340.721 Epidemiologic Inference in Public Health I

ACTIVITY:
Measures of Disease Frequency

Activities provide experience in applying epidemiologic methods, interpreting findings, and drawing inferences. Activities consist of a series of short answer questions and are held on Mondays or Wednesdays (8:30-10:00 am) per the course syllabus. Room and Group assignments are posted in CoursePlus. Attendance will be taken at the Activities and students are expected to attend and participate in the Activities.

Expectations for the Activities

1. *Individually, read the Activity and attempt to answer all the questions.*
2. *"Meet" with your group and discuss challenging concepts, questions and compare answers*
3. *Formulate group consensus of answers if possible (sometimes there is no right or wrong answer!)*
4. *Post questions to the Discussion Forum if there is disagreement in your group or if there is need for a clarification to answer the question.*
5. *If your group is presenting at the LiveTalk, review your answers with a TA by posting to the Discussion Forum in your Group's Category/Topic by 12PM EST of the Tuesday preceding the LiveTalk*

I. Comparison of Rates across Populations

Question 1

The table below summarizes results from the PRE-Activity Questions. Fill in the missing values.

Crude and Age-Adjusted* Breast Cancer Incidence Rates by Race

	White Females	Black Females	Ratio
Crude Rates			
Age-Adjusted Rates			

*Using direct standardization methods using the total population of white and black females as the standard population.

a. The ratio of crude breast cancer incidence rates comparing white women to black women is called the relative risk. Interpret that relative risk. Discuss possible reasons for the difference in crude breast cancer incidence rates.

b. Interpret the ratio of age-adjusted breast cancer incidence rates comparing white women to black women.

Question 2

How do the crude relative risk and the age-adjusted relative risk compare? Do they differ? If so, how do you explain the difference?

(HINT: Look again at the information in Table 3 from the PRE-Activity Questions.)

TABLE 3:

Invasive Breast Cancer Incidence Rates in White and Black Females by Age, United States, SEER, 1998-2002

	White Females				Black Females			
Age Group (years)	Average Number of Cases per year[1]	Population (In 1,000's)[2]	Percent of Total Population	Average annual incidence rate per 100,000 women at risk	Average Number of Cases per year[3]	Population (In 1,000's)[4]	Percent of Total Population	Average annual incidence rate per 100,000 women at risk
0 – 19	0	30,057	26	0	0	6,147	33	0
20 – 29	118	14,081	12	0.8	30	2,722	15	1.1
30 – 39	1,525	16,848	15	9.0	281	2,917	16	9.6
40 – 49	5,630	17,627	15	31.9	795	2,737	15	29.0
50 – 59	8,081	13,334	12	60.6	872	1,740	9	50.1
60 – 69	5,488	9,123	8	60.2	792	1,156	6	68.5
70 – 79	8,300	8,137	7	102.0	615	778	4	79.0
80+	5,023	5,527	5	90.9	316	448	2	70.5
All ages	34,165	114,734	100		3,701	18,645	100	
Average annual incidence rate per 100,000 women at risk (from Table 2):								

[1] SEER. Cancer Statistics Review 1975-2002: Table IV-3. [Number of cases accumulated over 5 years/5 years]
[2] Census P25-1130, Table 2: Projections of the Population by Age, Sex, Race and Hispanic Origin for the United States. As of July 1, 2000. [Midpoint population used to approximate average annual population]

Question 3

Why adjust? [HINT: which incidence rates (crude or adjusted) are more appropriate for inter-population comparisons – why?] Is it ever inappropriate to adjust? In what circumstances, if any, might you choose to present crude (unadjusted) rates?

II. Choice of Standard Population

In the Assignment, we created a hypothetical standard population by combining (summing) the populations of white and black females.

Other standard populations can be used for direct adjustment. The choice of a standard population for the age adjustment is somewhat arbitrary, although it is usually based on previous studies and desired comparison groups.

