Epidemiological Exercises

DR. M. SIVA DURGAPRASAD NAYAK, MD, PHD

ASSOCIATE PROFESSOR

Program indices

Q1

In a PHC with a population of 40,000, filarial survey was carried out. The following are the findings.

Population examined = 10,000

MF Positive alone (No signs/ symptoms) = 300

Patient with only signs/ symptoms = 400

MF Positive + Patient with signs/ symptoms = 100

Calculate Filarial disease rate, filarial endemicity rate and MF rate.

Q1 Answer

Population examined = 10,000

MF alone (no signs) = 300

Signs & symptoms only = 400

Signs + MF positive = 100

Total MF positive = MF alone (no signs) + Signs + MF positive = 300 + 100 = 400

Total disease (clinical cases) = Signs & symptoms only + Signs + MF positive = 400 + 100 = 500

MF rate = (400 / 10,000) × 100 = **4%**

Filarial disease rate = (500 / 10,000) × 100 = **5%**

Filarial endemicity rate = (MF + disease cases) = 300+400+100 = 800

Endemicity rate = (800 / 10,000) × 100 = **8%**

Q2

In a PHC covering a population of 45000 the following data was recorded under NMEP

Total slides examined = 3700

Slides positive for Malarial Parasite = 150

Of these 150 Positive for falciparum are = 60

Calculate API, ABER, Annual falciparum Incidence, Slide positivity rate,

Slide falciparum rate & falciparum rate.

Q2 Answer

Population = 45,000

Slides examined = 3,700

Total positive = 150

PF positive = 60

Annual Blood Examination Rate = (3700 / 45000) × 100 = **8.22%**

Annual Parasite Index = (150 / 45000) × 1000 = **3.33 per 1000**

Annual Falciparum Incidence (AFI) = (60 / 45000) × 1000 = **1.33 per 1000**

Slide Positivity Rate (SPR) = (150 / 3700) × 100 = **4.05%**

Slide Falciparum Rate (SFR) = (60 / 3700) × 100 = **1.62%**

Falciparum Rate (PF%) = (60 / 150) × 100 = **40%**

Q3

A district with a population of 3000000. The following data was recorded under National Tuberculosis Control Program in the year 2025.

TB. Cases on 1.1.2025 = 3000

New cases detected during 2025 = 700

Deaths due to TB During 2025 = 180

Cases discharged as cured = 650

Calculate the prevalence of Tuberculosis as on 1.1.2025 & 31.12.2025, incidence rate, case fatality rate.

Q3 Answer

Population = 30,00,000

Cases on 1.1.2025 = 3000

New cases during 2025 = 700

Deaths = 180; Cured = 650

Prevalence on 1.1.2025 = (Cases on 1.1.2025 / Population) * 1000 = (3000 / 30,00,000) × 1000 = **1 per 1000**

Cases on 31.12.2025 = Cases on 1.1.2025 + New cases during 2025 - Deaths - Cured = 3000 + 700 − 180 − 650 = 2870

Prevalence on 31.12.2025 = (2870 / 30,00,000) × 1000 = **0.96 per 1000**

Incidence rate = (700 / 30,00,000) × 1000 = **0.23 per 1000/year**

Case Fatality Rate (CFR) = (Deaths / Cases on 1.1.2025 + New cases during 2025)* 100 = (180 / 3700) × 100 = **4.86%**

All rates expressed per 1000 population except CFR (%).

Q4

In a district with a population of 30,00,000, 3000 cases of Leprosy were detected out of which Lepromatous Leprosy cases were 1200 and cases with deformity were 800. Calculate the Lepromatous Leprosy rate and Deformity rate

Q4 Answer

Population = 30,00,000

Total cases = 3000

Lepromatous Leprosy cases = 1200

Deformity cases = 800

Lepromatous Leprosy rate = (1200/3000000)×10000 = 4 per 10,000

Deformity rate = (800/3000000)×10000 = 2.67 per 10,000

Lepromatous Leprosy proportion = Lepromatous Leprosy cases * 100/ Total cases = 1200* 100/ 3000 = 40%

