

## Larger Variance on Top

Notice that this example labels the larger of the sample variances as the numerator and the smaller as the denominator. This is the easiest way to proceed and will always work so long as the correct degrees of freedom are kept with the correct sample variance.

# **Module 26: Confidence Intervals and Hypothesis Tests for Variances for Two Samples**

This module discusses confidence intervals and hypothesis tests for variances for the two sample situation.

## The Situation

To test hypotheses that two population variances,  $\sigma_1^2$  and  $\sigma_2^2$ , are equal, we use the F statistic below:

$$\frac{s_1^2}{\sigma_1^2} / \frac{s_2^2}{\sigma_2^2} = F(n_1 - 1, n_2 - 1)$$

The hypothesis that the two variances are equal, ie, that  $\sigma_1^2 = \sigma_2^2$ , can be expressed as :

$$H_0 : \sigma_1^2 / \sigma_2^2 = 1,$$

vs

$$H_1 : \sigma_1^2 / \sigma_2^2 \neq 1.$$

If we assume that the null hypothesis,  $H_0: \sigma_1^2/\sigma_2^2 = 1$ , is true, then we can use

$$F = s_1^2/s_2^2$$

for the test. We reject  $H_0: \sigma_1^2/\sigma_2^2 = 1$  if the value we calculate for  $F$  is not between

$$F_{\alpha/2}(n_1-1, n_2-1), \text{ and}$$

$$F_{1-\alpha/2}(n_1-1, n_2-1).$$

## Example

Two independent random samples of urinary histidine excretions yielded:

$$n_1 = 5$$

$$n_2 = 10$$

$$\bar{x}_1 = 300.8$$

$$\bar{x}_2 = 153.2$$

$$s_1^2 = 15,291.7$$

$$s_2^2 = 2,484.6$$

- |                                          |                                                                                       |
|------------------------------------------|---------------------------------------------------------------------------------------|
| 1. <i>The hypothesis:</i>                | $H_0 : \sigma_1^2 / \sigma_2^2 = 1,$<br>vs<br>$H_1 : \sigma_1^2 / \sigma_2^2 \neq 1.$ |
| 2. <i>The assumptions:</i>               | Independent samples,<br>normal distributions                                          |
| 3. <i>The <math>\alpha</math>-level:</i> | $\alpha = 0.05$                                                                       |
| 4. <i>The test statistic:</i>            | $F = s_1^2 / s_2^2$                                                                   |
| 5. <i>The critical region:</i>           | Reject if $F > F_{0.975}(4,9) = 4.72$                                                 |
| 6. <i>The result:</i>                    | $F = 15,291.7 / 2,484.6 = 6.15$                                                       |
| 7. <i>The conclusion:</i>                | Reject $H_0: \sigma_1^2 / \sigma_2^2 = 1$                                             |

# Prediction of Depressive Distress in a Community Sample of Women: The Role of Sexual Orientation

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Recent data consistently show that rates of depression among women are higher in high as opposed to low SES.<sup>1-3</sup> Reported rates of lifetime risk for depression among women in the general US population range between 10% and 25%, with point prevalence rates in community samples ranging from 5% to 15%.<sup>4-6</sup> Risk factors for depression include genetic, developmental, and hormonal factors,<sup>7,8</sup> family history,<sup>9,10</sup> previous depressive episodes,<sup>11</sup> chronic general medical conditions,<sup>12</sup> personality style or coping strategies,<sup>13</sup> negative life events associated with poverty,<sup>14</sup> psychosocial events or stressors,<sup>15</sup> and substance dependence.<sup>16</sup>

Nonstressor factors suggest that risk factors unique to women contribute substantially to sex differences in depression.<sup>17</sup> These factors include women's roles and status,<sup>18</sup> female sex role socialization,<sup>19,20</sup> presence of dependent children,<sup>21</sup> lower socioeconomic status relative to men,<sup>22</sup> and victimization against men (e.g., childhood sexual abuse,<sup>23</sup> physical or sexual violence, battering by an intimate partner, incest and incestuous rape, sexual harassment<sup>24-26</sup>). Although considerable knowledge about the sex correlates of depression in the general population has been amassed,<sup>27,28</sup> the applicability of this research to lesbians is unknown.<sup>29-31</sup>

## LESBIANS AND DEPRESSION

Despite a paucity of data on depression among lesbians, this group generally is thought to be at greater risk for depression than are heterosexual women.<sup>32-34</sup> In addition to risk factors shared with heterosexual women (e.g., relationship status and violence), chronic or intermittent of one substance or substance pair, perceived lack of or low social support from friends and family, lesbians are believed to be affected by additional unique risk factors, including the coming out process, level of disclosure of sexual orientation, dis-

**Objectives.** This study compared factors known or hypothesized to influence depressive symptomatology in a community sample of lesbians and heterosexual women.

**Methods.** Data were collected as a cross-sectional survey of lesbians' physical and mental health.

**Results.** Findings confirmed earlier reports suggesting that lesbians' life events include an elevated amount of abuse, and political stress, and coping styles are risk factors for depressive distress. However, findings of higher rates of medical history and of more risk factors for depressive distress among lesbians suggest that risk for depression may differ among lesbians and heterosexual women.

