a possible epidemiological indicator of reproductive hazards.

We have conducted a study to evaluate the possible role of exposure to metal fumes (particularly nickel and chromium) on the reproductive health of male workers in an Italian mint. The study was designed to evaluate specifically fertility problems, and the observed reduction in fertility is reported separately. We also noted, however, an interesting alteration of the gender ratio with reduced male births which we feel is worth reporting.

The workers were divided into administrative staff (non-exposed to metal fumes), technical and maintenance staff (with minimal exposure), coin stampers (exposed to metal fumes) and founders (highly exposed to metal fumes). Air sampling and biological monitoring of workers yielded concentrations of metals within the TLV-ACGIH. However, the blood nickel levels were very near the biological reference value of 0.5 µg/dl, especially among founders.

The proportion of male children among all offspring born to these men while working in the four job categories is shown in Table 1. Founders had a significantly reduced proportion of male children when compared to both the administrative staff and to the general population, where the proportion of males is 51%. We focused more specifically on the most recent birth of these workers, because information on exposure was more detailed for the last pregnancy of the couple. Again we note a reduction in the births of males among founders, which is statistically significant.

The limited number of cases included in our study do not allow a conclusion, but these data add to the evidence that occupational exposure might affect the gender ratio in favour of female births. The mechanism of this effect is under debate. James⁷ hypothesized that gender ratio is affected by hormone concentrations. High levels of gonadotropin and low levels of testosterone, favour the production of daughters.

However, among welders Bonde⁸ has observed hormonal alterations, poor semen quality and reduced fertility but no alteration in the gender ratio. The other possible mechanism may be related to a greater susceptibility of the fetuses, to early undetected pregnancy loss. This hypothesis is compatible with alterations of the sex ratio observed in Danish female physiotherapists.⁹

The question is certainly intriguing, and since gender ratio is an easily accessible epidemiological indicator, its study in particular occupationally exposed populations, may prove cost-effective.

Table 1 Gender ratio among the children of men exposed to metal fumes (nickel and chromium) in an Italian mint

<table>
<thead>
<tr>
<th></th>
<th>All offspring</th>
<th>Most recent offspring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>% Male</td>
</tr>
<tr>
<td>Non-exposed</td>
<td>48</td>
<td>58.3</td>
</tr>
<tr>
<td>Technical</td>
<td>74</td>
<td>48.6</td>
</tr>
<tr>
<td>Stampers</td>
<td>31</td>
<td>48.4</td>
</tr>
<tr>
<td>Founders</td>
<td>63</td>
<td>33.3</td>
</tr>
</tbody>
</table>

N.B. p¹ values were calculated comparing the non-exposed with the exposed groups, using the binomial test with approximation to the normal sex ratio in the general population (51%).

References

¹ Rockert HOE, Haglid K. Reversible changes in the rate of DNA synthesis in the testes of rats after daily exposure to a hyperbaric environment of air. ICRS Journal of Medical Science 1983;11:531.
⁵ Irgens A. Personal communication. 1996.
⁷ James WH. Evidence that mammalian sex ratios at birth are partially controlled by parental hormone levels at the time of conception. J Theor Biol 1996;180:271–86.
Sir—I am sorry I was unable to be present at the 15th International Scientific Meeting of the IEA in Florence. I am sure it proved memorable and enjoyable.

The IEA has come a long way since we held our first International Scientific Meeting in Noordwijk, Holland, in September 1957. Then there were only 58 participants and it was possible to hold an executive committee meeting in the bus on the way to the airport in order to plan our future programme before we dispersed. The Association has grown enormously in numbers and influence since then.

Our first chairman, Robert Cruickshank, never ceased to exhort us to spread the gospel of epidemiology throughout the world. The number and variety of the contributions to this international meeting and the large number of countries represented here indicated that Robert’s exhortations have borne magnificent fruit.

