PRACTICAL 9: POPULATION AND INDIVIDUAL STRATEGIES FOR PREVENTION

OBJECTIVES

At the end of the practical students should be able to:

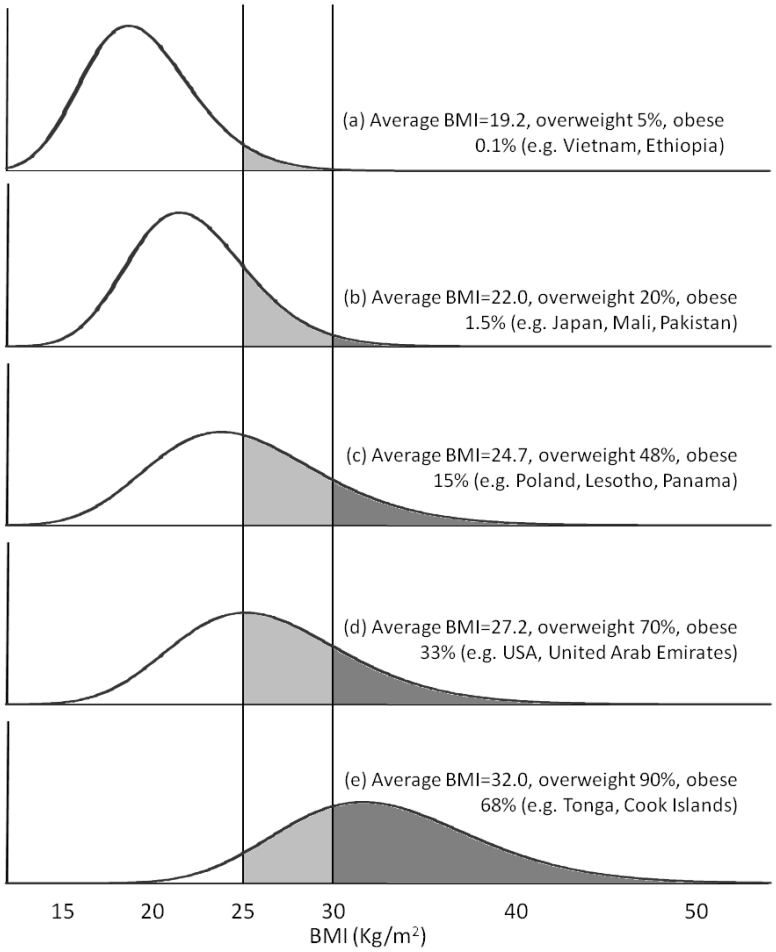
- Discuss different strategies for prevention
- Calculate and interpret attributable risk and population attributable risk measures
- Describe the difference between primary, secondary and tertiary prevention
- Demonstrate an understanding of the epidemiological measures of sensitivity, specificity, positive and negative predictive value and be able to calculate them.
- Critically evaluate the appropriateness and effectiveness of screening tools used in various contexts.
- Consider the consequences of overdiagnosis.

In this practical you will discuss different examples of commonly implemented strategies for prevention and calculate measures of attributable risk.

NB: Please complete all non-optional questions before beginning questions marked optional.

SECTION 1: OBESITY

Obesity is an increasing problem throughout the world, and is related to an increased risk of many diseases, including diabetes, heart diseases and cancer. Figure 2 below compares the distributions of BMI in different countries (Edwards P, Roberts I. Shifting population distributions of body mass index).



Question 1a Describe the relationship between the population average of BMI and the proportion of the population that is at high risk (i.e. obese)?

Question 1b Using these graphs, discuss which strategies you could use to prevent obesity in the population. Which approach would you take and why?

Question 1c Why does comparing the distribution of a risk factor *between* populations help us decide on our choice of strategy?

SECTION 2: GENITAL HERPES AND HIV

At one point, a focus of HIV prevention research was prevention of HSV-2 infection, which causes genital herpes (herpes simplex virus – HSV). People infected with HSV-2 are more vulnerable to infection with HIV.

A cohort study was conducted in South Africa following up 3274 men for 21 months. All the men were HIV negative at baseline and 9% of the men were infected with HSV-2 at baseline. The men were assessed for HIV infection during the follow-up. During the course of the follow-up 2.5% of the men developed HIV. Table 1 shows the risk of HIV among men by their HSV-2 status.

Table 1. Risk of HIV among men during 21 months of follow-up in a cohort from Orange Farm, South Africa (Sobngwi-Tambekou et al, 2009)

Group	Risk of HIV
Negative for HSV-2	1.7%
Positive for HSV-2	10.4%
Total population	2.5%

Question 2a: What proportion of the new cases of HIV could be attributable to the presence of HSV-2 infection in the population?

Question 2b: What is the importance of calculating population attributable risk percent over the more usually presented measure of relative risk?

