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Course: Diploma in Public Health

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1. Distinguish between descriptive epidemiology and analytical epidemiology
2. Write down and explain the mathematical expression of the following. (i) Incidence (ii) Prevalence
3. Apart from Randomized trials, describe four (4) other epidemiological research designs
4. Data from hospital records are one of the most important sources of information in epidemiologic studies.

   a) Outline the limitations of using hospital data.

   b) Describe the possible sources of error in interview surveys
5. Explain the main determinants of health

1. Distinguish between descriptive epidemiology and analytical epidemiology

Key terms:

Descriptive is classifying without expressing feelings or judging especially in a detailed and interesting way.

Epidemiology according WHO "is the study of the distribution and determinants of health-related states or events (including disease), and the application of this study to the control diseases and other health problems while,

Analytical is simply to examine facts and information in a very careful and critical way using analysis or logical reasoning. Therefore, **Descriptive epidemiology** provides a way of organizing and analyzing these data to understand variations in disease frequency geographically and over time, and how disease varies among people based on a host of personal characteristics (person, place, and time) and defines the relationship of disease to the population at risk by using the 5 Ws stands for: -

What asking clinical questions, **Who** the person is, **Where** this has taken place, **when** has this occurred. This is called **"distributions***"* in descriptive epidemiology. However, **why** or **how** questions are asked to identify the cause, risk factors and modes of transmission, these are called "**determinants"** in analytical epidemiology.

- ✓ When asking Five Ws **clinical** questions, we ask about the following: -

  Symptoms, Signs, Laboratory findings, Hospitalizations and Deaths
- ✓ When asking Five Ws: **Person** questions, we ask for the following: -

  Age, Sex, Occupation, Immunization status, Underlying disease, Medications, Nutritional status, Socioeconomic status, Marital status, Religion, Travel, Pets, Hobbies, Personal habits Genetics.
- ✓ When asking Five Ws: **Place** questions, we ask for the following: -

  Geographic Area, when did the Illness begins, contact occurred between, agent and host, source became infected, Home — patient ill, restaurant — food eaten and Farm — eggs infected.
- ✓ When asking Five Ws: **tim**e, questions, we focus on three trends such as **secular trends**, **seasonal pattern and epidemiological trends**: -
  - **Secular trends** Change over time and in long-term
  - **Seasonal patterns and trends** Cyclical trends Seen over several years

1. Epidemic trends

Increased occurrences above the expected number and involves a single case, depending on the expected number. There are **three types of descriptive epidemiology** studies as outlined and discussed below:

- **Case Report** describes person, place, time, information about a specific case and is usually about unexpected symptoms or events**.**

- **Case Series** describes person, place, and time information about a group of cases. It is either retrospective or prospective since this data may be used in analytic studies.
- **Incidence** studies describe the number of a disease during a specific time in a specific **population:** Allows calculation of true rates of occurrence of new cases of a disease during a specific time in a specific population.

Descriptive Studies Compared

Case report

- ✓ Individual case data

Case series

- ✓ Individual data on a group of cases

Incidence study

- ✓ New cases during a specific time

Overview of Analytic Studies

- Analytic studies used in research are frequently larger and more complex than descriptive studies
- Assess determinants of diseases
- Focus on risk factors and causes
- Analyze distribution of exposures and diseases
- Key feature: use comparison groups to test hypotheses looks for and measure associations

Descriptive & Analytic Studies Compared

Ways to study severe acute respiratory syndrome (SARS)

1. **Descriptive study**

• Case series: person, place, time, of first 100 patients with SARS

2. **Analytic study**

• Measure risk factors for SARS (contact with animals, infected people)

Types of **analytical Studies** are divided into **Experimental** (clinical and community) and **Observational** (Cohort, Case control, Cross sectional and Ecologic and as discussed and outlined below: -

1. **Experimental**
    - Clinical study only one new drug.
    - Community study effectiveness of a drug in preventing diseases in communities.
2. **Observational**
    - Cohort study who received the medicine and how many become ill after.
    - Case control identify ill cases and comparison group and Compare exposures.
    - Cross sectional survey both exposure and disease.
    - Ecologic compare populations rather than individuals.

According to WHO, 'Descriptive and analytical studies' plays an important role in epidemiology as it has both advantages and disadvantages when selecting samples.

