W1-2-60-1-6

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

UNIVERSITY EXAMINATIONS 2023/2024

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF MASTER OF SCIENCE IN EPIDEMIOLOGY & BIOSTATISTICS

PEH 3104: QUANTITATIVE EPIDEMIOLOGY

DATE: AUGUST 2023 **TIME: 3 HOURS**

INSTRUCTIONS: ANSWER ANY FOUR (4) QUESTIONS

1a). A scientist has developed a new test for anemia that does not require a finger prick to obtain blood (no one likes needles!). The new test "Hb Scanner" uses a scanner that can detect hemoglobin levels through the thin skin on the underside of a wrist. In a preliminary survey to validate the Hb Scanner, 2000 children visiting Kiambu county referral hospital were tested. The following table summarizes the findings from the study.

		Hemocue Machine		Total
		Anemia	No Anemia	
Hb scanner	Anemia	970	580	**1550**
	No Anemia	180	270	**450**
		1150	**850**	**2000**

i. What is the actual agreement (concordance rate) between the group assignments based on the two tests (the Hb Scanner and the Hb Machine)? (3 marks)
ii. What is the expected agreement? (3 Marks)
iii. Calculate the Kappa statistic? (4 Marks)
iv. Are the disagreements balanced or unbalanced? How would this affect your interpretation of a survey on anemia prevalence in children using the Hb Scanner if the gold-standard of diagnosis is Hemocue Machine? (5 Marks)

1b). The table below summarizes data for a cholera cohort. The county health services director wanted to know whether washing household items with water sourced from the river was associated with cholera. The county public health team had already established that a particular well was polluted. The county health services director wondered whether this would confound the relationship between river water use and cholera.

	Polluted well		**Other well**		**Total**	
	River water		River water		River water	
	Yes	No	Yes	No	Yes	No
Cases	1,500	500	600	200	2,100	700
Person-years	200,000	100,000	100,000	50,000	300,000	150,000

i. Is there an association between use of the polluted well and use of river water for washing household items? (2 Marks) Hint: this question relates only to the use of wells and river water; the number of cases is not relevant here.
ii. From your answer to (i) above, do you think that well use could be confounding the effect of river water use? (2 Marks)
iii. Demonstrate your answer to (ii) above by comparing the crude effect of river water use on disease with the stratum specific effects in those using and not using the well. (6 Marks)

2a). The following description is adapted from a published abstract. Aoki *et al.* Incidence of injury among adolescent soccer players: a comparative study of artificial and natural grass turfs. Clin J Sport Med 2010; 20: 1-7. The objective of this research was to investigate the incidence of acute injuries and soccer-related chronic pain from long-term training and during matches in adolescent players using natural grass turfs and artificial turfs. Study participants were youth soccer players (12-17 years of age) from 6 teams, with a predominant tendency to train on either natural turf or artificial turf. Of 332 players enrolled in this study, 301 remained to completion. Medically diagnosed acute injuries and chronic pain were recorded daily by team health care staff throughout 2005 and this information was provided to the researchers. Acute injuries per 1000 player hours on each surface and chronic complaints per 1000 player hours were evaluated according to frequency of surface used most of the time. There was no significant difference in the incidence of acute injuries between the two surfaces during training and competition. However, the artificial turf group showed a significantly higher incidence of low back pain during training (RR = 1.63, 95% confidence interval = 1.06 - 2.48). Age (early rather than late adolescence) and prolonged training hours were factors associated with an increased incidence of chronic pain in the artificial turf group.

CONCLUSION: Adolescent players routinely training on artificial turfs for prolonged periods should be carefully monitored, even on artificial turfs conforming to new standards.

i. In your own words, describe the relationship between turf type used for training and low back pain. Include an explanation and interpretation of the information contained in the brackets. (5 Marks) .
ii. A total of 332 players were enrolled and 301 completed the study. Suppose that almost all the 31 players who did not complete the study came from teams that trained on artificial turf. As an epidemiologist, explain why you would be concerned about this and how it might affect the results of the study. (5 Marks) .

2b). The Great Britain Asbestos Survey was established in 1971 to monitor mortality among workers with varying levels of exposure to asbestos. Workers were recruited during their 2-yearly medical examinations. A brief questionnaire was completed during the medical examination. As part of the questionnaire workers were asked to report on their length of employment and type of job (i.e. manufacturing, removal, insulation installation or other). Participants were flagged through the National Health Service Central Register (NHS CR), so that the investigators were notified automatically if any deaths occurred during follow-up, and the cause of death. In the latest analysis of this cohort, there had been 15,496 deaths among

98,117 workers followed up for 1,779,580 person-years. NB. 98% of the participants were successfully traced for follow-up through NHSCR.