**Conclusions.** Sexual orientation may represent an important but poorly understood risk factor for depressive distress, as well as medical history and behavior. (Am J Public Health. 2003;93:1007-1011.)

continued experience, and chronic exposure associated with being a member of a unique level minority group.<sup>35-38</sup>

The aims of the present study were to (1) compare indicators of depressive distress among lesbians and a demographically matched sample of heterosexual women and (2) assess the relevance of several hypothesized or known predictors with depressive distress in lesbians and heterosexual women. Such information is important in understanding risk factors for depression among lesbians and for identifying interventions that address these risks.

## METHODS

### Study Design and Data Collection

Data were collected as part of a study conducted by the Chicago Lesbian Community Care for Project D.A.U.M. (1996). The study began in Chicago and was replicated in Minneapolis-St Paul, MN, and New York City during 1998 through 2000. The goal was to gather information on the general health status as well as behavioral and environmental health risks of lesbians. The study was designed to obtain a diverse sample of women who relate directly or indirectly to health with women.

As a means of reaching the broadest possible range of women, the survey instrument

was distributed in a variety of formal and informal health venues (e.g., health fairs, discussion groups, bookstores, coffee and farm tea houses, coffee houses, college social, support, therapeutic, medical, and political groups and organizations). In addition, lesbian participants were recruited through numerous informal social networks. Informed and informed consent were used to collect survey data.

Each lesbian who completed the questionnaire was instructed to give a second, randomized copy to a female friend, acquaintance, or colleague whose work role included student, homemaker, or retired was as similar as possible to her own. In the Chicago survey, we did not specify that the "randomized copy" selected for heterosexual friends be heterosexual friends to sample community of only about half as many heterosexual women as lesbians. Instructions provided to the Minnesota and New York surveys specified that the "randomized counterpart" be a woman whose the lesbian knew or presumed to be heterosexual.

Eligible respondents at the other 2 sites, for 1-year respondents in New York City were given a small incentive of \$15 for completing the survey and for providing a randomized counterpart. Lesbian and nonlesbian counterpart pairs were given \$20 for completing the survey. In addition, representatives of lesbian health business groups were invited to act as

**TABLE 2—Study Predictive Variables, by Gender Orientation**

	Lesbians (n = 170)	Heterosexuals (n = 270)
<b>Dependent variables (No. %)</b>		
Ever received therapy	426 (249) <sup>a</sup>	517 (193)
Ever sought for depression	388 (228)	500 (187)
Current situation	380 (224) <sup>a</sup>	508 (189)
Never attempted	93 (55) <sup>b</sup>	111 (41)
<b>Predictive variables</b>		
Childhood sexual abuse (No. %)	101 (60) <sup>a</sup>	111 (41)
Parent abuse (No. %)	140 (83)	111 (41)
History of violence (heterosexual (No. %)	161 (95)	170 (63)
History of violence (lesbian (No. %)	207 (122)	207 (77)
Child abuse index score (SD)	31 (1.3)	17 (1.0)
Parent coping strategies score (SD)	1.3 (1.0)	1.5 (1.0)

Note. Numbers in each percentage were based on a history of receiving therapy (score on the 100 range from 0–100 with higher scores reflecting both greater support and severity of the concern). Parent coping strategies score range from 0–10 with higher scores representing more frequent use of a variety of problem coping strategies in response to stress.

<sup>a</sup>p < .05. <sup>b</sup>p < .001.

had “received therapy or counseling for an emotional or mental health problem” at some point in their life (Table 2). This rate was significantly higher than that among both bisexual women (50%;  $\chi^2 = 4.3$ , *p* = .03). However, rates of current therapy or counseling did not differ for lesbians (43%) and heterosexual women (45%;  $\chi^2 = 2.0$ , not significant).

Treatment for depression (either personal or of a friend) (43%) and heterosexual women (43%) reported that they had sought therapy or counseling for depression. Given the percent of lesbians and 20% of bisexual and women reported that they had been prescribed medications for a mental or emotional problem. Among those who had received medications, 50% of lesbians and 75% of heterosexual women reported taking an antidepressant medication at some point. The majority of women who reported seeking help for sadness or depression (83%) also reported receiving antidepressants. More than half of the total sample of lesbians (61%) and heterosexual women (63%) reported at least one of these 2 indicators of past treatment for depression.

Current situation and coping strategies. Significant differences were found between lesbian and heterosexual women in regard to reports of whether they had seriously considered

committing suicide and whether they had actually attempted suicide in the past. Fifty-one percent of lesbians and 34% of heterosexual women reported seriously considering suicide at some point in the past (7% difference). Most notable although among women in this study is a gap between the ages of 15 and 25 years. More than twice as many lesbians as heterosexual women in this age group reported serious thoughts (7% difference).