2. Write down and explain the mathematical expression of the following. (i) Incidence (ii) Prevalence

Incidence is a measure of disease that allows us to determine a person's probability of being diagnosed with a disease during a given period. Therefore, incidence is the number of newly diagnosed cases of a disease. An incidence rate is the number of new cases of a disease divided by the number of persons at risk for the disease. If, over the course of one year, five women are diagnosed with breast cancer, out of a total female study population of 200 (who do not have breast cancer at the beginning of the study period), then we would say the incidence of breast cancer in this population was 0.025. (or 2,500 per 100,000 women-years of study).

Prevalence is a measure of disease that allows us to determine a person's likelihood of having a disease. Therefore, the number of prevalent cases is the total number of cases of disease existing in a population. A prevalence rate is the total number of cases of a disease existing in a population divided by the total population. So, if a measurement of cancer is taken in a population of 40,000 people and 1,200 were recently diagnosed with cancer and 3,500 are living with cancer, then the prevalence of cancer is 0.118. (or 11,750 per 100,000 persons**).**

3.Apart from Randomized trials, describe four (4) other epidemiological research designs

In epidemiology, researchers are interested in measuring or assessing the relationship of exposure with a disease or an outcome. As a first step, they define the hypothesis based on the research question and then decide which study design will be best suitable to answer that question. How the investigation is conducted by the researcher is directed by the chosen study design. The study designs can be broadly classified as **experimental** or **observational** based on the approach used to assess whether exposure and an outcome are associated. In an experimental study design, researchers assign patients to intervention and control/comparison groups to isolate the effects of the intervention. Being able to control various aspects of the experimental study design enables the researchers to identify causal links between interventions and outcomes of interest. In several instances, an experimental study design may not be feasible or suitable; in such situations, observational studies are conducted. Observational studies, as the name indicates, involve merely observing the patients in a non-controlled environment without interfering or manipulating with other aspects of the study and therefore are non-experimental. The observation can be prospective, retrospective or current depending on the subtype of an observational study.

1. **Observational Studies**

- **Case-Control Studies**

Case-control studies are used to determine the degree of associations between various risk factors and outcomes. The factors that affect the risk of a disease are called exposures. Case-control studies can help identify beneficial

or harmful exposures. In a case-control study, as the name suggests, there are two groups of patients-cases and controls. Cases are patients who have a particular disease, condition, or disability. Controls are those patients that do not have the disease. Typically, researchers identify appropriate representative controls for the cases that they are studying from the general population. Then they retrospectively look in the past for the possible exposures these patients might have had to a risk factor. Selecting the patients for the control group is a very critical component of research based on case-control studies. Due to the retrospective nature of the study design, case-control studies are subject to recall bias. Case-control studies are inexpensive, efficient, and often less time consuming to conduct. This study design is especially suitable for rare diseases that have longer latency periods.

- **Case-Crossover Studies**

Case-crossover studies are helpful to study triggers within an individual. When the researcher is studying a transient exposure or risk factor, the case-crossover design is useful. This is a relatively new study design where there is a case and a control component both of which come from the same individual. Each case is self-matched by serving as its own control. Determining the period of the control and case components is a critical and difficult aspect of a case-crossover study.

- **Cohort Studies**

Cohort studies initially classify patients into two groups based on their exposure status. Cohorts are followed over time to see who develops the disease in the exposed and non-exposed groups. Cohort studies can be retrospective or prospective. Incidence can be directly calculated from a cohort study as you begin with exposed and unexposed patients, unlike a case-control study where you start with diseased and non-diseased patients. Relative risk is the measure of effect for a cohort study. Cohort studies are subject to very low recall bias, and multiple outcomes can be studied simultaneously. One of the disadvantages of cohort studies is that they are more prone to selection bias. Studying rare diseases and outcomes that have long follow-up periods can be very expensive and time-consuming using cohort studies.

- **Cross-Sectional Studies**

Cross-sectional studies are observational in nature and give a snapshot of the characteristics of study subjects in a single point of time. Unlike cohort studies, cross-sectional studies do not have a follow-up period and therefore are relatively simple to conduct. As the exposure status and outcome of interest information is collected in a single moment in time often by surveys, cross-sectional study design cannot provide cause-effect relationship and is the weakest of the observational designs. This study design is generally used to assess the prevalence of a disease in a population.

- **Ecological Studies**

Ecological studies are used when data at an individual level is unavailable or when large-scale comparisons are needed to study the population-level effect of exposures on a disease condition. Therefore, ecological study results are applicable only at the population level. The types of measures in ecological studies are

aggregates of individual-level data. These studies, therefore, are subject to a type of confounding called ecological fallacy which occurs when relationships identified at group level data are assumed to be true for individuals. Ecological studies are generally used in public health research.

