COMPARATIVE INCIDENCE OF ANGLE-CLOSURE GLAUCOMA AMONG DIFFERENT NATIONAL GROUPS IN VICTORIA, AUSTRALIA*

BY

RONALD F. LOWE

Royal Victorian Eye and Ear Hospital, Melbourne, and Ophthalmic Research Institute of Australia

AFTER the second world war, the emigration of peoples from Europe to Australia was greatly accelerated. The large numbers of these different national groups now resident in Australia has permitted investigations of different disease incidence among them.

During the examination of over 300 patients who had angle-closure glaucoma (in one of its forms previously described by Lowe, 1961), it was possible to tabulate 210 patients according to country of birth (Table I). These patients were drawn from the cross-indexed history files of The Royal Victorian Eye and Ear Hospital from 1954 to 1961 and a few were examined in private practice. Some had originally attended the hospital with angle-closure glaucoma before 1954 but had been re-examined and included in the list after return visits to hospital or when requested to attend for review. Examinations of all these patients were conducted during 1961 and 1962.

The population census figures for 1954 and 1961 are presented to give an idea of the proportions of the different nationalities (Census Bulletin, 1962). The 1954 and 1961 censuses showed that 50 per cent. of the population was under the age of 30 years and below this age the manifestation of angle-closure glaucoma is very uncommon (Lowe, 1961).

The general population figures have not been used as they represent a higher average economic level than that of the patients who came mostly from the lower income groups and were attending a public hospital. To counteract the economic factors the racial distribution of 1,000 patients over the age of 30 years, attending the hospital seriatim during part of 1961 has also been set out in Table I for more appropriate comparison.

It appeared particularly strange that no Italians and only one male Greek had attended with angle-closure glaucoma, and it seemed possible that Italian and Greek women in Australia might be reluctant to attend this
### Table

**BIRTHPLACES OF INHABITANTS OF VICTORIA DURING THE YEARS 1954 AND DURING 1961. OF 275 PATIENTS WITH PRIMARY ANGLE-CLOSURE GLAUCOMA DACRYOCYSTORHINOSTOMY**

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Australia</td>
<td>1,020</td>
<td>1,062</td>
<td>2,083</td>
<td>1,160</td>
<td>1,199</td>
<td>2,360</td>
</tr>
<tr>
<td>United Kingdom + Republic of Eire</td>
<td>92</td>
<td>78</td>
<td>171</td>
<td>108</td>
<td>97</td>
<td>206</td>
</tr>
<tr>
<td>Germany</td>
<td>11</td>
<td>10</td>
<td>21</td>
<td>20</td>
<td>18</td>
<td>39</td>
</tr>
<tr>
<td>Greece</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>17</td>
<td>14</td>
<td>31</td>
</tr>
<tr>
<td>Italy</td>
<td>27</td>
<td>14</td>
<td>42</td>
<td>51</td>
<td>38</td>
<td>90</td>
</tr>
<tr>
<td>Malta</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>10</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>Netherlands</td>
<td>9</td>
<td>6</td>
<td>15</td>
<td>20</td>
<td>16</td>
<td>36</td>
</tr>
<tr>
<td>Poland</td>
<td>12</td>
<td>8</td>
<td>21</td>
<td>13</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>Other Europe</td>
<td>26</td>
<td>18</td>
<td>45</td>
<td>43</td>
<td>30</td>
<td>73</td>
</tr>
<tr>
<td><strong>Total Europe</strong></td>
<td>190</td>
<td>143</td>
<td>333</td>
<td>285</td>
<td>233</td>
<td>519</td>
</tr>
<tr>
<td>Other Places</td>
<td>19</td>
<td>14</td>
<td>34</td>
<td>26</td>
<td>11</td>
<td>38</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>1,231</td>
<td>1,221</td>
<td>2,452</td>
<td>1,474</td>
<td>1,455</td>
<td>2,930</td>
</tr>
</tbody>
</table>

† Australian census figures for the State of Victoria are given to the nearest thousands.

particular hospital because of language difficulties or from a desire to avoid operations. It so happens, however, that the operation of dacryocystorhinostomy is frequently performed under general anaesthesia at this hospital. This operation is seldom performed in persons under the age of 30 years and there is a considerable preponderance of females compared with males, so that in these respects dacryocystorhinostomy is comparable with operations for acute angle-closure glaucoma. Both are non-fatal diseases, but there is no comparison between the distress they cause. Angle-closure glaucoma blurs vision and threatens blindness and the intense pain of most attacks of acute glaucoma is so severe that the patients are usually driven to hospital to seek relief, whereas those who ultimately undergo dacryocystorhinostomy merely seek relief from a discharging and wet eye. The figures for dacryocystorhinostomy show that there has been no reluctance among certain national groups to attend hospital through social difficulties or a fear of surgery and general anaesthesia.
ANGLE-CLOSURE IN DIFFERENT NATIONAL GROUPS