The following table contains standard populations used frequently in computing age-adjusted rates:

Age Group (years)	1940 US Standard Million[3] (%)	1970 US Standard Million[5] (%)	2000 US Standard Million[5] (%)	WHO World Standard Million[4] (%)
0 – 19	344,086 (34%)	378,769 (38%)	286,869 (29%)	346,150 (34%)
20 – 29	172,284 (17%)	146,881 (15%)	131,007 (13%)	161,450 (16%)
30 – 39	150,284 (15%)	110,905 (11%)	151,806 (15%)	147,550 (15%)
40 – 49	129,439 (13%)	118,580 (12%)	153,969 (15%)	126,250 (13%)
50 – 59	99,497 (10%)	103,720 (10%)	111,170 (11%)	99,150 (10%)
60 – 69	64,822 (6%)	76,809 (8%)	73,057 (7%)	66,750 (7%)
70 – 79	30,937 (3%)	45,660 (5%)	58,772 (6%)	37,250 (4%)
80+	8,651 (1%)	18,676 (2%)	33,350 (3%)	15,450 (1%)
Total	1,000,000	1,000,000	1,000,000	1,000,000

[3] http://www.seer.cancer.gov/stdpopulations/stdpop.19ages.html

[4] WHO World Standard Population Distribution, based on World Average population between 2000 – 2025. Available at: http://w3.whosea.org/healthreport/pdf/paper31.pdf

Question 4

Compare the WHO World Standard Population (last column in Table 4) to the Standard Population in Table 3. How do they compare? Given what you learned about direct standardization in the Assignment, how do you expect the age-adjusted breast cancer incidence rates that were adjusted using the combined population (calculated as part of the Assignment) to compare to the age-adjusted breast cancer incidence rates that are adjusted using the WHO World Standard Population? Why?

(To make the comparison easier, data on the two standard populations is summarized for you in the table below).

Age Group (years)	Combined Population Standard (In 1,000's) (%)	WHO World Standard (Million) (%)
0 – 19	36,204 (27%)	346,150 (34%)
20 – 29	16,803 (13%)	161,450 (16%)
30 – 39	19,765 (15%)	147,550 (15%)
40 – 49	20,364 (15%)	126,250 (13%)
50 – 59	15,074 (11%)	99,150 (10%)
60 – 69	10,279 (8%)	66,750 (7%)
70 – 79	8,915 (7%)	37,250 (4%)
80+	5,975 (4%)	15,450 (1%)
Total	133,379	1,000,000

(For more practice calculating rates, or to help better understand how the rates would compare, see Table 5 at the end of this Activity – it's not required for the Activity but is fun!)

Question 5

What issues should one consider in selecting a standard population?

III. Indirect Standardization

Question 6

Suppose that the SMR for mortality from all causes among former mercury miners is 1.40. Interpret this SMR.

Question 7

Why calculate an SMR? When might you choose to calculate an SMR instead of use direct adjustment? (HINT: Consider the real example in the following abstract.)

Statin drugs and risk of advanced prostate cancer

Platz, EA, Leitzmann MF, Visvanathan K, et al. J Natl Cancer Inst. 2006 Dec 20;98(24):1819-25.

BACKGROUND:

Statins are commonly used cholesterol-lowering drugs that have proapoptotic and antimetastatic activities that could affect cancer risk or progression. Results from previous epidemiologic studies of the association between statin use and cancer have been inconsistent. We investigated the association of statin use with total and advanced prostate cancer, the latter being the most important endpoint to prevent.

METHODS:

We analyzed data from an ongoing prospective cohort study of 34,989 US male health professionals who were cancer free in 1990 and were followed to 2002. Participants reported their use of cholesterol-lowering drugs on biennial questionnaires. Prostate cancer diagnosis was confirmed by medical record review. Multivariable-adjusted relative risks (RRs) were estimated from Cox proportional hazards regression models. Statistical tests were two-sided.

