

114. On Weinberg's Statistical Method in Human Heredity.

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In the study of human heredity, where, of course, any artificial crossing experiments are impossible, when it is required to estimate the probability of a patient of a certain disease (= true rate of appearance of patients of the disease) among brothers, provided that the disease is known to be inherited according to a certain type of Mendelian law of inheritance, the difficulties occur, for instance, even brothers which were borne by parents having genes of that disease are not counted in the statistical data, unless they actually have at least one patient. To overcome such difficulty, W. Weinberg¹⁾ had developed methods for estimating the true rate of appearance of patients among brothers early in 1913. Recently, Dr. M. Masuyama²⁾ criticized the Weinberg's method on the basis of the theory of modern mathematical statistics and derived the formula of estimate, which, however, turned out to be the same as that of Weinberg. Further, Masuyama derived the confidence limits for the parameter representing the probability from the asymptotical properties of the maximum likelihood estimate.

It seems to the author, however, that Masuyama's theory is not completely reasonable in the following two respects:

(1) First the probability of a patient of some disease among brothers is not constant, but varies in value according to genotype of the parent by which the brothers were borne. And further the existence probability or probability *à priori* of each genotype in the population of parents is unknown in almost all cases.

(2) Second, Masuyama's assumption that all patients in the data may be considered as randomly drawn from the population is implausible in practice. It will be rather more plausible to consider that one patient of brothers happened to come to the doctor, and then the doctor knows that there are more patients among his brothers. So we should not consider each patient but each brother as a sampling unit.

The purpose of this note is to modify Weinberg-Masuyama's theory in two respects above mentioned to conform the situations which seems to be of more frequent occurrence in practice.

First, for the sake of simplicity of explanations, we shall assume that genotypes of parents by which the brothers were