Lab: Incidence and Prevalence
HIV Trends in Zimbabwe

Read: Gregson, S., Garnett, G. P., Nyamukapa, C. A., Hallett, T. B., Lewis, J. J., Mason, P. R., . . . Anderson, R. M. (2006). HIV decline associated with behavior change in eastern Zimbabwe. *Science*, 311(5761), 664 - 666. (Note: The *Science* website has supporting material, including data from the baseline survey (1998–2000) and follow-up study (2001–2003). Two tables from this supplementary material are reproduced on pages 3 & 4 of this lab.)

Questions

1. The article states "Surveillance data indicate that HIV prevalence has declined in several countries in east Africa" (p. 664, c1). Which of the following statements about the dynamics of incidence and prevalence is (are) true, assuming that all other factors remain unchanged? Briefly *explain* each of your answers.

   a. Prevention of new HIV infections through increased condom use will tend to reduce HIV prevalence.
   b. Prolongation of HIV survival through more widespread use of antiretrovirals will tend to increase HIV prevalence.
   c. Outmigration of persons infected with HIV will tend to reduce HIV prevalence.
   d. Reduced HIV transmission from detection and treatment of other sexually transmitted diseases will tend to increase HIV prevalence.

2. "HIV prevalence in the 12 study sites was observed to decline over an average 3-year inter-survey interval from 23.0% to 20.5% . . ." (p. 664, c2). There were 9,454 individuals surveyed at baseline. How many persons with HIV were detected at the baseline survey? Show your work. {Note: P = A / N, where A represents the number of cases. Therefore, A = P × N.)

3. The article states that "The age pattern of change in HIV prevalence is consistent with one that occurs through the natural dynamics of an HIV epidemic, but the quantum of the declines recorded in younger age groups, over a relatively short 3-year period, and the concentration of the decline among people with secondary school education strongly suggested a contribution of sexual behavior change" (p. 664, c2-3). Which of the following comparisons of age-specific prevalences in Table S2 (page 3) gives the strongest indication for an influence of HIV-related mortality or migration (outflow) on prevalence rather than (or in additional to) lower incidence through behavior change? Choose the best answer and provide a brief explanation of support.

   a. 24-26 year-old men at baseline compared to 24-26 year-old men at follow-up

b. 24-26 year-old men at baseline compared to 27-29 year-old men at follow-up

c. 30-32 year-old women at baseline compared to 30-32 year-old women at follow-up

d. 30-32 year-old women at baseline compared to 33-35 year-old women at follow-up

4. "Surveillance data from local antenatal clinic attendees indicated modest declines in HIV prevalence overall (21.1% to 19.2%) and at young ages (fig. S1)." (p. 664, c3). Describe at least two possible changes in sexual behavior that would lead to a reduction in HIV transmissions in the population but would not, at least initially, lead to a reduction in HIV incidence and prevalence in antenatal clinic attendees?

5. The article states "The contributions of mortality and new HIV infections to changes in HIV prevalence observed in the closed cohort are shown in Fig. 2 and table S4" (p.664, c3; reproduced on page 4). The article goes on to say "HIV incidence was highest in men aged 20 to 44 years and women aged 15 to 29 years." Use the data in table S4 to calculate the incidence rate for women aged 15 to 29 years. Show the calculation (to 3 significant digits) and state the result in one sentence.
[Incidence counts and person-time are shown within each age strata.]

6. The article reports that the relative risk of death for HIV-infected men (compared to HIV-negative men) was 11.3 (p. 664, c3, para. 3). Use the data in table S4 to show the calculation of this relative risk. Also, state the meaning of this relative risk in one sentence. [Note that the first line in Table S4 is for 17-54-year old men.]

7. The HIV incidence rate for 15-17 year-old women was 1.29 per 100 women-years (table S4). Use this incidence rate to estimate the 3-year HIV incidence proportion (risk) in this sub-cohort. Show the calculation, and state the result in one sentence. [When the incidence is low, incidence proportion ≈ incidence rate × time.]

Table S2 from the online source. Comparison of HIV prevalence in two periods by sex and age.