Question 2c: What assumption would you be making if you asserted that one third of cases of HIV could be avoided if HSV-2 infection were to be prevented (HSV-2 cannot be cured)?

SECTION 3: EVALUATION OF A CERVICAL CANCER SCREENING TOOL

Incidence of both cervical cancer and HIV infection is high in sub Saharan Africa. To understand more about how the treatment of HIV may interact with the detection of cervical cancer in this setting, between June and November 2009 a group of HIV positive women in Nairobi, Kenya were enrolled in a study that compared the 'gold standard' cervical screening test (colposcopy-directed biopsy) with three common alternative methods available for women in resource-limited settings (Chung et al. 2013). One of these methods was visual inspection with acetic acid (VIA) – this method is cheaper the colposcopy-directed biopsy and does not require a laboratory.

'Cervical intraepithelial neoplasia' (CIN) is a term used to describe abnormal cervical cell change. CIN is categorised into grade 1, 2 or 3 depending on the severity of the abnormalities (CIN 2 and CIN 3 considered more severe). Below is a table showing data from the study comparing VIA with the gold standard (colposcopy-directed biopsy) to detect CIN 2/3:

Table. VIA testing of high risk types compared with histology results from colposcopy directed biopsy*

	Colposcopy-directed biopsy	
	CIN 2/3	**Normal or CIN 1**
Visual Inspection with acetic acid (VIA)		
Positive	71	54
Negative	42	118
Total	**113**	**172**

**Data extracted from Chung MH et al 2013 and modified to increase prevalence to make the example clearer*

Question 3a: Using the data in the above table, calculate the proportion of women selected into the study who had CIN 2/3.

Question 3b: Using the data in the above table, calculate the VIA test's:

a. Sensitivity

b. Specificity

c. Positive predictive value (PPV)

d. Negative predictive value (NPV)

Question 3c: Based on results from 3b, discuss the appropriateness of VIA as opposed to colposcopy directed biopsy for cervical screening in this setting, considering the prevalence of CIN 2/3. What about this setting makes VIA appropriate/inappropriate? Would you recommend the use of VIA for HIV positive women in Nairobi? Why/why not?

Question 3d: Now imagine if the prevalence of CIN 2/3 in this population was 10%. Using the same number of women tested (285) and the same test sensitivity and specificity you calculated for question 2, draw up a 2x2 table (see blank table over page) and calculate the PPV and NPV for VIA in this setting. Comment on any difference that the lower prevalence may have on the PPV and NPV of the test.

[Hint: start by calculating the total number of CIN 2/3 positive women according to the gold standard test (the bottom row), then use the sensitivity and specificity to calculate the numbers in the cells of the table.]

PPV=

NPV=

SECTION 4: UNIVERSAL SUICIDE SCREENING IN SCHOOLS

The 2014 World Health Organization report *"Health for the world's adolescents. A second chance in the second decade"* has identified adolescent mental health as an emerging global public health priority (WHO 2014). Half of mental health disorders begin by the age of 14 and many are unidentified. Suicide is the third most common cause of adolescent deaths globally.

The past few decades have seen an increase in school based suicide screening programmes, particularly in the United States (Joe and Bryant 2007). The Columbia Suicide Screen (CSS) is a self-report tool used in schools (Shaffer et al. 2004). It is made up of 11 items and includes questions on suicide attempts, three-month prevalence of suicidal ideation, negative mood and substance abuse. The CSS's original scoring algorithm has a sensitivity of 0.75, specificity 0.83, PPV of 0.16 and a NPV of 0.99 for identifying high school students *at risk of suicide*.

Question 4a: What do the CSS's measures of validity tell you about its usefulness in identifying students at risk of suicide?

Question 4b: If the CSS was adopted in schools, what practical implications would it have for them? What resources might be necessary to manage these implications?

SECTION 5: BIDI SMOKING AND MORTALITY IN INDIA (OPTIONAL DO IN YOUR OWN TIME)

A case-control study was carried out to determine the effects of prolonged smoking of bidis (small hand rolled cigarettes) on adult mortality in India.

The study was conducted in 5000 areas chosen randomly from all parts of India. Each home in which an adult male death had been recorded between 2010 and 2013 was visited by a field worker. Relatives were asked to provide information on the history of tobacco use in these men.

All adult males living in the households of the men who had died were also asked about their own smoking history. Data from this study are presented below.

Smoked bidis within the previous five years	Adult men who died(Cases)	Adult men who survived(Controls)
Yes	20,910	13,760
No	20,090	29,240
All	**41,000**	**43,000**

Question 5a: What is the magnitude of the association between bidi-smoking and mortality? Interpret your result.

Question 5b: What is the prevalence of bidi-smoking in the general population of adult men in India? What assumptions have you made?

Question 5c: What proportion of adult male mortality in India is attributable to bidi-smoking? What is this measure called?