<table>
<thead>
<tr>
<th>1,000 Consecutive Patients Born before 1930†</th>
<th>Primary Angle-closure Glaucoma</th>
<th>Dacryocystorhinostomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>Females</td>
<td>Total</td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>343</td>
<td>353</td>
<td>696</td>
</tr>
<tr>
<td>63</td>
<td>61</td>
<td>124</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>25</td>
<td>13</td>
<td>38</td>
</tr>
<tr>
<td>34</td>
<td>17</td>
<td>51</td>
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<tr>
<td>7</td>
<td>5</td>
<td>12</td>
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<td>10</td>
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<td>19</td>
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<tr>
<td>17</td>
<td>11</td>
<td>28</td>
</tr>
<tr>
<td>168</td>
<td>121</td>
<td>289</td>
</tr>
<tr>
<td>9</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>520</td>
<td>480</td>
<td>1,000</td>
</tr>
</tbody>
</table>

* Includes 5 Jewish.
† Includes 5 Jewish.
‡ Attending the Royal Victorian Eye and Ear Hospital, 1961.

Statistical Analysis

In Table I the distribution of birthplaces of the patients with primary angle-closure glaucoma seen between 1954 and 1961, and of those undergoing dacryocystorhinostomy between 1954 and 1961 are presented with that of 1,000 consecutive patients born before 1930 and seen in 1961 at The Royal Victorian Eye and Ear Hospital. This last group will provide a control series. There is a great excess of females for angle-closure glaucoma ($\chi^2 = 76.45; P < 0.001$) and also for dacryocystorhinostomy ($\chi^2 = 50.66; P < 0.001$), but not for the control series ($\chi^2 = 1.6; P > 0.20$).

Comparing the sub-totals for each national group, it can be seen that the relative frequencies differ between the three sets of data mainly because of an apparent deficiency of primary angle-closure glaucoma among Italian and Greek nationals, and a possible excess among the United Kingdom and Irish nationals.
To look at the data further we must combine some national groups to perform statistical tests. In Table II the totals for Australia, United Kingdom + Eire, Germany + Netherlands + Poland, Malta + Greece + Italy, “Other Countries in Europe” + “Other Places” are presented. For the comparison of primary angle-closure glaucoma and dacryocystorhinostomy operations there are two sets of five totals making a 2 x 5 table. A heterogeneity $\chi^2$ for four degrees of freedom can be calculated on this Table. This came to 38.80 which is highly significant ($P < 0.001$). Thus the incidence of the two conditions is shown to differ between national groups.

**TABLE II**

DATA IN TABLE I ARRANGED FOR HETEROGENEITY TESTS (SEE TEXT)

<table>
<thead>
<tr>
<th>Birthplace</th>
<th>Primary Angle-closure Glaucoma</th>
<th>Dacryocystorhinostomy</th>
<th>Control Group of 1,000 Consecutive Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>187</td>
<td>90</td>
<td>696</td>
</tr>
<tr>
<td>United Kingdom + Eire</td>
<td>52</td>
<td>18</td>
<td>124</td>
</tr>
<tr>
<td>Germany + Netherlands + Poland</td>
<td>11</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>Malta + Greece + Italy</td>
<td>5</td>
<td>25</td>
<td>101</td>
</tr>
<tr>
<td>Other Countries in Europe</td>
<td>20</td>
<td>4</td>
<td>43</td>
</tr>
<tr>
<td>Other Places</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>275</td>
<td>146</td>
<td>1,000</td>
</tr>
</tbody>
</table>

For the comparison of primary angle-closure glaucoma with the control group $\chi^2 = 28.45$ ($P < 0.001$), which is highly significant.

For the comparison of dacryocystorhinostomy with the control group $\chi^2 = 9.78$ ($0.02 < P < 0.05$), which is only on the borderline of significance.

Thus the distribution of primary angle-closure glaucoma differs greatly from that of the control and from that of the dacryocystorhinostomy group, but the control group does not differ greatly from the dacryocystorhinostomy group.

To look at these differences further we can carry out $\chi^2$ tests on the 2 x 2 tables made up of the number of Australian-born patients compared with various other relevant national groups. The results of such tests are presented in Table III (opposite).
There is a significant $\chi^2$ for the difference in the relative numbers of Australian-born and United Kingdom + Eire-born with reference to primary angle-closure glaucoma incidence and the control group, so that there is a slight excess of glaucoma cases in the United Kingdom + Eire group compared with the Australian group. This result can be regarded as merely suggestive in view of complications such as income, social class, and the possibility that age distributions differ between Australian-born and immigrants.