2. Experimental Studies

- **Randomized Clinical Trials**

Randomized clinical trials or randomized control trials (RCT) are considered the gold standard of study design. In an RCT the researcher randomly assigns the subjects to a control group and an experimental group. Randomization in RCT avoids confounding and minimizes selection bias. This enables the researcher to have similar experimental and control groups thereby enabling them to isolate the effect of an intervention. The experimental group gets the exposure/treatment which can be an agent involved in causation, prevention or treatment of a disease. The control group receives no treatment, a placebo treatment or another standard of care treatment depending on the objective of the study. The groups are then followed prospectively to see who develops the outcome of interest. RCT's are expensive, and researchers using this study design often face issues with the integrity of randomization due to refusals, drops outs, crossovers, and non-compliance.

4. Data from hospital records are one of the most important sources of information in epidemiologic studies.

a) Outline the limitations of using hospital data.

EPIDEMIOLOGICAL investigation in hospitals is not new. In the past its use has been discouraged by those who maintained that the data would not be sufficiently representative to be of research value. The passage of time and experience have shed doubt on this attitude; and numerous examples of the value of epidemiology in hospitals can now be found in the literature. As hospitals have grown in importance with respect to the medical needs of communities, they have also become more valuable resources for the epidemiologic study of disease in populations.

A Definition of "Epidemiology in Hospitals"

"Epidemiology in Hospitals" may be defined as any investigation relating cases identified in hospitals to a population obtained from either these same hospitals or a definable community served by these hospitals. The purpose is to discover attributes associated with the cases or the frequency and distribution of the cases which may lead to a better understanding of the cause and

prevention of these conditions. This definition implies two types of **studies, depending on** whether the population at risk (the denominator population) or the control group is derived from within hospitals or from the community at large. The cases (the numerator population) are by definition

detected within hospitals.

- **Type I studies**, "Epidemiology within Hospitals," are restricted to cases and controls drawn from one or more institutions.
- **Type II studies**, "Community-wide Hospital Epidemiology," usually involves those cases

which are drawn from all hospitals serving a community and which can be related to a geographically defined community population. My definition is admittedly broad; but it is defensible based on the fundamental operations in epidemiology -namely, relating case populations to "at risk" or control populations. This session on "Epidemiology in Hospitals" further bears out this viewpoint, as evidenced by the wide range of epidemiologic studies which can be performed in hospitals. The papers presented extended from clinical research to hospital administration and even to community action. This paper will be confined mainly to inpatient hospital studies. The same Potential Uses:

Possible Type I Studies (Epidemiology within Hospitals)

To study disease resulting from hospitalization

To study the natural history of a disease

To study attributes associated with disease

To study associations between diseases

To facilitate cooperative experimental, clinical, and epidemiologic studies

Possible Type II Studies (Community-wide Hospital Epidemiology)

To determine disease morbidity

To describe demographic and geographic patterns of disease

To identify instances of familial occurrence of disease

To facilitate comparative study of hospital and death certificate indexing of causes of death

To study administrative planning principles, apply to outpatient investigations except that good diagnostic indexes are not usually kept on outpatients. Various health insurance plans, such as the Health Insurance Plan of Greater

According to New York and the Kaiser Foundation health Plan, have highly efficient diagnostic indexing of outpatient as well as inpatient services; and these records have been used for research purposes.

Type I Studies: "Epidemiology within Hospitals"-The studies included in this category have not ordinarily been considered epidemiologic. The analytic technics utilized, however, are entirely

analogous to those in epidemiology. They involve populations of cases rather than individual patients; and they embody a comparison of those cases with either a population at risk or with a control population. Such methods are employed most obviously in studies of illness resulting from hospitalization, e.g., hospital-acquired infections,4 adverse effects of drugs,5 and delayed effects

b) Describe the possible sources of error in interview surveys

Key term:

Survey is look carefully and thoroughly at (someone or something), especially so as to appraise them or examine and record the area and features of (an area of land) so as to construct a map, plan, or description**.** However, the following are the possible sources of error in interview survey as outlined and explained below: -

- **Population Specification**

This type of error occurs when the researcher selects an inappropriate population or universe from which to obtain data.

Example: Packaged goods manufacturers often conduct surveys of housewives, because they are easier to contact, and it is assumed they decide what is to be purchased and do the actual purchasing. In this situation there often is population specification error. The husband may purchase a significant share of the packaged goods and have significant direct and indirect influence over what is bought. For this reason, excluding husbands from samples may yield results targeted to the wrong audience.