The scope of epidemiology has also expanded greatly during the 45 years since the IEA was founded. The IEA’s early great interest in non-communicable disease epidemiological research has expanded to cover all types of disease, trauma and congenital defects, and clinical trials. Sophisticated statistics and social factors applied to medicine are all embraced today. In addition, a large part of research resources, perhaps too large a part, is now devoted to studying how to improve the efficiency of existing health services. Such studies are valuable and are naturally welcomed by governments and health authorities if they lead to economies in expenditure on health but I wonder if this great expansion in health service research may not have led to fewer resources, in terms of money and manpower, being available for research on our most important task, the prevention of disease.

I believe that there are opportunities ahead for epidemiologists, not yet much explored, to apply their skills and knowledge for the benefit of society in fields other than that of health and disease.

May I conclude by sending my warm greetings to any of my old friends who attended the meeting in Florence and to all the younger, and I am sure equally enthusiastic epidemiologists, in whose hands the future lies.

Below is a group photograph of those attending the 1964 IEA meeting in Princeton. I am unable to put a name to some of the group. Perhaps some readers may be able to rectify this. I would be delighted to hear from anyone present at the IEA Princeton Meeting.

KEY TO PHOTOGRAPH

Front Row
1. J.J. Day
2. P. Muntendam
3. R. Badgley
4. W.I.N. Kessel
5. A. Boddy
6. A. Robertson
7. R.R. Gillies
8. J.M. Last
9. J. Ashford
10. W. Holland
11. M. Acheson
12. J. Lawrence
13. D. Clark
14. C.R. Lowe
15. J.R. Goldsmith
16. A.O. Plaja
17. A. Giron
18. O.K. Sagen
19. E. Medina
20. J. Inclan
21. J.G. Zimmer
22. E. Cruickshank
23. J. Strong

Second Row
1. Mrs J. Day
2. Mrs Muntendam
3. T.A. Burch
4. R.M. Acheson
5. H. Willard
6. P. Yekutiel
7. L. Breslow
8. Mrs K.O. Elsom
9. Mrs S. Klepper
10. Miss B. Evans
11. Mrs. Smillie
12. Dr Alice Stewart
13. Miss M. Frank
14. E.G. Clark
15. Dr Dorothea C. Leighton
16. Mrs O. Plaja
17. A.R. Kagan
18.
19. Mrs. Smillie
20. Mrs O. Plaja
21. A.R. Kagan
22.
23.

Third Row
1. P.P. Sadoul
2. H.A. Valkenburg
3. R. Armijo
4. H. Hilleboe
5. P.C. Elwood
6. A.L. Cochrane
7. G.A. Rose
8. R. Belmar
9. W.G. Smillie
10. N.G.S. Raghavan
11. A.M. Davies
12. K. Newell
13. J.C. McDonald
14. P.J. Collard
15. R. Cruickshank
16. T. Anderson
17. L. Kurland
18. S. Hammond
19. R. Scott
20. M. Terris
21. 22. 23.
27. R.F.L. Logan
28. M. Kaplan
29. T. McKeown
30. S.J. Bosch
31. F.H. Epstein

Back Row—Standing
1. R. Berg
2. W. Fleming
3. E. Perrin
4. R. Huntley
5. V.W. Sidel
6. J.W. Macleod
7. G. Lindgren
8. G. Inge
9. R. Berfenstam
10. A.M.M. Payne
11. K. Raska
12. I.T.T. Higgins
13. J.A.H. Lee
14. J. Stokes, III
15. M. Savicevic
16. C. Vukmanovic
17. R.M. Gonzalez
18. D.A. Henderson
19. A.D. Langmuir
20. B.G. Ferris, Jr
21. 22. 23.
27. 28. 29.
30. 31.
Princeton, USA—1964
INTERNATIONAL EPIDEMIOLOGICAL ASSOCIATION
Participants at a meeting on 'Comparability in International Epidemiology'