PUBLIC HEALTH AND EPIDEMIOLOGY

AURTHOR (S)

Kovin S Naidoo: Brien Holden Vision Institute, Public Health Division, Durban, South Africa; University of KwaZulu Natal (UKZN), Durban, South Africa

Brien Holden: Brien Holden Vision Institute, University of New South Wales (UNSW), Australia

PEER REVIEWER (S)

Ron Fyfe: Past Chairman of the Public Health Committee of WCO; Currently: Asia Pacific representative on WCO Public Health Committee and member of the board of Vision 2020 New Zealand

THIS CHAPTER WILL INCLUDE A REVIEW OF:

- Epidemiology
- Eye care and epidemiology

EPIDEMIOLOGY

Epidemiology aims to establish the patterns of disease and ill health by defining the distribution and determinants of disease and ill health. Epidemiology contributes to the control and prevention of disease, shapes health care policy, aids in the planning of health services and leads to an overall improvement in the health of individuals and societies.

According to Bhopal (2008) epidemiology combines elements of clinical, biological, social and ecological sciences:

Clinical and Biological Science: Epidemiology is particularly relevant to medicine rather than laboratory science, but the increasing collaboration between geneticists and epidemiologists is changing the balance.

Social Science: Epidemiology is concerned with disease in populations. Human beings live in societies, where behaviour and attitudes are shaped by interaction among people, which in turn are governed by the conventions and laws.

Ecological Science: Populations exist in a physical environment which is a dominant force in determining health. The study of life in relation to the environment is ecology.

EYE CARE AND EPIDEMIOLOGY

Given that the delivery of eye care in developing countries is severely hindered by limited financial and physical resources and inadequately trained personnel, the identification of eye care priorities is crucial to the success of the delivery system. The current lack of adequate epidemiological data on eye care problems is a major stumbling block in the developing world in general. Such epidemiological data could guide the effective delivery of preventive and promotive eye care and identify national and provincial eye care priorities. By way of example, health promotion interventions, such as eye health education, could be guided by the key factors that contribute to visual morbidity. Limited clinical resources can be mobilised to focus on the key indicators of blindness and visual morbidity. Furthermore, the key determinants of visual morbidity should be used in the projections and planning activities of the healthcare system.

EYE CARE AND EPIDEMIOLOGY(CONT.)

The current paucity of national and local epidemiological data indicates the urgent need for population-based studies. This would allow for the development of an epidemiological profile of the various visual conditions and the determinants of these conditions, thereby informing not only the nature of curative service provision, but also the design of preventative and promotive strategies, such as lifestyle changes. Furthermore "without reliable prevalence data it is impossible to determine which geographic areas or which age cohort needs to be targeted. Also without reliable baseline data it is impossible to determine whether interventions to eliminate avoidable blindness for example from refractive errors, have been successful".

The most secure source of prevalence data are population-based prevalence surveys conducted according to strict criteria. The importance of population-based studies is widely accepted, however, such studies are expensive, time-consuming and difficult to conduct and, thus, population-based studies are often conducted with certain limitations.

The methods used in epidemiological research may be grouped into two primary types:

- Experimental (e.g. randomised clinical trials and community interventions);
- Observational (e.g. cross-sectional studies, case-control studies and longitudinal cohort studies)

Most studies sample defined populations with the intention of determining the prevalence of blindness and visual impairment as well as establishing the relative importance of potentially blinding conditions. These eye surveys are observational studies and usually utilise a cross-sectional design.

In making comparisons, caution has to be exercised even in population-based surveys as some have focussed on a particular age group, a specific region of the country not representative of others or a particular disease condition. Furthermore, the definition of blindness, and also the criteria for defining the presence or absence of ocular disease, may vary.

RAPID ASSESSMENT OF CATARACT STUDY (RACS)

Resources do not always allow for comprehensive epidemiological studies. The Rapid Assessment of Cataract Study (RACS) has sought to develop a cost effective, rapid and reliable method of determining an estimate of the prevalence of blindness due to cataracts, and to determine cataract surgical coverage and the visual outcomes.It is a simple tool to plan and evaluate interventions and not meant to replace scientifically sound detailed surveys and unfortunately cannot provide generalizable estimates. Furthermore it is confined to the elderly and blindness and visual impairment due to cataracts. RACSS was subsequently modified to include all causes of avoidable blindness and the RAAB methodology was developed.