- **Sampling**

Sampling error occurs when a probability sampling method is used to select a sample, but the resulting sample is not representative of the population concern. Unfortunately, some element of sampling error is unavoidable. This is accounted for in confidence intervals, assuming a probability sampling method is used. Suppose that we collected a random sample of 500 people in South Sudan adult population to gauge their entertainment preferences. Then, upon analysis, found it to be composed of 70% females. This sample would not be representative of the general adult population and would influence the data. The entertainment preferences of females would hold more weight, preventing accurate extrapolation to the South Sudan general adult population. Sampling error is affected by the homogeneity of the population being studied and sampled from and by the size of the sample.

- **Selection**

Selection error is the sampling error for a sample selected by a nonprobability method.

Example: Interviewers conducting a mall intercept study have a natural tendency to select those respondents who are the most accessible and agreeable whenever there is latitude to do so. Such samples often comprise friends and associates who bear some degree of resemblance in characteristics to those of the desired population.

- **Non-responsive**

Nonresponse error can exist when an obtained sample differs from the original selected sample.

Example: In telephone surveys, some respondents are inaccessible because they are not at home for the initial call or call-backs. Others have moved or are away from home for the period of the survey. Not-at-home respondents are typically younger with no small children and have a much higher proportion of working wives than households with someone at home. People who have moved or are away for the survey

period have a higher geographic mobility than the average of the population. Thus, most surveys can anticipate errors from non-contact of respondents. Online surveys seek to avoid this error through e-mail distribution, thus eliminating not-at-home respondents.

- **Measurement**

Measurement error is generated by the measurement process itself and represents the difference between the information generated and the information wanted by the researcher.

Example: A retail store would like to assess customer feedback from at-the-counter purchases. The survey is developed but fails to target those who purchase in the store. Instead, results are skewed by customers who bought items online.

5 Explain the main determinants of health

Health is a state of complete physically, mentally, spiritually and economically sound not merely the absence or infirmity. WHO in 1948 while determinants refer to factors that decisively affects the nature or outcome of our health. However, the following are the main determinants of health as outlined and described below: -

The determinants of health

Introduction

Many factors combine to affect the health of individuals and communities. Whether people are healthy or not, is determined by their circumstances and environment. To a large extent, factors such as where we live, the state of our environment, genetics, our income and education level, and our relationships with friends and family all have considerable impacts on health, whereas the more commonly considered factors such as access and use of health care services often have less of an impact.

The determinants of health include:

The social and economic environment, the physical environment, and

the person's individual characteristics and behaviours.

The context of people's lives determines their health, and so blaming individuals for having poor health or crediting them for good health is inappropriate. Individuals are unlikely to be able to directly control many of the determinants of health. These determinants—or things that make people healthy or not—include the below factors, and many others:

Income and social status - higher income and social status are linked to better health. The greater the gap between the richest and poorest people, the greater the differences in health.

Education – low education levels are linked with poor health, more stress and lower self-confidence.

Physical environment – safe water and clean air, healthy workplaces, safe houses, communities and roads all contribute to good health.

Employment and working conditions – people in employment are healthier, particularly those who have more control over their working conditions.

Social support networks – greater support from families, friends and communities is linked to better health.

Culture - customs and traditions, and the beliefs of the family and community all affect health.

Genetics - inheritance plays a part in determining lifespan, healthiness and the likelihood of developing certain illnesses.

Personal behavior and coping skills – balanced eating, keeping active, smoking, drinking, and how we deal with life's stresses and challenges all affect health.

Health services - access and use of services that prevent and treat disease influences health

Gender - Men and women suffer from different types of diseases at different ages.

Transport

Evidence of health impact focus on:

- Accidents between motor vehicles, bicycles and pedestrians (particularly children and young people).
- Pollution from burning fossil fuels such as particulates and ozone.
- Noise from transportation.
- Psychosocial effects such as severance of communities by large roads and the restriction of children's movement.
- Climate change due to CO2 emission due to diesel use,
- Loss of land
- Improved physical activity from cycling or walking
- Increased access to employment, shops and support services
- Recreational uses of road spaces
- Contributes to economic development
- Vector borne diseases

Food and Agriculture

Agricultural production issues and manufacturing

- Tobacco farming and its impact on heart disease, stroke, certain cancers and chronic respiratory disease. Including passive smoking and impact of foetal development. Pesticide policies on tobacco crops require consideration.
- Changes in land use, soil quality, choice of crop, use of agricultural labor and occupational health.
- Mechanization of work previously done by hand, and plantation agriculture.
- Fisheries – biotoxins, pollution, chemical use, wastewater, processing, and occupational health

- Forestry – vector borne diseases, occupational health, and food security.
- Livestock use – vector borne diseases, drug residues, animal feed, waste, and food security.
- Sustainable farming including chemical and energy use, biodiversity, organic production methods, and diversity of foods produced.
- Fertilizer use – nitrate levels in food, pollution of waterways, re-use of agricultural waste.
- Water – irrigation use and its impact on river/water-table levels and production outputs.
- Pesticide usage and veterinary drugs– legal requirements, best practice, consumer issues.
- Food packaging, preservation and safety, and avoidance of long storage and travel.