**Predictors of Depressive Distress**

*Physical and sexual abuse.* Although lesbians and heterosexual women were equally likely to report that they had been victims of nonsexual physical violence (47% and 41%, respectively), significantly more lesbians (43%) than heterosexual women (43%) reported experiencing childhood sexual abuse (7% difference). Because our analysis included only women who had experienced sexual abuse, the ages of 15 years (ages were 41% and 41%, respectively, of all lesbians and heterosexual women who reported any nonsexual and sexual abuse) were probably underrepresented. The number of lesbians and heterosexual women who seriously experienced childhood sexual abuse.

*Child abuse.* Overall rates were on the global stress index were in the lower range and did not differ according to sexual orientation. More stress index scores were of (SD) =

7.0 for heterosexual women and 6.0 (SD) = 6.6 for lesbians ( $t_{(440)} = 0.97$ , *p* = .33).

*Parental stress.* No differences were found between the lesbians and heterosexual women in terms of level of perceived stress. This measure of distress (which used heterosexual women (43%) reported moderate to extreme levels of perceived stress ( $t_{(270)} = 1.1$ , *p* = .26). The only statistically significant difference in number of stress for lesbians and heterosexual women involved children ( $t_{(270)} = 5.0$ , *p* < .001) and sexual activity ( $t_{(270)} = 7.0$ , *p* < .001), with heterosexual women rated child stress as moderately or extremely elevated, and more lesbians rated sexual activity as moderately or extremely elevated.

*Perceived support.* Differences were also noted between lesbians and heterosexual women in terms of perceived lack of support. More heterosexual women (31%) than lesbians (23%) reported an absence of social support ( $t_{(270)} = 5.5$ , *p* < .001).

*Coping strategies and response to stress.*

Overall, use of problem coping strategies was low among both lesbians and heterosexual women (mean of 2.4 on the 10-point measure, SD = 1.0). Whereas neither sex reliably had percentages of lesbians (7%) and heterosexual women (10%) reported taking or considering not feelings during times of stress, lesbians were more likely to report never using talking as a coping strategy (43% vs 41%,  $\chi^2 = 0.0$ , *p* < .10).

Moreover, fewer lesbians (10%) than heterosexual women (13%) reported always something has when they were stressed ( $t_{(270)} = 5.4$ , *p* < .001) or being nervous as a coping strategy (43% vs 45%). Only 7% of both sexes and 6% of heterosexuals reported overwhelming situations often. A higher percentage of heterosexual women (7%) than lesbians (10%) reported becoming overly concerned in response to stress, but this difference was not statistically significant ( $t_{(270)} = 4.0$ , *p* < .001).

**Multivariate Predictive Models of Depressive Distress**

Only variables significantly related to at least 1 of the indicators of depressive distress in the bivariate analysis were included in the multivariate analysis. Demographic characteristics entered included education level (0 =



**TABLE 3—Study Predictor Variables, by Sexual Orientation**

	Lesbians (n = 553)	Heterosexuals (n = 278)
<b>Dependent variables, No. (%)</b>		
Ever received therapy	429 (78)**	157 (56)
Ever treated for depression	284 (50)	109 (39)
Suicidal ideation	280 (51)**	104 (38)
Suicide attempts	91 (22)*	22 (8)
<b>Predictor variables</b>		
Childhood sexual abuse, No. (%)	108 (30)**	45 (16)
Physical abuse, No. (%)	340 (61)	114 (41)
Widowed or widower of own kind, No. (%)	401 (65)	229 (83)
Emotionality in response to stress (anxiousness or anger), No. (%)	267 (60%)	207 (75%)
Global stress index, mean (SD)	26 (6.8)	17 (7.0)
Positive coping strategies, mean (SD)	3.3 (1.8)	3.6 (1.9)

Note. Numbers on which percentages were based vary because of missing data on some variables. Scores on the GSI range from 0–54, with higher scores reflecting both greater number and severity of life stressors. Positive coping strategies scores range from 0–12, with higher scores representing more frequent use of a variety of positive coping strategies in response to stress.

\* $P < .05$ ; \*\* $P < .001$ .

## The Question

Table 3 indicates that the mean Global Stress Index for Lesbians is 16 with  $SD = 6.8$  and for Heterosexual women is 17 with  $SD = 7.0$ . Do the populations from which these samples were taken have the same variance?

# Testing the Hypothesis

Sample 1: Heterosexual sample

Sample 2: Lesbian sample

1. *The hypothesis:*  $H_0 : \sigma_1^2 / \sigma_2^2 = 1,$

vs

$H_1 : \sigma_1^2 / \sigma_2^2 \neq 1.$

2. *The assumptions:* Independence, normal distribution

3. *The  $\alpha$ -level:*  $\alpha = 0.05$

4. *The test statistic:*  $F = s_1^2/s_2^2$

$$n_1 = 279, s_1^2 = 49.0 \quad n_2 = 550, s_2^2 = 46.2$$

5. *The critical region:* Reject if  $F > F_{0.975}(278, 549) \sim 1.20$

6. *The result:*  $F = 49.0/46.2 = 1.06$

7. *The conclusion:* Accept  $H_0: \sigma_1^2/\sigma_2^2 = 1$