TREATMENT SUGGESTIONS

Twenty-four-hour lifeline—All members of the practice must be aware of the families at risk, even if they are not directly concerned with them. It has been possible to encourage the families to establish links with the whole practice and to use the doctor on duty if a crisis occurs when the primary therapist is absent.

Therapeutic relationship—This is provided by the team; the doctor or health visitor acts as the primary therapist and sees the family either at home or in the health centre. In some cases both husband and wife are seen regularly. In others, the mother attends a therapeutic group with an attached playgroup, which has been established recently in the practice. This will be described elsewhere.

Child care—The child is seen regularly either at home or in a clinic. Most parents of children at risk have rich fantasies and unrealistic expectations of their child's capabilities and development. These must be gradually and gently brought nearer to reality, which may take weeks or months.

Practical help—We have found the most useful form of practical help to be the provision of a playgroup/nursery place. Help with transport, baby-sitting, domestic arrangements, social activities, and, in extreme cases, housing has alleviated family stress and reduced the risks to the child. We try to maintain an honest and realistic approach to these problems to avoid raising false hopes and expectations.

Referral to other agencies—Informal discussion with members of the social services is often as important as a formal referral. Even after referral the responsibility for the case is shared. In some cases, psychiatric or paediatric specialist services, or both, are necessary. Each member of the primary health care team has a continuing contribution to make to assessment and management.

OUTCOME

It is too soon to know how much such an approach will reduce the prevalence of actual abuse. We know that two of the 30 at-risk children have suffered minor inflicted injuries—a bruise and a red slap mark on the face. Both of these would have passed unnoticed without the extra attention the families were receiving.

We are confident that all the families have benefited from our intervention, particularly those mothers and children attending the therapeutic group. Children have been seen to make outstanding progress in all aspects of their development.

Conclusion

Child abuse is the result of a process with origins years, sometimes generations, before the event. The process is complex and different for every family. Factors in the parents' biographies, social problems, and ill health are all included. Identification of the syndrome needs recognition of the continuing process rather than diagnosis of an isolated medical event.

Most abusing families are known to the family doctor—firstly, because there is increased actual ill health and, secondly, because medical symptoms are often used as a way of seeking help. If the family doctor regards each consultation as part of the family dynamics and not as a single isolated event he has the unique opportunity for recognising early predictors of child abuse.

Early recognition of the problem is itself a step towards prevention. Reluctance to make the diagnosis could increase the risk. We have shown that the primary health care team can attempt to treat the problem of child abuse in the community and work towards prevention with the back-up of specialist services.

References

1 Ounsted, C, Oppenheimer, R, and Lindsay, J, *Developmental Medicine and Child Neurology*, 1974, **16**, 447.
2 Lynch, M, Steinberg, D, and Ounsted, C, *British Medical Journal*, 1975, **2**, 127.
3 Lynch, M A, *Lancet*, 1975, **2**, 317.
4 Ounsted, C, and Lynch, M, *Child Abuse and Neglect. The Family and the Community*, ed R E Helfer and C H Kempe. Cambridge, Mass, Ballinger, 1976.
5 Lynch, M, and Ounsted, C, in *Child Abuse and Neglect. The Family and the Community*, ed R E Helfer and C H Kempe. Cambridge, Mass, Ballinger, 1976.
Lynch, M, Roberts, J, and Gordon, M, *Developmental Medicine and Child Neurology*. In press.
7 Department of Health and Social Security, *Memorandum on Non-accidental Injury to Children*. London, HMSO, 1974.
8 Department of Health and Social Security, *Non-accidental Injury to Children. Model Instructions for Accident and Emergency Departments*. London, HMSO, 1975.
9 Department of Health and Social Security, *Non-accidental Injury to Children: Reports from Area Review Committees*. London, HMSO, 1976.
10 Oliver, J E, and Taylor, A, *British Journal of Psychiatry*, 1971, **119**, 473.
11 Oliver, J E, and Cox, J, *British Journal of Psychiatry*, 1973, **123**, 81.
12 Ounsted, C, *World Medicine*, 1975, **10**, 27.
13 Browne, K, and Freeling, P, *The Doctor-Patient Relationship*, p 62. Edinburgh, Livingstone, 1967.
14 Gray, J, *et al*, *The Denver Predictive Study*. To be published.
15 Gray, J A, *Handbook of Psychopharmacology*, ed L Iverson, S Iverson, and S Snyder. New York, Plenum Press. In press.

Statistics at Square One

XX—Correlation (concluded)

T D V SWINSCOW

The regression equation

Correlation between two variables means that when one of them changes by a certain amount the other changes on the average by a certain amount. For instance, in Dr Green's children (Part

British Medical Journal

T D V SWINSCOW, MSC, MB, deputy editor

XIX) greater height is associated on the average with greater anatomical dead space. If y represents the dependent variable and x the independent variable, this relationship is described as the regression of y on x. The relationship can be represented by a simple equation called the regression equation. In this context "regression" (the term is a historical anomaly) simply means that the average value of y is a "function" of x, that is, it changes with x.

The regression equation representing how much y changes with any given change of x can be used to construct a *regression line* on a scatter diagram, and in the simplest case this is assumed

to be a straight line. The direction in which the line slopes depends on whether the correlation is positive or negative. When the two sets of observations increase or decrease together (positive), the slope is upwards from left to right; when one set decreases as the other increases, the slope is downwards from left to right. As the line must be straight, it will probably pass through few, if any, of the dots. Apart from its being straight we have to define two other features of it if we are to place it correctly on the diagram. The first of these is its distance above the base line; the second is its slope. They are expressed in the following *regression equation:*

$$y = a + bx.$$

With this equation we can find a series of values of y, the dependent variable, that correspond to each of a series of values of x, the independent variable. The letters a and b are the *regression coefficients.* They have to be calculated from the data. The letter a signifies the distance above the base line at which the regression line cuts the vertical (y) axis. The letter b signifies the amount by which a change in x must be multiplied to give the corresponding average change in y. In this way it represents the degree to which the line slopes upwards or downwards.