Access to, and distribution of food

- Household food security – appropriate food being available, with adequate access and being affordable (location of markets, supermarkets and closure of small suppliers creating food deserts in cities).
- Food supplies, including national and regional food security, and regional production.
- National food security – able to provide adequate nutrition within a country without relying heavily on imported products
- Cold-chain reliability – the safety of transporting products that deteriorate microbiologically in the heat.

Dietary patterns, diversity of food available and home production, particularly:

- Fruit and vegetable consumption on reduced stroke, heart disease and risk of certain cancers,
- Total, saturated and polyunsaturated fat, carbohydrates and sugars consumption on obesity, heart disease, stroke and other vascular diseases.
- Alcohol consumption and impact on social effects related to behaviour (traffic accidents, work/home accidents, violence, social relations, unwanted pregnancy and STDs), and toxic effects (all-cause mortality, alcoholism, certain cancers, liver cirrhosis, psychosis, poisoning, gastritis, stroke, foetal alcohol syndrome and others).
- Micronutrients such as iron, vitamin A, zinc and iodine and their impact on deficiency syndromes.

Food safety and foodborne illness hazards

Food and water are the major sources of exposure to both chemical and biological hazards. They impose a substantial health risk to consumers and economic burdens on individuals, communities and nations.

- Microorganisms such as salmonella, campylobacter, E. coli O157, listeria, cholera.
- Viruses such as hepatitis A, and parasites such as trichomoniasis in pigs and cattle.
- Naturally occurring toxins such as mycotoxins, marine biotoxins and glycosides.
- Unconventional agents such as the agent causing bovine spongiform encephalopathy (BSE, or "mad cow disease"),

- Persistant organic pollutants such as dioxins and PCBs. Metals such as lead and mercury.
- New foods developed from biotechnology such as crops modified to resist pests, changes in animal husbandry, antibiotic use and new food additives

Housing

Evidence of health impacts focus on:

- Improvements in housing and improved mental health and general health
- The possibility of improved housing leading to rent rises, impacting negatively on health.
- Movement of original tenants after housing improvement and therefore not benefiting from the improvements.
- Housing tenure, outdoor temperature, indoor air quality, dampness, housing design, rent subsidies, relocation, allergens and dust mites, home accident prevention, and fire prevention and the homelessness.

Waste

Evidence of health impacts focuses on environmental and social determinants related to:

- the transmission of agents of infectious disease from human and animal excreta (sanitation, hygiene and water-related);
- exposure to toxic chemicals in human and animal excreta; and in industrial wastes discharged into the environment;
- environmental degradation, direct and indirect impacts on health;
- exposure to radioactive wastes;
- exposure to health-care wastes;
- exposure to solid wastes and involvement in informal waste recycling; and
- breeding of disease vectors

Energy

Evidence of health impacts focus on health hazzards such as:

- Fossil fuels
- Biomass fuels
- Hydropower and their impact on vector borne diseases, and pollution
- Electricity generation and transmission
- Nuclear power
- Other energy sources
- Occupational health effects of energy workers
- Impacts on ecosystems, agriculture, forests, fisheries and building materials
- Noise

- Visual impact
- Global warming

Industry

Evidence of health impacts focus on industrial sectors such as:

- Asbestos and manmade fibers
- Basic chemicals
- Cement, glass and ceramics
- Electronics
- Iron and steel
- Manufacture of rubber and plastic products
- Metal products
- Mining
- Pesticides, paints and pharmaceuticals
- Petroleum products
- Pulp and paer
- Service industries
- Textiles and leather
- Wood and furniture.

Urbanization

Evidence of health impacts focus on topics such as:

- Urban housing problems
- City environment and non-communicable diseases
- Communicable diseases
- Road trauma
- Psychosocial disorders
- Sustainable urban development
- Urban wastes
- Health services

In conclusion, the above are not the exhausted list, however water, radiation, nutrition and health are important in public health.

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