RAPID ASSESSMENT OF AVOIDABLE BLINDNESS (RAAB)

The Rapid Assessment of Avoidable Blindness (RAAB) is another simple, cost effective and rapid survey methodology that can provide data on the prevalence and causes of blindness. RAAB focuses primarily on the prevalence of avoidable blindness, which is blindness due to cataract, refractive errors, trachoma, onchocerciasis, and other corneal scarring. RAAB is an updated and modified version of the Rapid Assessment of Cataract Surgical Services (RACSS).

Main aims of RAAB

- To estimate the prevalence and causes of avoidable blindness and visual impairment in people aged 50 and above
- To assess cataract surgical coverage
- To identify the main barriers to the uptake of cataract surgery
- To measure outcome after cataract surgery

Limitations of RAAB

- Diagnostic facilities are limited and therefore diagnosing posterior segment disease becomes a challenge.
- RAAB only includes people aged over 50 and therefore the prevalence of blindness in people aged under 50 cannot be estimated
- RAAB measures the prevalence and causes of visual impairment, but it does not assess active trachoma, trichiasis, or infection with onchocerciasis when these are not vision-impairing

EYE CARE AND EPIDEMIOLOGY(CONT.)

Dineen *et al* (2006) investigated the suitability of using the 50 plus year olds as an indicator of overall prevalence and causes of blindness and visual impairment. They showed that assessment of the 50 year and above age group was a good indicator for the causes of blindness and visual impairment in the total population and for determining those causes of blindness that are avoidable. Such an assessment requires a much smaller sample size, less than 20% of the sample size for the total population, and is likely to be less expensive.

The above study indicates that the RAAB methodology can be a viable alternative in some situations to the comprehensive population based epidemiological evaluations.

OPHTHALMIC EPIDEMIOLOGY

Ophthalmic Epidemiology is the **quantitative** study of the **distribution** and **determinants** of eye diseases to inform effective control and prevention strategies, policy formulation and planning. Ophthalmic Epidemiology is concerned with the frequency of eye diseases. This cannot be accurately determined by just observing the number of people in two different groups as the size of the two groups is important. Therefore a rate is calculated by dividing the numerator (number of cases) by the denominator (the population of interest or at risk).

Quantitative refers to the amount and frequency of occurrence of the eye disease or condition e.g. 5% of myopia

Distribution refers to the population, community or group affected and their specific characteristics e.g. 5% of myopia in school children aged 5-15 years in South Africa

Determinants refer to the causes of the eye disease e.g. genetics, too much near work or other factors that may cause myopia.

KEY MEASURES IN EPIDEMIOLOGY

Rate

The rate is a measure of the frequency of a disease:

$$\frac{\text{Number of cases}}{\text{The population at risk}} \times 100 \text{ or } 1000 \text{ or } 10000$$

Incidence and Prevalence

Incidence cases are the number of cases reported during a specified period in a defined population (Ehrlich, 2008).

The cumulative incidence is the proportion of the at-risk population who develop an eye disease in a specified period. Therefore those who had the ocular disease at the beginning of the study are not part of the at-risk population.

$$\frac{\text{Persons developing disease in a specified period}}{\text{Persons free of disease at recruitment into the study}} \times 100/1000/10000$$

- Expressed as % per month / year
- It measures denominator only at ONE point in time
- Number of diabetics (without diabetic retinopathy) developing diabetic retinopathy over a specified period

Incidence Rate

It refers to the number of new cases in a particular area or group. Considers the length of time each of the individuals remained under observation before developing the disease e.g. a diabetic who develops diabetic retinopathy after 6 months contributes 0.5 years where as someone who develops the disease after 12 months contributes 1 year. Both will contribute to the numerator if they developed the disease.

$$\frac{\text{No. of new cases of an eye disease occurring in a specific period}}{\text{Disease free period of each individual cumulated}} \times 100$$

EYE CARE AND EPIDEMIOLOGY(CONT.)

