WORLD HEALTH ORGANIZATION

REGIONAL OFFICE FOR THE EASTERN MEDITERRANEAN

ORGANISATION MONDIALE DE LA SANTE

BUREAU RÉGIONAL DE LA MÉDITERRANÉE ORIENTALE

SEMINAR ON VITAL AND HEALTH STATISTICS

Damascus, 19-27 October 1963

Agenda Item 9 (b)

EM/SEM.VHS/14
10 September 1963

ORIGINAL: ENGLISH

STATISTICS IN POST-GRADUATE PUBLIC HEALTH COURSES

by

Professor C.R. Lowe
WHO Special Seminar Consultant

Professor of Social and Occupational Medicine
Welsh National School of Medicine, Cardiff, U.K.

Much of what I have written about the teaching of statistics to medical students applies with equal force to the teaching of post-graduate public health students and to repeat it would serve no useful purpose. I propose, instead, to present in detail what I consider would be an effective post-graduate syllabus. As a preliminary to this, it will be helpful to mention and to discuss the implications of two important ways in which the post-graduate differs from the undergraduate teaching situation.

In the first place, the post-graduate in contra-distinction to the undergraduate student will readily accept, or has already accepted, the importance of the numerical approach to medical problems and its particular relevance to public health. Statistical methods have always been an essential tool, operationally and in research, for the public health doctor. In his day-to-day work he is concerned with measuring and comparing the health of population groups in the hope of identifying harmful influences against which preventive measures can be taken, with the evaluation of the effectiveness of such measures when they have been introduced and with the measurement of the need for and effectiveness of medical and social services under his jurisdiction. This, and smaller classes, make it much easier for the teacher to establish a satisfactory relationship with the student and to teach his subject in greater depth.

Second, the purpose of post-graduate teaching is very different from that of undergraduate teaching. As I have already pointed out, the aim of teaching statistics to medical students is to arouse their interest in the quantitative way of looking at biological problems and make them aware of the importance and relevance of the statistical approach to medicine. After qualification, few of them will ever need to use statistical methods in their work; their teaching, therefore, should be concerned more with principles than with practice. The public health doctor, on the other hand, uses statistical methods in his daily work, and a major aim of post-graduate teaching should be to enable him to handle those methods with ease and confidence. He must, of course, understand the basic theory and principles of statistics, but a great deal of emphasis will also need to be placed upon methodology and practice.

It should be clear from the preceding considerations, that although in outline the teaching programme for post-graduates may appear much the same as that for undergraduates, in detail it will differ considerably in respect of emphasis and depth of approach. As for undergraduates, the teaching divides conveniently into three parts:

I Statistical Theory and Methods

II Vital and Health Statistics

III Application of Statistical Methods to Public Health Problems.

But in the first part, a substantial amount of time will need to be devoted to practical work, which should proceed, at the least, to the calculation of correlation co-efficients and simple regression equations. For the more able students, it can be extended to include partial correlation and multiple regression, possibly even to analysis of variance. In the second part, students, in addition to being taught how to calculate and use the standard indices of natality, fertility, mortality and morbidity, must also be given a detailed and comprehensive account of their own country's vital and health statistics, provided with the opportunity to become familiar with the official publications which will (or should be) their future bench books, and allowed to acquire a working knowledge of official publications on the world health situation. In the third part of the programme, which is concerned with the application of statistical methods to public health problems, it is again advisable to supplement and illustrate the formal teaching with practical work. This can best be done by means of a class research project, the members of the class investigating as a cooperative enterprise, but under the teacher's guidance, a public health problem, designing a survey questionnaire, collecting and analysing the data and preparing a report to present to a critical audience.

I. STATISTICAL THEORY AND METHODS

(Ten one-hour lectures and ten one-and-a-half hour practical classes)

1. Introduction

The relevance of statistical theory and methods to public health and preventive medicine. Variability of medical and biological data. Instrumental and observer variation. Sampling variation. The statistical concept of probability.

2. Practical Class

Introduction to mathematical tables, slide rule, calculating machines and punch card machines.

3. The Normal Distribution

Qualitative and quantitative data. Grouping of data. Description by histogram and by table. Distribution as a frequency curve. The normal curve. Mean, range, percentiles and standard deviation.