Deformity proportion = Deformity cases * 100 / Total cases = 800 *100 / 3000 = 26.7%

It Indicates late detection. So we have to Strengthen early case detection

Epidemiological Studies calculations

Q5

In a case control study of oral contraceptive use and risk of Myocardial infarction, it was found that out of 156 women with Myocardial infarction, 23 were oral contraceptive users at the time of their hospital admission. Of the 3120 control women without Myocardial infarction, 304 were current oral contraceptive users. Construct appropriate 2x2 table. Calculate a measure of association between oral contraceptive use and Myocardial infarction.

Q5 Answer

	MI Cases	Controls	Total
OC Users	**23**	**304**	**327**
Non-OC Users	**133**	**2816**	**2949**
Total	**156**	**3120**	**3276**

Q5 Answer

Cases (MI) = 156 → Exposed = 23 ; Unexposed = 133

Controls = 3120 → Exposed = 304 ; Unexposed = 2816

Measure used in case-control = Odds Ratio

Odds Ratio = (23×2816)/(133×304)

Odds Ratio = 64768 / 40432

Odds Ratio ≈ 1.6. Odds Ratio >1 Indicates positive association. Oral Contraceptives use increases MI risk. Association strength = 1.6 times risk

Q6

	Lung Cancer	
	Present	Absent
Smokers	100	99900
Non-Smokers	8	99992

From the given data, calculate the following

a. Calculate incidence among smokers

b. Calculate incidence among Non- smokers

c. Relative risk (RR) , Attributable risk (AR)

Q6 Answer

Incidence among smokers = 100/100000 = 0.001 = = 100 per 100,000

Incidence among non-smokers = 8/100000 = 0.00008 = 8 per 100,000

Relative Risk = Incidence among smokers/ Incidence among non-smokers = 0.001/0.00008 = 12.5

Smokers have 12.5 times risk

Attributable Risk = Incidence among smokers - Incidence among non-smokers = 100 – 8 = 92 per 100,000

Indicates excess risk due to smoking

Strong association

Smoking major risk factor

Relative Risk = 12.5 ; Attributable Risk = 92/100000

Screening

Q7

	Present	Absent
Positive	**85**	**50**
Negative.	**25**	**90**

Calculate Sensitivity, Specificity, positive and negative predictive values from the data

Q7 Answer

True Positives = 85; False Positives = 50

False Negatives = 25; True Negatives = 90

Sensitivity = True Positives *100 / (True Positives + False Negatives) =

85 ×100 / (85+25) = 77.3%

Specificity = True Negatives * 100 / (True Negatives + False Positives) =

90 * 100 / (90 + 50) = 64.3%

Positive Predictive Value = True Positives *100 / (True Positives + False Positives) = 85 * 100 / (85 + 50) = 63%

Negative Predictive Value = True Negatives * 100 / (True Negatives + False Negatives) = 90 * 100 / (90 +25) = 78.3%

Moderate sensitivity and Low specificity

Q8

Tri dot Test	Disease		
	Present	Absent	Total
Positive	85	20	105
Negative	25	80	105
Total	110	100	210

A study was done to test the validity of western blot test to detect HIV/AIDS infection.

The following results were obtained.

Calculate sensitivity, specificity, positive predictive value, negative predictive value, percentage of false positive & false negatives.

Q8 Answer

True Positive (TP) = 85

False Positive (FP) = 20

False Negative (FN) = 25

True Negative (TN) = 80

Sensitivity = TP / (TP+FN) ×100 = 85/110 ×100 = **77.3%**

Specificity = TN / (TN+FP) ×100 = 80/100 ×100 = **80%**

PPV = TP / (TP+FP) ×100 = 85/105 ×100 = **81%**

NPV = TN / (TN+FN) ×100 = 80/105 ×100 = **76.2%**

False Positive % = FP / (FP+TN) ×100 = 20%

False Negative % = FN / (FN+TP) ×100 = 22.7%

Demographics

Q9

In a trial of contraceptives 3000 women were followed for 2 years. During this period there were 50 live births (includes 1 twin), 10 still births & 3 abortions Calculate failure rate.