- Difficult to measure
- Cohort studies are conventionalsource for incidence data
- Number of new cases of diabetic retinopathy in a particular community

Prevalence Rate

Measures number of cases at a point in time

$$\frac{\text{No. of persons with disease at a specified time}}{\text{No. of people in the area or region of interest}} \times 100$$

- Cross sectional studies (surveys) conventional source for prevalence data
- Easier to measure than incidence rates
- Number of people over 40 years with presbyopia

Relative Risk

Relative risk has become one of the standard measures in biomedical research. It usually means the multiple of risk of the outcome in one group compared with another group and is expressed as the risk ratio in cohort studies and clinical trials (Zhang & Yu, 1998).

e.g. The risk of developing cataracts in fisherman versus office workers.

ODDs Ratio

When the risk ratio cannot be obtained directly (such as in a case-control study), the odds ratio is calculated and often interpreted as if it were the risk ratio (Zhang & Yu, 1998).

Subsequently, the term *relative risk* commonly refers to either the risk ratio or the odds ratio. However, only under certain conditions does the odds ratio approximate the risk ratio. When the incidence of an outcome of interest in the study population is low (<10%), the odds ratio is close to the risk ratio. However, the more frequent the outcome become, the more the odds ratio will overestimate the risk ratio when it is more than 1, or underestimate the risk ratio when it is less than 1.

SOURCES OF DATA

Preliminary assessment

- Hospital, clinic and eye camp data
- Schools and institutions for blind
- Blind registers
- Health and social insurance records
- Anecdotal information
- Previous comprehensive health surveys
- National and regional censuses

More accurate information

- Population based sample surveys
- Captive group statistics
- Sentinel centre approach

Secondary hospital data

- Provides preliminary information
- Seasonal and geographical trends seen
- Surgical patterns can be elicited
- Easy to collect
- OPD Registers, inpatient records, OT case sheets

EYE CARE AND EPIDEMIOLOGY(CONT.)

- Paediatric hospitals provide data on ROP, VAD etc.

Disadvantages of hospital data

- Only severe and long standing cases
- Only more mobile patients
- Clientele depends on socio-economic status
- Bigger the hospital the less representative
- Bigger the hospital the more difficult to define catchment population

Blindness registers

- Used in developed countries
- Live registers are maintained
- Fresh cases added
- Treated and dead removed
- Good information on magnitude and trends
- Not possible in developing countries
- Concept used for cancers in India

Blind school data

- Very useful for childhood blindness
- Suffers because most blind children are outside institutions
- Only practical method in developing countries

Social welfare records

- Insurance records
- Disability pension records
- Social security schemes
- ESI Data

Sentinel centre approach

- Used successfully in diarrhoea and EPI
- Recently in blindness
- Very promising
- Low cost and good returns
- Hospitals with high case load identified and data is collected at fixed intervals

Captive group statistics

- Special screening programmes in schools and factories etc.
- Vision screening programmes in schools is a good example
- Not representative of populations but gives good indication of magnitude and trends
- Most screening programmes can provide useful information

Surveys for need assessment

- Best way to collect representative data
- Standard examination and sampling methods are required
- Has multifaceted uses
- Helps to determine magnitude and causes
- Is a costly exercise
- Needs careful planning and implementation

SELECTED READING/REFERENCES

- Bhopal RS, 2008.**Concepts of Epidemiology: Integrating the ideas, theories, principles and methods of epidemiology**.2nd Edition.Oxford University Press, United Kingdom
- Dineen BP, Foster A, Faal H, 2006.**A proposed rapid methodology to assess the prevalence and causes of blindness and visual impairment**. Ophthalmic epidemiology, 13 (1):31-4
- Epidemiology: **A Manual for South Africa Oxford University Press, USA**
- Ehrlich R and Joubert G, 2008.**Epidemiology: a research manual for South Africa**.Oxford University Press, USA
- Zhang J and Yu KF, 1998.**What's the relative risk?: a method of correcting the odds ratio in cohort studies of common outcomes**.Journal of American Medical Association 280(19):1690-1691