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NOMOGRAMS FOR RATES PER 1,000

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A series of three nomograms is presented as an aid in assessing the significance of rates per 1,000, which depends, of course, upon the numbers at risk. These nomograms are extensions of a previous set (Rosenbaum, 1959), which were expressed as percentages, and where the size of sample did not exceed 4,000. The derivation of the nomograms is explained in that paper, and is not repeated here. The size of sample is now extended to 1,000,000, and the three problems originally dealt with on a single nomogram are now separated for greater clarity. The range of values formerly covered is included in the present set.

I. Confidence Limits to a Rate

In the first nomogram the right-hand scale *m* shows the size of sample; the left-hand scale *p* shows the rate per 1,000 being considered. On joining them by a straight line, the point at which the central scale is cut indicates the 95% and 99% confidence limits to the rate *p*.

Example.—In the week ending September 16, 1961, 15,658 births were recorded in England and Wales, of which 291 were stillbirths (*Brit. med. J.*, 1961). This represents a rate of 18.6 per 1,000. If a ruler is placed across the nomogram from this point on the left-hand scale to 15,658 on the right-hand scale, it cuts the centre scale at the value 2.1 on the 95% side, and 2.8 on the 99% side. Thus the 95% confidence limits to the rate are ± 2.1 , and the 99% confidence limits are ± 2.8 . Note that these are also the confidence limits to the rate of live births, 981.4 per 1,000.

It should be pointed out that the confidence limits also provide a test for the significance of a difference from a standard rate which is known without any presumption of error, the criterion being whether the confidence limits embrace the standard rate or not. For example, if there were a standard stillbirth rate of 20 per 1,000 the 95% confidence limits obtained above—namely, 16.5 and 20.7—include this value, and so the difference is not significant.

The nomogram cannot be used for a very small value of *p* and at the same time of *m*. It is probably safe to use when *p* is based on 10 cases or more.

II. Difference Between Two Rates

In the second nomogram we are interested in comparing two rates *p* and *q*, one based on a sample of size *m*, and the other on a sample of size *n*. The left-hand scale shows the size of the two samples combined, $N=m+n$. The right-hand scale shows the two rates added together, $P=p+q$.

If these points are joined by a straight line the central scale is cut at a point which indicates whether the difference $p-q$ is significant or not. That is to say, if $p-q$ is greater than the value indicated on the 5% side of the central scale it is significant at the 5% level, and similarly on the 1% side.

Example.—The first report of the Medical Research Council tuberculosis vaccines trial (M.R.C., 1956) covered the incidence of tuberculosis during the first

Nomogram I. Confidence limits to a rate.

Nomogram II. Difference between two rates.

Nomogram III. Comparisons in the same population.

30 months of the trial. Among the 13,200 tuberculin-negative participants who were not vaccinated, there were 64 cases of tuberculosis, a rate of 4.85 per 1,000. Among the 14,100 tuberculin-negative participants who were given B.C.G. vaccine, there were 13 cases of tuberculosis, a rate of 0.92 per 1,000. If a ruler is placed across the nomogram from 27,300 on the left-hand scale to 5.77 on the right-hand scale, it cuts the centre scale at the value 1.3 on the 5% side, and 1.7 on the 1% side. Since even the latter is exceeded by the difference in rates of 3.93, the difference is significant at the 1% level.

This nomogram is most accurate when the two samples are of the same size—that is, $m=n$. It is reasonably satisfactory up to a difference in size of 3 to 1.

III. Comparison Between Two Rates in the Same Population

Whereas the second nomogram dealt with two populations, each yielding a sample rate, the present nomogram is concerned with only one population in which, say, two independent conditions need to be compared. It is necessary, in the present context, to assume that no person is subject to both.

The left-hand scale m shows the size of sample; the right-hand scale shows the two rates added together, $P=p_1+p_2$.

If these points are joined by a straight line, the central scale is cut at a point which indicates whether the difference p_1-p_2 is significant or not. That is to say, if p_1-p_2 is greater than the value indicated on the 5% side of the central scale, it is significant at the 5% level, and similarly on the 1% side.