Population sub-group	1998-2000		2001-2003		Test for difference		
	%	n	%	n	OR*	(95% CI)	p
Overall	23.0	9454	20.5	7019	0.87	(0.80-0.95)	0.001
Males	19.5	4320	18.2	3047	0.84	(0.74-0.96)	0.010
Females	25.9	5134	22.3	3972	0.88	(0.79-0.98)	0.015
Males							
17	0.5	376	0.5	200	1.02	(0.09-12.02)	0.990
18-20	2.3	907	0.8	644	0.38	(0.14-1.04)	0.059
21-23	7.2	640	4.7	424	0.66	(0.38-1.14)	0.136
24-26	22.0	610	13.8	347	0.58	(0.40-0.84)	0.004
27-29	28.2	365	25.5	330	0.87	(0.61-1.23)	0.420
30-32	45.9	283	32.2	227	0.54	(0.37-0.78)	0.001
33-35	47.9	240	47.5	158	1.07	(0.70-1.64)	0.745
36-38	38.6	215	45.6	158	1.33	(0.83-2.03)	0.183
39-41	39.7	184	35.0	140	0.82	(0.51-1.32)	0.414
42-44	28.1	135	37.3	126	1.58	(0.93-2.71)	0.094
45-47	33.6	122	21.5	93	0.53	(0.28-0.99)	0.047
48-50	28.8	104	34.9	106	1.31	(0.72-2.38)	0.373
51-54	18.7	139	25.5	94	1.74	(0.89-3.38)	0.104
Females							
15-17	4.0	755	1.4	801	0.39	(0.19-0.79)	0.010
18-20	12.6	716	6.7	536	0.53	(0.35-0.80)	0.002
21-23	27.9	613	19.9	396	0.61	(0.45-0.84)	0.002
24-26	39.1	555	30.9	349	0.69	(0.51-0.92)	0.012
27-29	41.4	473	35.3	346	0.77	(0.57-1.03)	0.081
30-32	41.6	401	43.8	347	1.19	(0.88-1.61)	0.261
33-35	36.6	402	36.2	282	0.96	(0.69-1.33)	0.805
36-38	32.2	404	32.4	296	1.04	(0.75-1.45)	0.801
39-41	29.2	366	28.9	325	0.99	(0.71-1.39)	0.958
42-44	16.5	449	29.3	294	2.09	(1.46-3.00)	<0.001

* Adjusted for three-year age-group, location and whether lived in current location for at least three years

Table S2:   **Comparison of HIV prevalence in 1998-2000 versus 2001-2003 by sex and age-group**

Table S4 from the online source. Changes in prevalence in a cohort of 9454 adults.

Age at baseline	HIV prevalence % (95% CI)		Mortality/100 pyar* (number of events/pyar)		HIV incidence /100 pyar	Baseline subjects	Follow -up**
	1998-2000	2001-2003	HIV+	HIV-	(events/pyar)	N	%
Males							
17-54	19.5 (18.3-20.7)	23.9 (22.1-25.7)	6.87 (130/1893.4)	0.61 (48/7839.7)	1.87 (99/5295.3)	4,320	54.1
17	0.5 (0.1-1.9)	1.6 (0.3-4.7)	0.00 (0/4.7)	0.61 (5/824.5)	0.37 (2/543.9)	376	49.6
18-20	2,3 (1.4-3.5)	5,3 (3.2-8.2)	0.00 (0/45.5)	0.38 (7/1826.1)	1.06 (11/1036.6)	907	39.6
21-23	7.2 (5.3-9.5)	16.8 (12.7-21.6)	2.92 (3/102.6)	0.39 (5/1281.2)	3.22 (25/777.1)	640	46.4
24-26	22.0 (18.7-25.5)	27.9 (23.1-33.2)	4.36 (13/298.4)	0.83 (9/1087.3)	2.89 (21/727.8)	610	53.9
27-29	28.2 (23.7-33.1)	30.1 (23.6-37.2)	2.72 (6/220.3)	1.01 (6/595.7)	1.98 (8/403.2)	365	52.7
30-34	47.2 (42.5-52.1)	49.0 (42.5-55.5)	5.62 (26/462.6)	0.38 (2/530.6)	1.82 (7/384.0)	436	59.1
35-44	37.5 (33.7-41.5)	35.0 (30.3-40.0)	8.81 (48/544.7)	0.79 (8/1006.6)	2.15 (18/836.1)	621	73.5
45-54	26.6 (22.1-31.4)	22.9 (17.8-28.6)	15.84 (34/214.7)	0.87 (6/687.7)	1.19 (7/586.7)	365	76.9
Females							
15-44	25.9 (24.7-27.1)	27.6 (26.1-29.2)	5.16 (161/3121.5)	0.54 (51/9443.0)	1.67 (122/7314.1)	5,134	66.3
15-17	4,0 (2.7-5.6)	7,7 (5.1-11.0)	1.59 (1/63.0)	0.63 (10/1590.3)	1.29 (13/1008.6)	755	47.4
18-20	12,4 (10.1-15.1)	18.4 (14.5-22.9)	4.85 (9/185.7)	0.64 (9/1406.5)	2.83 (25/884.6)	716	49.3
21-23	27.9 (24.4-31.6)	33.0 (27.9-38.5)	4.32 (16/370.1)	0.20 (2/1002.7)	2.67 (18/673.6)	613	53.4
24-26	39.1 (35.0-43.3)	37.8 (32.6-43.2)	4.30 (21/488.9)	0.24 (2/846.8)	2.57 (17/662.1)	555	63.9
27-29	41.4 (37.0-46.0)	41.9 (36.4-47.6)	5.21 (24/460.6)	0.42 (3/722.2)	3.26 (19/582.2)	473	70.9
30-34	40.5 (36.7-44.4)	36.1 (31.7-40.7)	4.94 (31/627.5)	0.48 (5/1034.7)	0.78 (7/894.8)	651	74.3
35-44	26.4 (24.1-28.8)	24.6 (22.1-27.2)	6.37 (59/925.7)	0.70 (20/2839.7)	0.88 (23/2608.2)	1,371	88.0

pyar=person-years at risk.

* By HIV infection status at baseline interview.

** Amongst baseline respondents not known to have died.

Table S4: Components of change in HIV prevalence in a closed cohort of 9,454 adults followed for 3 years