However, there is a very significant $\chi^2$ for the difference in the relative numbers of Australian-born compared with both Italian-born and Greek-born in regard to the comparison between the incidence of primary angle-closure glaucoma and of dacryocystorhinostomy. The same applies for the comparison between primary angle-closure glaucoma and the control. This is due to a great deficiency of Italian-born and Greek-born glaucoma cases relative to Australian-born cases. On the other hand, compared with the Australian-born, the comparison of dacryocystorhinostomy frequency with the control, shows a slight excess of the Italian-born. As pointed out earlier, the number of Italian and Greek-born attending for dacryocystorhinostomy argues against there being much procrastination in attending for primary angle-closure glaucoma, so that the deficiency of glaucoma cases is probably real.

In any study of this nature, considerable sources of error can arise, some of which we have pointed out. The study of any condition with variable age at onset is subject to complications, especially when comparing the migrant groups which differ in their age distributions. To minimize the age factor,
only persons over the age of 30 years have been considered. However, the
fact that the glaucoma cases are so rare in the Italian and Greek-born com-
pared with cases of dacryocystorhinostomy and the control group does argue
for a real difference in incidence between these groups and the Australian-
born. In this context it would be of interest to compare groups in various
European countries with a standardized scheme of diagnosis, as regards both
primary angle-closure glaucoma and shallow anterior chamber and narrow
angles, which are anatomical characteristics predisposing to attacks of
primary angle-closure glaucoma.

Discussion

Primary angle-closure glaucoma usually occurs in eyes with a recognizable
anatomical predisposition, viz. a shallow anterior chamber with a narrow
entrance to the drainage angle of the anterior chamber. Glaucoma results
from apposition of the iris to the corneo-scleral trabeculae thereby preventing
the drainage of the aqueous. Familial studies have shown a high incidence
of shallow anterior chambers among the sibs of patients with primary angle-
closure glaucoma (Tornquist, 1953; Kellerman and Posner, 1955; Paterson,
1961). Primary angle-closure glaucoma mainly occurs in subacute or acute
attacks which are precipitated by well-recognized environmental factors,
such as respiratory illness, fatigue, emotional disturbances, or worry (Lowe,
1961). A considerable proportion of the sufferers appear to be particular
personality types.

It appears unlikely that the Italian and Greek migrants suffer significantly
less from the environmental factors that precipitate angle-closure glaucoma in
other peoples. However, despite the recognition of environmental factors,
the exact mechanism by which they induce the subacute or acute attacks of
glaucoma remains unknown. Do the ocular physiological responses to
environmental factors differ among Italian and Greek migrants to Australia
compared with other peoples, or does the anatomy of their eyes not predispose
to the development of primary angle-closure glaucoma? Superficially the
eyes of Italians and Greeks appear very similar to those of Maltese. The
reason for the rarity of primary angle-closure glaucoma among Italian and
Greek migrants in the State of Victoria remains so far unknown.

The figures for primary angle-closure glaucoma for Poland and "Other
Europe" show a very high proportion of Jewish people. Most of these
patients give grim histories of extreme terror and grave hardship while they
were in Europe during the second world war, and, they tend, as a group, to
be highly emotional. Their dreadful experiences appear to have had a major
effect in causing their attacks of subacute or acute angle-closure glaucoma.

Summary

From a comparison between a control series of patients born before 1930
and attending seriatim The Royal Victorian Eye and Ear Hospital some time
in 1961, a series of 146 patients who attended The Royal Victorian Eye and Ear Hospital for dacryocystorhinostomy, and a series of 275 cases of primary angle-closure glaucoma, the following conclusions may be drawn:

(1) Comparing the incidence of primary angle-closure glaucoma with that of dacryocystorhinostomy there is a highly significant difference between certain national groups.

(2) Compared with the control series there is a highly significant difference for the incidence of primary angle-closure glaucoma and a barely significant difference for dacryocystorhinostomy in certain national groups.

(3) There is a remarkably small incidence of primary angle-closure glaucoma among Italian and Greek migrants compared with the Australian-born. The difference appears to be real.

(4) There is a slight excess of dacryocystorhinostomy among the Italian-born compared with the Australian-born.

This paper stems from Research Projects No. 13 of The Royal Victorian Eye and Ear Hospital and No. 14 of The Ophthalmic Research Institute of Australia. In compiling Table I much assistance was given by the staff of the medical records section of The Royal Eye and Ear Hospital, Melbourne.

I wish to thank Dr. Peter Parsons, reader in human genetics, Department of Zoology, University of Melbourne, for preparing the statistical analyses.

REFERENCES

ADDENDUM

Between the time this paper was submitted and the receipt of the proofs, a further 83 patients with angle-closure glaucoma were examined. This additional number included two female Greeks but still no Italians.
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