Example 1.—An investigation by McConnell, Pyke, and Fraser Roberts (1956) into blood groups in diabetes mellitus used, in the Oxford area, a control sample numbering 6,492, of whom 2,888 or 445 per 1,000, were group O, and 2,839, or 437 per 1,000, were group A. If a ruler is placed across the nomogram from 6,492 on the left-hand scale to 882 on the right-hand scale, it cuts the centre scale at the value 23 on the 5% side. Since the difference in rates is only 8, it does not reach significance. If it happens that the two rates add up to 1,000 per 1,000—that is, there are two alternative conditions and no remainder—it is possible, and indeed preferable, to use the first nomogram, above. The test is then whether the confidence limits to either rate overlap the value 500 per 1,000. If they do, the rates are not significantly different.

Example 2.—From the same source as Example 1 we find that 3,146 out of a control sample of 6,510 in the S.W. Lancs area were group O—that is, 483 per 1,000. Therefore 517 per 1,000 belonged to other groups. As in Example 1, we can compare these rates and find them just significantly different at the 1% level. Alternatively, using the first nomogram, the 99% confidence limits for group O are 467–499, which just exclude the value 500. (Of course, for the group not –O, the limits are 501–533).

In all three nomograms it is sufficiently accurate to use linear interpolation when a value is not marked on a scale.

Summary

Three nomograms are presented as an aid in assessing the significance of rates per 1,000 in the following situations: (1) providing confidence limits to

a rate; (2) comparing two rates based on different samples; and (3) comparing two rates based on distinct elements in the same sample.

In each nomogram, one outer scale shows the size of sample or combined samples, the other outer scale shows the rate or combined rates, and a straight line joining the two cuts the central scale at a point indicating the required limits or significance.

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[EDITOR'S NOTE.—It has been found impracticable to publish the nomograms here in a size that would make them really useful. They have therefore been separately printed full scale on art paper for those who are interested. Copies may be obtained from the Publishing Manager on application.]

Medical Memoranda

Plunging Parotid Tumour

The term "plunging goitre" designates a goitre which normally lies in the anterior mediastinum but which appears in the neck on deglutition. As is well known, the term comes from the French *plonger*, to dive or submerge, and the metaphor would be more apt if the phenomenon occurred in the reverse direction and a normally placed goitre temporarily disappeared. I have recently met with a similar phenomenon in a mixed tumour of the parotid gland, the temporary complete disappearance of which on two occasions gave rise to diagnostic difficulty amounting to bewilderment. Operation revealed a literal plunging explanation. I am not aware of any previous reports of this phenomenon in the parotid gland.

CASE REPORT

The patient, a man of 60, had a swelling in the region of the left parotid which had been slowly growing for five to six years. On examination there was a swelling in the lower pole of the left parotid, made more obvious by a thin face and neck. It was approximately 1½ in. (3.8 cm.) in its long diameter, moderately firm in consistency, smooth in outline, mobile, and apparently superficial. It thus had the typical clinical features of an expanding space-occupying lesion of the parotid, of which mixed parotid tumour is the commonest example, and this was the diagnosis made.

The only unusual feature was that a year previously another surgeon had made the same diagnosis and had operated with a view to removal of the tumour. At operation the tumour had completely disappeared and all that he found was the normal lower pole of the parotid, biopsy of which revealed normal parotid tissue with minor inflammatory changes. When the patient recovered from the anaesthetic, to the surgeon's natural chagrin the lump was noted to be back again and unchanged. After discussion with the surgeon, the only explanation I could suggest was that the lesion was a cyst which had ruptured during the operation and refilled immediately afterwards, though this seemed unsatisfactory. In any case, further operation with a view to removal of the lump was decided upon.

On July 17, 1962, under general anaesthesia the left parotid was exposed by the usual cosmetic cervico-facial incision, the scar of the original incision being excised. Shortly after the incision had been made and before any