4. Practical Class

Calculation of mean and standard deviation for ungrouped and grouped data.

5. Other Distributions

Skewness. Median and mode. Poisson distribution.

6. Practical Class

Exercises in the use of the Poisson distribution.

7. Sampling Distributions

Universe and sample. Sampling and distribution of the mean. Standard error of the mean. Confidence limits. Tests of significance. Standard error of the differences between two means. The "t" test.

8. Practical Class

Calculation of the standard error of the mean and of difference between two means.

9. The Concept of Statistical Probability

Probability in practice and theory. Addition and multiplication of probabilities. Combinations and permutations. The binomial theorem.

10. Practical Class

Exercises in the calculation of probabilities and in some applications of the binomial theorem.

11. Proportions and Percentages

The use of proportions and percentages in the analysis of data. Sampling distribution of proportions. The standard error of a proportion and of the difference between two proportions.

12. Practical Class

Calculation of the standard error of a proportion and of the difference between two proportions.

13. Interpretation of a Series of Proportions

Fourfold tables. More complex tables. The concept of degrees of freedom. Testing a null hypothesis. Sampling distribution of X^2 and its interpretation.

14. Practical Class

Calculation and interpretation of X^2.

15. Association and Correlation

Measurement of the degree of relationship between two variables. Linear and non-linear association. The coefficient of correlation and its standard error. Interpretation of correlation. Concomitant and causal relationships.

16. Practical Class

Construction of scatter diagrams. Calculation of the coefficient of correlation.

17. Regression

Simple regression equations. Sampling distribution of the regression coefficient. Uses and interpretation.

18. Practical Class

Calculation of simple regression equations.

19. Common Fallacies and Difficulties

The misuse of numerical methods. Misleading graphical representation. Faulty design of experiments and surveys. Dangers of extrapolation.

20. Practical Class

Practical examples from current medical literature of faults in planning, presentation and interpretation.

II. VITAL AND HEALTH STATISTICS

(Nine one-hour lectures and seven one-and-a-half hour practical classes)

1. Size, Structure, Growth and Movement of Populations

The scope and purpose of a population census. Sex, age, marital status, place of birth, language, family size and structure, housing, education, occupation, etc. The distribution and collection of schedules. Sampling methods. Publication of results. Uses and validity of census data. Estimation of intercensal populations.

2. Practical Class

Exploration of official census publications. Construction of tables. Presentation of data in diagramatic form (graphs, arithmetic and logarithmic; histograms; maps; pi diagrams; population age-pyramids).

3. Births, Marriages and Deaths

History of registration of births, marriages and deaths. Crude birth and death rates and rate of natural increase. Age-specific death rates. Fertility and replacement rates. Family size. Legitimacy. Multiple births. The sex ratio. Uses and validity of data obtained by registration, with particular reference to completeness.

4. Practical Class

Calculation of intercensal populations and of birth, fertility and death rates.

5. Classification of Diseases and Causes of Death

The need for and historical development of classifications. International statistical classification of diseases. Medical certification of cause of death. Uses and validity of death certificates. Local and international comparisons and trends.

6. Foetal, Infant and Maternal Mortality

Definitions of foetal, infant and maternal mortality rates. Causes of death classed to pregnancy and child bearing. Causes of foetal and infant death. Local and international comparisons and trends.

7. Practical Class

Exploration of official publications on cause of death, with particular reference to foetal, infant and maternal mortality. Calculation of stillbirth, neonatal, perinatal, infant and maternal mortality rates. Exercise in coding cause of death.

8. Mortality Trends and Comparisons

Difficulties of interpretation of mortality comparisons and of mortality trends. Use of sex, age, and cause specific rates. Methods of standardisation.

9. Practical Class

Calculation of standardised mortality rates by direct and indirect methods.

10. Occupation and Socio-economic Group

Classification of populations and of deaths by occupation and the derivation of socio-economic groups. Uses, difficulties of interpretation and limitations. Standardised mortality ratios.

11. Practical Class

Exercise in coding occupations. Calculation of standardised mortality ratios.

12. Life Tables and Follow-up Studies

Probability of dying between selected ages. Probability of surviving from one age to another. Expectation of life. Uses and limitations of life tables. Application to prognosis and survival after treatment.