i. Calculate the average mortality rate for the whole cohort during this follow-up, stating the units. For each individual, when would follow-up time begin and end? (5 Marks)
ii. Was loss to follow-up a potential source of bias in this study? (3 Marks)
iii. Comment on the accuracy of outcome assessment within the cohort. (2 Marks)
iv. Can the association between asbestos exposure and mortality be assessed within this cohort? (5 Marks)

3a). A test is used to screen people for hepatitis B. The sensitivity of the test is 95% and the specificity of the test is 90%. Assume that the total number of persons being tested for hepatitis B is 50,000 and the true prevalence of hepatitis B in the population is 100 per 50,000.

i. Summarize the above information in a 2x2 table (4 Marks)
ii. Calculate the proportion of true positives (4 Marks)
iii. Briefly discuss the differences between screening and diagnosis (10 Marks).

3b). **In a cohort study of back belts for preventing back injuries.** Wassell and coworkers (JAMA. 2000 Dec 6;284(21):2727-32) conducted a cohort study to determine the effectiveness of wearing back belts to prevent disabling low-back injuries at work. From April 1996 through April 1998, they interviewed 2939 material handlers who wore a back belt every work day. Within this group, 502 reported back injuries. They also interviewed 2601 material handling employees who chose not to wear a back belt. Among these employees, 455 reported back injuries.

i. What is the relative risk of back injury associated with no back belt use? (4 Marks)

ii. Interpret the relative risk to a policy maker with no epidemiological background. (3 Marks)

4a.) Use the information in the following table to answer the questions below.

Age Groups	**Population Distribution of Community A in 2018**	**Observed Deaths in Community A in 2018**	**Death rates for Community B(per 100,000) in 2018**
0 – 29	150,000	150	26
30 – 59	100,000	75	100
60+	200,000	250	125
Total	450,000	475	

i. Using community B as the standard, calculate and interpret the standardized mortality ratio (SMR) for Community A. (6 Marks)

ii. Briefly discuss the disadvantages of SRM. (4 Marks)

4b.) A good screening test needs to be both reliable and valid, discuss (15 Marks)

5a.) *Helicobacter pylori* is a spiral bacterium that lives in the stomach and duodenum (section of intestine just below stomach). The inside of the stomach is exposed to gastric juice and is protected by a thick layer of mucus that covers the stomach lining. *H. pylori* lives in this mucous lining. It is responsible for peptic ulcer disease and chronic gastritis and is thought to be a risk factor for stomach cancer. About half the world's population is infected with *H. pylori*, most living in developing countries. A new low-cost diagnostic test, the local urease test (LUT), has been developed to test for the presence of the bacterium. The performance of LUT in actual trials is presented in the table below. In your calculations assume true prevalence is 0.0001.

	Cases (infected)	Controls (No infected)
+LUT	126	1
-LUT	0	84

i. Calculate the specificity and sensitivity of this diagnostic test and briefly interpret your results regarding the probability of a positive test when the person has the infection and the probability of a negative test when the person does not have the infection. (10 Marks)

ii. Calculate the positive and negative predictive values of this diagnostic test and briefly interpret your results regarding the diagnostic abilities of this test. (10 Marks)

5b.) Use the data provided in the table below to compute the measures requested.

	Has Disease	**Does not have disease**	**Total**
Exposed	651	450	1011
Unexposed	367	145	512
Total	1018	595	1613

i. The prevalence of the disease, assuming the disease is chronic with no cure and no study participants have died (1 Mark)

ii. The risk ratio (2 Marks)

iii. The risk difference in exposed and unexposed (2 Marks)

6a. The table below summarizes the incidence and outcome of out of hospital cardiac arrest/heart attacks treated by emergency medical services (EMS) personnel from April 1, 2009 through March 31, 2010 in three countries.

	County A	County B	County C
Population size	1666798	1751119	2779373
Treated cardiac arrest	1170	793	1634

Died	997	688	1446
Survived	191	85	160

i. Calculate the incidence, case fatality and mortality of treated out of hospital cardiac arrests for each county. (9 Marks)

ii. Which of the three measures (mortality, case fatality, incidence) would you expect to be most directly affected by more aggressive control of risk factors for heart disease e.g. reducing high cholesterol levels or hypertension control. Explain your reasoning. (3 Marks)

iii. Which of the three measures (mortality, case fatality, incidence) would you expect to be most directly affected by improvement of EMS in each county. E.g. by each county government reducing response time by providing more ambulances and employing sufficient numbers and more competent EMS technicians. Explain your reasoning (3 Marks)

6b. Why is an adjusted beta coefficient better than an unadjusted one in measuring an X ~ Y relationship? (4 Marks)

6c. Why can demographic factors also be used as confounders in multiple regression to verify a hypothetical X ~ Y relationship suggested by bivariate analysis? (6 Marks)