Question 5d: What assumptions have you implicitly made when calculating the measure above?

SECTION 6: POPULATION SCREENING FOR PROSTATE CANCER (OPTIONAL: DO IN YOUR OWN TIME)

Prostate specific antigen (PSA) is a protein produced by the prostate. A raised PSA level can be a sign of prostate cancer and the PSA blood test is used as a screening tool to detect possible early stage prostate cancer.

The European Randomised study of Screening for Prostate Cancer (ERSPC) is a multicentre, randomised screening trial conducted in the Netherlands, Belgium, Sweden, Finland, Italy, Spain, Switzerland and France (Schröder et al. 2014). Eligible men aged 50-74 were randomly assigned to the intervention (invitation to screen) or control (no screening invitation). The trial began in 1993 and recruitment was completed in 2005, with 72,891 men randomised to the intervention and 89,352 randomised to the control group.

Men who screened positive (i.e. elevated PSA defined as ≥ 3.0 ng per millilitre) at their first test were referred for biopsy in most centres (Schröder et al. 2012). Further treatment (e.g. radiation, prostatectomy, active surveillance) depended on the result of the biopsy.

At 13-year follow up (after adjustment for non-participation), the rate ratio of cancer incidence comparing the intervention and control groups was 1.57 (95% CI 1.51-1.62). The rate ratio for prostate cancer mortality was 0.73 (95% CI 0.61-0.88). The authors estimated 41% overdiagnosis, that is, men who screened positive that would not have been diagnosed during their lifetime if they had not screened (these men would have remained asymptomatic and hence not diagnosed).

Question 6a: Using the results from this trial, discuss the risks and benefits of screening for prostate cancer. What do the rate ratios tell you? What are some of the consequences of overdiagnosis?

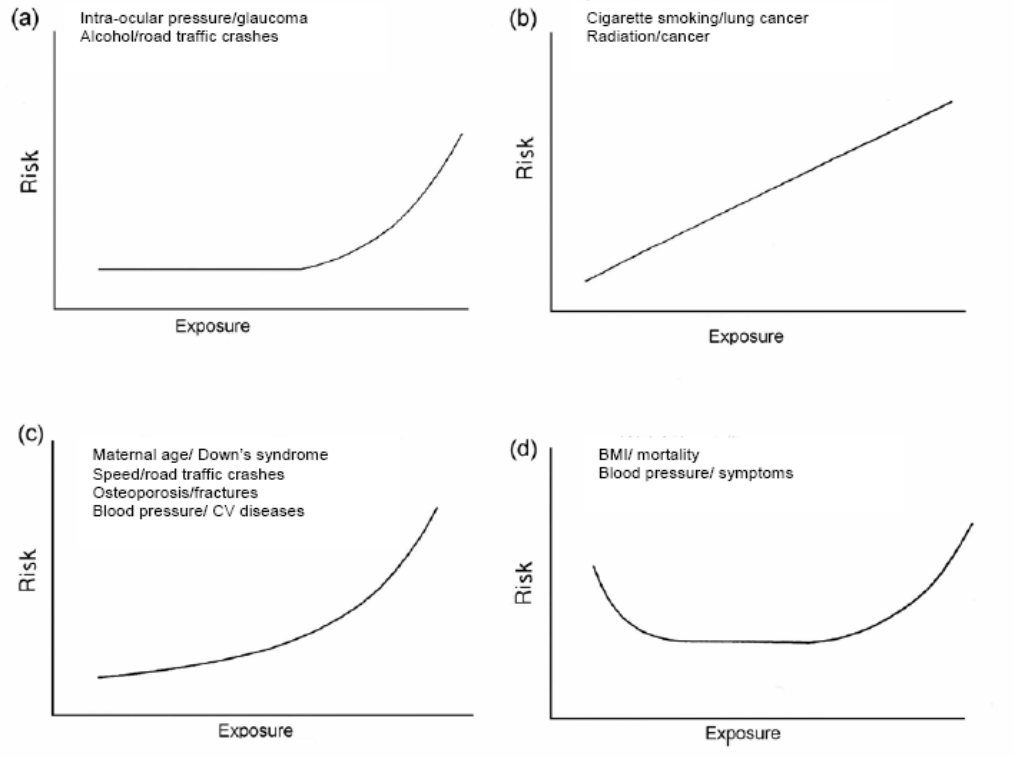
Question 6b: What are the main advantages of using RCTs to evaluate screening tool? What are some of the drawbacks that need to be taken into account?

SECTION 7: DOSE-RESPONSE CURVES

(OPTIONAL DO IN YOUR OWN TIME)

The shape of the dose-response curve is an important influence on strategies for prevention. Describe each of the dose-response relationships presented below (Figure 1) and their implications for prevention policy.

Figure 1: Schematic models of four possible relationships between exposure to a cause and the associated risk of disease.



a)

b)

c)

d)

References

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