Table 3. Relative risk of prostate cancer by duration of use of statin drugs among 34 989 male health professionals, 1990–2002

Prostate cancer	Duration of use of statin drugs*			P_{trend}‡
	Never†	<5 y	≥5 y	
Total				
No. of cases	2212	241	126	
Person-years at risk	329 357	29 159	18 423	
$RR_{age\text{-}adjusted}$ (95% CI)§	1.00 (reference)	1.02 (0.89 to 1.17)	0.83 (0.69 to 1.00)	.30
$RR_{multivariable}$‖ (95% CI)	1.00 (reference)	1.04 (0.91 to 1.19)	0.85 (0.71 to 1.03)	.49
Organ-confined				
No. of cases	1439	174	101	
Person-years at risk	330 100	29 227	18 448	
$RR_{age\text{-}adjusted}$ (95% CI)	1.00 (reference)	1.04 (0.89 to 1.23)	0.85 (0.69 to 1.04)	.59
$RR_{multivariable}$‖ (95% CI)	1.00 (reference)	1.06 (0.90 to 1.25)	0.87 (0.70 to 1.07)	.82
Advanced				
No. of cases	298	15	3	
Person-years at risk	331 092	29 367	18 535	
$RR_{age\text{-}adjusted}$ (95% CI)	1.00 (reference)	0.57 (0.34 to 0.96)	0.25 (0.08 to 0.78)	.002
$RR_{multivariable}$‖ (95% CI)	1.00 (reference)	0.60 (0.35 to 1.03)	0.26 (0.08 to 0.83)	.003
Metastatic or fatal				
No. of cases	223	10	0¶	
Person-years at risk	331 161	29 372	18 537	
$RR_{age\text{-}adjusted}$ (95% CI)	1.00 (reference)	0.49 (0.26 to 0.93)	0.00 (–)	.001
$RR_{multivariable}$‖ (95% CI)	1.00 (reference)	0.52 (0.27 to 1.00)	0.00 (–)	.002

*Also includes users of nonstatin cholesterol-lowering drugs.

†The reference group is men who never used statin drugs. This reference group differs from that in Table 2, in which men who were not currently using statin drugs are the reference group.

‡From a Wald test of the β coefficient for duration of use.

§RR = relative risk; CI = confidence interval.

‖Relative risk adjusted for age; body mass index at age 21; height; pack-years of cigarette smoking in the previous decade; first-degree family history of prostate cancer; major ancestry; diabetes mellitus; vasectomy; vigorous physical activity; use of aspirin; intakes of total energy, calcium, fructose, α-linolenic acid, tomato sauce, red meat, fish, and alcohol; intake of supplemental zinc; and high intake of vitamin E.

¶The expected number of cases based on the age- and time period–specific incidence rates in the never users is 8.0.

Question 8

Complete the following table, comparing the direct and indirect methods of adjustment.

	Direct Adjustment	Indirect Adjustment
From what population are the age-specific incidence rates drawn?		
From what population are the age-specific weights drawn?		
What useful comparisons can be made with each method of standardization?		
Under what circumstances are each method of adjustment applied?		
What is an advantage of each method of adjustment?		
What is a limitation of each method of adjustment?		

III. More Practice! (Optional – not required)

Isn't this fun? Want more practice? Need to prove to yourself how the age-adjusted rates compare when using the combined standard population vs. using the WHO standard population? Using the data from Table 5 (below), calculate age-adjusted incidence rates for both racial groups using **the WHO World Standard Population** as the standard population.

TABLE 5:
Age-Adjustment of Invasive Breast Cancer Incidence in White and Black Females, United States, SEER, 1998-2002 Using WHO World Standard Population

		White Females		Black Females	
Age Group (years)	***WHO World Standard Population***	Average annual incidence per 100,000 women at risk	Expected Number of Cases for White Females	Average annual incidence per 100,000 women at risk	Expected Number of Cases for Black Females
0 – 19	346,150 (34%)	0		0	
20 – 29	161,450 (16%)	0.8	1.29	1.1	1.78
30 – 39	147,550 (15%)	9.0		9.6	
40 – 49	126,250 (13%)	31.9		29.0	
50 – 59	99,150 (10%)	60.6		50.1	
60 – 69	66,750 (7%)	60.2		68.5	
70 – 79	37,250 (4%)	102.0		79.0	
80+	15,450 (1%)	90.9		70.6	
Total:	1,000,000				
Age-adjusted annual incidence rate per 100,000 population:					