Q9 Answer

Total women followed = 3000

Duration = 2 years → Total woman-years = 3000 × 2 = 6000 woman-years

Live births = 50 (including 1 twin counted as 1 confinement)

Still births = 10

Abortions = 3

Total pregnancies (failures) = 50 + 10 + 3 = 63

Failure rate formula = (Total pregnancies ÷ Total woman-years) × 100

= (63 ÷ 6000) × 100

= 1.05 per 100 woman-years

Failure rate = 1.05 per 100 woman-years

Q10

In a town with mid-year population 50,000, total live births during the year were 1,200 and total deaths were 400. Among these births, age-specific fertility data show Total Fertility Rate (TFR) = 2.5. Calculate Crude Birth Rate (CBR), Crude Death Rate (CDR), Population Growth Rate and interpret TFR.

Q10 Answer

CBR = Total Live births * 1000 / Midyear population = (1200 / 50,000) ×1000 = **24 per 1000 population**.

CDR = Total Deaths * 1000 / Midyear population = (400 / 50,000) ×1000 = **8 per 1000 population**.

Natural increase rate = CBR − CDR = 24 − 8 = **16 per 1000**.

Population growth rate (%) = (16/1000) ×100 = **1.6% per year**.

If migration absent, annual population increase = 50,000 × 1.6% = **800 persons/year**.

TFR = 2.5, meaning average woman gives birth to 2.5 children.

Replacement level fertility ≈ 2.1.

TFR >2.1 indicates population will continue to grow.

High CBR with low CDR suggests early expanding stage of demographic transition.

Public health focus: family planning, maternal & child health services.

Q11

In a district with 10,000 live births during the year, there were 120 early neonatal deaths (0–7 days), 60 late neonatal deaths (8–28 days), 200 total infant deaths (<1 year), and 300 under-five deaths. Calculate Early Neonatal Mortality Rate (ENMR), Late Neonatal Mortality Rate (LNMR), Neonatal Mortality Rate (NMR), Infant Mortality Rate (IMR), and Under-Five Mortality Rate (U5MR).

Q11 Answer

Early Neonatal Mortality Rate = (120 / 10,000) ×1000 = **12 per 1000 live births**.

Late Neonatal Mortality Rate = (60 / 10,000) ×1000 = **6 per 1000 live births**.

Neonatal Mortality Rate = (120+60)/10,000 ×1000 = 180/10,000 ×1000 = **18 per 1000**.

Infant Mortality Rate = (200 / 10,000) ×1000 = **20 per 1000 live births**.

Under 5 Mortality Rate = (300 / 10,000) ×1000 = **30 per 1000 live births**.

Early neonatal deaths form majority of neonatal deaths (120/180).

High ENMR suggests problems in intrapartum and immediate newborn care.

IMR reflects overall socio-economic and health status.

U5MR includes neonatal + post-neonatal + 1–4 year deaths.

Strengthen ANC, skilled birth attendance, and immunization services.

Q12

Mid-year population of a city in 2001 = 10,20,000.

Total live births = 30,000

Total deaths = 12,000

Maternal deaths = 120

Infant deaths = 1600

Deaths within 28 days = 850

Still births = 280

Deaths within 1 week = 500

Q12 Answer

Crude Birth Rate (CBR) = (30,000 / 10,20,000) ×1000 = 29.4 per 1000.

Crude Death Rate (CDR) = (12,000 / 10,20,000) ×1000 = 11.8 per 1000.

Maternal Mortality Ratio (MMR) = (120 / 30,000) ×100,000 = 400 per 100,000 live births.

Infant Mortality Rate (IMR) = (1600 / 30,000) ×1000 = 53.3 per 1000 live births.

Neonatal Mortality Rate (NMR) = (850 / 30,000) ×1000 = 28.3 per 1000.

Early Neonatal Mortality Rate (ENMR) = (500 / 30,000) ×1000 = 16.7 per 1000.