13. Practical Class

Construction of a life table from data on follow-up after treatment.

14. Measurement of Morbidity

Essential differences between morbidity and mortality data. No clear line between health and sickness. Complications introduced by duration, recurrence, and multiple morbidity. Recommended definitions for use in morbidity studies.

15. Sources of Morbidity Data

Notification of infectious and industrial disease. Registration schemes (cancer, tuberculosis and mental health). Medical records (hospital services, out-patient and in-patient; school, maternity and child health services; domiciliary medical practice; industrial medical services). Health insurance. Field studies.

16. Practical Class

Exploration of official sources of morbidity data. Calculation of some of the commonly used indices of hospital bed and out-patient department usage.

III. APPLICATION OF STATISTICAL METHODS TO PUBLIC HEALTH PROBLEMS

(Nine one-hour lectures)

1. Scope of Research in Public Health

Three aspects of research in public health and preventive medicine:

a) study of distribution and determinants of health and disease in populations;

b) measurement of effectiveness of preventive measures;

c) study of need for and effectiveness of health services.

Methods include: cross-sectional surveys (infectious disease, non-infectious disease, human biology); prospective or longitudinal surveys; surveys for the appraisal of health services.

2. Design of Surveys

Observation, measurement and questionnaire. Use of existing records. Mail questionnaires and interviews. Design of questionnaires (content, wording, order, coding). Sampling techniques (random, systematic, stratified). Sources of bias (non-response, observer and instrumental variation). Pilot studies.

3. Cross-sectional Surveys

a) Infectious Disease

Characteristics of an epidemic. Distribution in space and time. Water, food, air and vector-borne infection. Relation to sex, age, season, crowding, nutrition, and other variables. Strategy of investigation of epidemic and endemic infection. Tuberculosis. Typhoid. Streptococcal infections. Malaria.

b) Non-infectious Disease

How cross-sectional surveys can uncover clues to aetiology of chronic disease. Morbidity and mortality related to sex, age, occupation, socio-economic and marital status, fertility, place of birth and domicile (variations within a country and between countries) etc. Malignant disease. Atherosclerosis. Congenital malformations.

c) Human Biology

Distribution of biological attributes and processes in relation to ethnic group, socio-economic status etc. Pregnancy (weight changes, duration of gestation, blood pressure, blood picture etc.). Birth weight. Anthropometry of children and adults. Ageing. Menstruation. Blood pressure. Biochemical measurements. Respiratory function etc.

4. Prospective Surveys

Follow-up or longitudinal study of an unaffected population classified according to exposure. Advantages and disadvantages. Interpretation. Exposure of foetus to X-rays. Child growth and development.

5. Retrospective Surveys

Comparison of affected patients with unaffected controls in respect of past exposure. Selection of patients and of controls. Random and systematic sampling. Stratification and matching. Sources of bias. Interpretation. Estimated risk. Cancer of lung and smoking.

6. Experimental Surveys

Design of field trials of prophylactic procedures. Randomisation and double-blind techniques. Sequential analysis. Ethical considerations. B.C.G. and poliomyelitis vaccine. Naturally occurring experiments (fluoride in water; twin studies).

7. Surveys of Health Services

Estimation of need for health services (midwifery, mental illness, tuberculosis etc.). Measuring the effectiveness and quality of existing services. Evaluation of new services (e.g. screening procedures). Attitude of patients to services and the use they make of them.

Some Useful Books

"Survey Methods in Social Investigation" - C.A. Moser, Heineman. London, 1961

"Principles of Epidemiology" - I. Taylor and J. Knowelden. Churchill, London, 1958

"Introduction to Health Statistics" - S. Swaroop. Livingstone, London, 1960

"Uses of Epidemiology" - J.N. Morris. Livingstone, London, 1957

"Epidemiologic Methods" - B. MacMahon, T.F. Pugh and J. Ipsen. Churchill, London, 1960

"Facts from Figures" - M.J. Moroney. Penguin Books, London, 1951

"Principles of Medical Statistics" - A. Bradford Hill. Lancet, London, 1961

"Elements of Vital Statistics" - B. Benjamin. Allen and Unwin, London, 1959

"Measurements of the Public Health" - F.A.E. Crew. Oliver and Boyd, London, 1948