Deacon's Challenge

No 155 – Answer

A screening programme for Down's Syndrome has a screen positive rate of 2.3% and a detection rate of 85%. Calculate the probability that a pregnancy judged to be at low risk will result in an affected child, given that the incidence of Down's Syndrome at term is 1.84/1000 live births in the absence of selective abortion. State any assumptions made.

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The screen positive rate is the proportion of all results which are positive and will consist of both true positives (TP) and false positives (FP):

$$\text{Screen positive rate} = \frac{(TP + FP) \times 100}{(TP + FP + TN + FN)} = 2.3\%$$

The detection rate is the same thing as sensitivity and is the proportion of all patients with Downs (TP + FN) which are detected by the test:

$$\text{Detection rate} = \frac{TP \times 100}{(TP + FN)} = 85\%$$

The calculation can be performed with absolute numbers, percentages or proportions. It is simplest to take an arbitrary population size so as to arrive at manageable numbers. Working with a total population of 1,000,000 the numbers become:

Total population = (TP + FP + TN + FN) = 1,000,000

Total with Downs = (TP + FN) = 1.84 x 1,000 = 1,840

Total without Downs = (TN + FP) = 1,000,000 - 1,840 = 998,160

Substitute (TP + FN) = 1840 into the expression for detection rate and solve for TP:

$$\frac{TP \times 100}{1840} = 85$$

$$TP = \frac{85 \times 1840}{100} = 1,564$$

Subtraction of this value from the total with Downs gives FN:

FN = Total with Downs - TP

= 1840 - 1564 = 276

Substitution of TP = 1,564 into the expression for screen positive rate allows calculation of FP:

$$\frac{(1,564 + FP) \times 100}{1,000,000} = 2.3$$

$$1,564 + FP = \frac{2.3 \times 1,000,000}{100} = 23,000$$

FP = 23,000 - 1,564 = 21,436

Subtraction of this value from the total without Downs gives the value of TN:

TN = 998,160 - 21,436 = 976,724

The total classified at low risk is all the negative results (TN + FN) whereas the number in this group with Downs is FN, therefore

Probability of Downs in low risk group

$$= \frac{FN}{(TN + FN)}$$

$$= \frac{276}{(976,724 + 276)}$$

$$= \frac{276}{977,000}$$

= **0.000282** (to 3 sig figs)

or 0.0282%

Therefore 1 in 1/0.000282 = 1 in 3,546 of those identified as low risk will be Down's pregnancies. ■

Question 156

A 62-year old woman has diabetes insipidus and loss of thirst sensation. Following a hot fortnight, she is admitted to the Emergency Department with dehydration. She is known normally to weigh 62 Kg.

On admission, she is found to have a serum sodium concentration of 156 mmol/L. Estimate her water deficit.

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