Once the correlation coefficient has been computed the regression coefficients are easy to work out. We use results that we have already obtained. The formulae for finding a and b are as follows (in the order in which we calculate them):

$$b = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\Sigma(x - \bar{x})^2}. \quad a = \bar{y} - b\,\bar{x}.$$

The calculation of the correlation coefficient in Part XIX on Dr Green's data gave the following:

$\Sigma(x - \bar{x})(y - \bar{y}) = 5\ 426 \cdot 6$
$\Sigma(x - \bar{x})^2 = 5\ 251 \cdot 6$
$\bar{y} = 66 \cdot 93$
$\bar{x} = 144 \cdot 6.$

Applying these figures to the formulae for the regression coefficients, we have:

$b = \dfrac{5\ 426 \cdot 6}{5\ 251 \cdot 6} = 1 \cdot 033$

$a = 66 \cdot 93 - (1 \cdot 033 \times 144 \cdot 6) = -82 \cdot 4.$

Therefore the equation for the regression of y on x becomes in this case

$y = -82 \cdot 4 + 1 \cdot 033x.$

This means that, on the average, for every increase in height of 1 cm the increase in anatomical dead space is 1·033 ml *over the range of measurements made.*

The line representing the equation is shown superimposed on the scatter diagram of Dr Green's data in fig 20.1. The way to draw the line is to take three values of x, one on the left side of the scatter diagram, one in the middle, and one on the right, and substitute these in the equation. Dr Green's figures come out as follows:
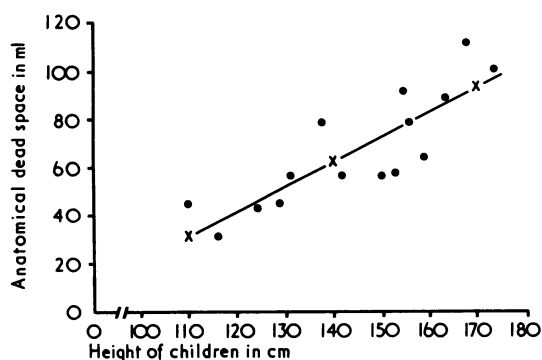

FIG 20.1—Regression line drawn on scatter diagram relating height and pulmonary anatomical dead space in 15 children (fig 18.2).

If x = 110, y = (1·033 × 110) − 82·4 = 31·2
If x = 140, y = (1·033 × 140) − 82·4 = 62·2
If x = 170, y = (1·033 × 170) − 82·4 = 93·2

Though two points are enough to define the line, three are better as a check. Having put them on the scatter diagram, we simply draw the line through them.

Regression lines give us useful information about the data they are collected from. They show how one variable changes on the average with another, and they can be used to find out what one variable is likely to be when we know the other—provided we ask this question within the limits of the scatter diagram. But to project the line at either end—to extrapolate—is always risky. The relationship between x and y may change, or some kind of cut-off point may exist. For instance, a regression line might be drawn relating the chronological age of some children to their bone age, and it might be a straight line from, say, the age of 5 years to 10, but to project it up to the age of 30 would clearly lead to error.

Exercise 20. From the data in exercise 19: if values of x represent mean distances of nearest five termite hills and values of y represent percentages of kala-azar cases, what is the equation for the regression of y on x? What does it mean? *Answer:* y = 36 − 0·23x. It means that, on the average, for every 10 m increase in mean distance of the five nearest termite hills, the percentage of cases of kala-azar falls by 2·3 (= 10 × 0·23). This can be safely accepted only within the area measured here.

This article concludes the series "Statistics at Square One." The articles are being revised for republication shortly in book form. Two further sections will then be added, on rank correlation and Fisher's exact probability test.

Would fructose at the end of a day reduce the length of time in which ethanol would be exercising its toxic effect on tissue, particularly nervous tissue? How much fructose would be required to metabolise a given quantity of alcohol?

Undoubtedly fructose taken at the end of the day would accelerate the metabolism of alcohol circulating then. This does not necessarily mean that the hangover effects of alcoholic drinks could be avoided, because these are partly caused by substances other than ethyl alcohol. At least 25 to 50 g of fructose would be needed and this would make a small but perhaps appreciable contribution to daily calorie intake.

Is it possible to diagnose conditions of insidious onset such as neoplasms of the pancreas, kidney, and central nervous system at an early and treatable stage by routine ultrasound scanning and computerised tomography?

There is no simple answer to this complex question. The short answer is No, not until "practical possibility," "early and treatable stage," and "routine," have been defined accurately. The reasons for this are: (a) ultrasound has no place in detecting central nervous system tumours compared with the pre-eminence of computerised tomography; (b) excretion urography is still the first choice for investigating the urinary tract, and subsequent investigations depend entirely on the results of the urogram and not on a predetermined routine. Both ultrasound and computerised tomography are important complementary tests, especially in distinguishing cysts from solid tumours; (c) the pancreas and other upper abdominal retroperitoneal structures are highly promising for computerised tomography, and advances have been made in grey-scale ultrasonic scanning of this region as well. The resolution of both techniques is good, but pancreatic pseudocyst is recognised more readily than carcinoma by both techniques and these striking developments still require correlation with other techniques before their place can be judged; and (d) the concept of having "routine" ultrasound scanning and computerised tomography is not acceptable until the method of patient selection has been defined. The potential demands for computerised tomography exceed the capacity of the instruments available, and there is no question of conducting population surveys.