Late Neonatal Mortality Rate (LNMR) = (850−500=350 / 30,000) ×1000 = 11.7 per 1000.

Still Birth Rate (SBR) = (280 / (30,000+280)) ×1000 ≈ 9.2 per 1000 total births.

Perinatal Mortality Rate (PMR) = (280+500)/(30,000+280) ×1000 ≈ 25.8 per 1000.

Natural growth rate ≈ (29.4−11.8) = 17.6 per 1000 population.

Nutrition

Q13

Comment of the following

- **What is supplementary action of protein?**
- **Jowar eating causes pellagra.**

Q13 Answer

Supplementary action = Combining two proteins improves biological value.

Example: Cereal + Pulse (Rice + Dal).

Cereals deficient in lysine.

Pulses deficient in methionine.

Together → complete amino acid profile.

Jawar (sorghum) rich in leucine.

Excess leucine interferes with tryptophan metabolism.

Tryptophan needed for niacin synthesis.

Leads to niacin deficiency.

Hence Jawar diet → Pellagra.

Q14

Calculate the B.M.I. of Mrs. Radha, with a weight of 62 kgs & height of 152 cm Specify grade of obesity. Please comment on the risk of mortality.

Q14 Answer

Weight = 62 kg

Height = 1.52 m

BMI = Weight in Kg / Height in m^2 = $62/(1.52^2)$

= 62/2.31

= 26.8 kg/m^2

Category = Overweight (Pre-obese).

More than 25 Pre obese, More than 30 Obese

Increased CVD risk

Advise 500 kcal/day deficit

150–300 min/week exercise

Target BMI <23 kg/m^2

Q15

A 50-year-old male with Type 2 Diabetes (weight 70 kg) attends PHC. Plan dietary management as per public health recommendations.

Q15 Answer

Total calories: 25 kcal/kg/day → 70×25 = **1750 kcal/day**.

Carbohydrates: 50–55% calories (~220–240 g/day), prefer low GI foods.

Protein: 1 g/kg/day → **70 g/day** (pulses, egg white, fish).

Fat: <30% calories; saturated fat <7%; avoid trans fats.

Fiber intake ≥25–40 g/day (whole grains, vegetables).

Restrict sugar to <5% of total calories (~20 g/day max).

Divide into 3 major + 2 small meals to prevent glucose spikes.

Salt <5 g/day to reduce CVD risk.

Avoid refined flour, sweetened beverages, fried foods.

Monitor fasting and postprandial glucose regularly.

Q16

A 60-year-old female (60 kg) diagnosed with Chronic Kidney Disease stage 3. Advise dietary management.

Q16 Answer

Total calories: 30–35 kcal/kg/day → **1800–2100 kcal/day**.

Protein restriction: 0.6–0.8 g/kg/day → **36–48 g/day**.

Prefer high biological value protein (egg white, milk).

Sodium restriction: <2 g sodium/day (~5 g salt).

Potassium restriction if high: limit banana, orange, coconut water.

Phosphorus restriction: avoid cola, processed cheese.

Fluid intake = 24-hr urine output + 500 ml.

Avoid high protein diet and NSAIDs.

Maintain HbA1c <7% if diabetic.

Regular monitoring of serum creatinine and electrolytes.

Q17

A 24-year-old primigravida (55 kg) in 2nd trimester visits ANC clinic. Plan dietary advice.

Q17 Answer

Additional calories: +350 kcal/day (2nd & 3rd trimester).

Total protein requirement: 1.1 g/kg/day (~60 g/day).

Iron: 27 mg/day; IFA tablet (60 mg elemental iron + 500 µg folic acid).

Folic acid: 400 µg/day in early pregnancy.

Calcium: 1200 mg/day (milk, ragi, supplements).

Iodine: 250 µg/day (iodized salt).

Eat 5 small balanced meals/day.

Include green leafy vegetables, pulses, eggs, fruits.

Avoid alcohol, tobacco, excess caffeine (>200 mg/day).

Target weight gain: 11–16 kg during pregnancy.

Thank you…