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, i.e., that $\sigma_1^2 = \sigma_2^2$, can be expressed as:

$$H_0 : \frac{\sigma_1^2}{\sigma_2^2} = 1,$$

vs

$$H_1 : \frac{\sigma_1^2}{\sigma_2^2} \neq 1.$$
If we assume that the null hypothesis, $H_0: \sigma_1^2/\sigma_2^2 = 1$, is true, then we can use

$$F = \frac{s_1^2}{s_2^2}$$

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:

\[ n_1 = 5 \]
\[ \overline{x}_1 = 300.8 \]
\[ s_1^2 = 15,291.7 \]
\[ n_2 = 10 \]
\[ \overline{x}_2 = 153.2 \]
\[ s_2^2 = 2,484.6 \]
1. The hypothesis:

\[ H_0 : \frac{\sigma_1^2}{\sigma_2^2} = 1, \]

vs

\[ H_1 : \frac{\sigma_1^2}{\sigma_2^2} \neq 1. \]

2. The assumptions:

Independent samples,
normal distributions

3. The \( \alpha \)-level:

\( \alpha = 0.05 \)

4. The test statistic:

\( F = \frac{s_1^2}{s_2^2} \)

5. The critical region:

Reject if \( F > F_{0.95}(4,9) = 4.72 \)

6. The result:

\( F = \frac{15,291.7}{2,484.6} = 6.15 \)

7. The conclusion:

Reject \( H_0 : \frac{\sigma_1^2}{\sigma_2^2} = 1 \)
Prediction of Depressive Distress in a Community Sample of Women: The Role of Sexual Orientation

Alicia R. Matthews, PhD, Karen L. Hughes, PhD, RN, Brenda Joseph, PhD, Lisa A. Santoro, PhD, and Roberta Caplan, MS, MPH

Studies have consistently shown that rates of depression among women are twice as high as those among men, when reported rates of lifetime risk for depression among women in the general US population range between 30% and 35%, with point prevalence rates in community samples ranging from 5% to 10%. Risk factors for depression include genetic, biological, and hormonal factors (2), family history (2), previous depressive episodes (2), chronic physical medical conditions (3), personality style or coping strategies (4), negative life events associated with poverty (5), interpersonal stress or victimization (6), and substance dependence (7).

Numerous studies suggest that risk factors unique to women contribute substantially to sex differences in depression. These factors include women's roles and status, female sex hormones, and lower socioeconomic status (8). In particular, lower socioeconomic status and estradiol levels are linked to increased risk of depressive symptoms (9). Two factors that have been investigated are (1) the role of depression in women's lives and (2) the relationship between depressive symptoms and lower estradiol levels. Although considerable knowledge about the etiology of depression exists, the etiology of depression in women remains largely unknown (10). The aim of the present study was to (1) compare indicators of depressive distress among women and a demographically similar group of men; (2) examine the impact of certain health conditions, including medical conditions and mental health conditions, on depression; (3) examine the relationships between selected health conditions and depression; and (4) examine the association between depression and lower estradiol levels.

The study was conducted in a community sample of women and men aged 40 and older. The sample was selected from a larger, ongoing study of depression and health in women. The study was designed to investigate the prevalence of depressive symptoms in an adult population and to identify risk factors for depression among women and men.

METHODS

Study Design and Data Collection

Data were collected as part of a study funded by the National Institute of Mental Health. The study was conducted in Chicago and was replicated in Minneapolis, St. Paul, Minn., and New York City during 1998 through 1999. The study included interviews with women and men, as well as measures of physical and mental health. The study was designed to investigate the prevalence of depressive symptoms in an adult population and to identify risk factors for depression among women and men.

As a means of reaching the broadest possible range of women, the survey instrument was distributed in a variety of formal and informal settings, including women's groups, health centers, libraries, and community centers. The study was designed to include women who were not currently receiving mental health care and who were not currently receiving mental health treatment.

In addition, the study included interviews with women and men, as well as measures of physical and mental health. The study was designed to investigate the prevalence of depressive symptoms in an adult population and to identify risk factors for depression among women and men.


had "stressful therapy or consulting for an emotional or mental health problem" or not (see Table 3). The results were significantly higher than those among heterosexual women (50.9%, 95% CI: 49.7-52.2, P<0.001). However, rates of current therapy or counseling did not differ for lesbians (39.4%) and heterosexual women (35.3%, 95% CI: 33.9-36.8, P=0.29).

Treatment for depressive behavior problems of lesbians (51.6%) and heterosexual women (47.8%) reported that they had sought therapy or counseling for depression. Twenty percent of lesbians and 20% of heterosexual women reported that they had been prescribed medication for a mental or emotional condition. Among those who had received medication, 69% 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 (59.8%) also reported receiving antidepressants. More than half of the total sample of lesbians (60%) and heterosexual women (50%) reported at least one of these 3 indicators of treatment for depression.

Successful avoidance and suicide attempts. Significant differences were found between lesbians and heterosexual women in regard to reports of whether they had seriously considered

**TABLE 3—Most Predictive Variables, by Sexual Orientation**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Lesbians (n=533)</th>
<th>Heterosexuals (n=799)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression history</td>
<td>0.30 (0.20-0.40)</td>
<td>0.30 (0.20-0.40)</td>
</tr>
<tr>
<td>Antidepressant use, %</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Mental health counseling, %</td>
<td>20.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Suicide ideation</td>
<td>30.0 (0.20-0.40)</td>
<td>30.0 (0.20-0.40)</td>
</tr>
<tr>
<td>Attempted suicide</td>
<td>10.0</td>
<td>10.0</td>
</tr>
</tbody>
</table>

Note: Numbers on each row are based on percentages that exceed yes or no, and are based on the full sample. For the range of 0.0-1.0, with higher values indicating the greatest number and severity of the symptoms. Linear coping strategies range from 0-1, with higher values indicating more frequent use of a variety of positive coping strategies in response to stress.

**Predictors of Depressive Distress**

Physical and sexual abuse. Although lesbians and heterosexual women were equally likely to report that they had been victims of non-physical violence and sexual assault (40% and 41%, respectively), significantly more lesbians (52%) than heterosexual women (46%) reported experiencing childhood sexual assault (P<0.001).

Because our analyses included only women who had experienced sexual abuse before the age of 18 years (97% were 45% and 41%, respectively), all lesbians and heterosexual women who reported any sexual assault were considered. These cases probably underestimate the number of lesbians and heterosexual women who have experienced childhood sexual abuse (P<0.001).

Global stress. Overall mean scores on the global stress index were in the lesser range and did not differ according to sexual orientation. Mean stress index scores were 1.7 (SES—

**Note:** For heterosexual women, the index was 0.82; for lesbians, the index was 0.95.

**Physical abuse.** No differences were found between the lesbians and heterosexual women in terms of level of perceived stress. The majority of lesbians (50.9%) and heterosexual women (50.9%) reported moderate to severe levels of perceived stress (48.5% and 51.5%, respectively). The only statistically significant differences were in terms of stress for lesbians and heterosexual women. Lesbians (18.4%) and heterosexual women (10.3%) reported feeling or extremely stressed, and more lesbians reported feeling extremely stressed or extremely anxious.

**Psychological support.** Differences were observed between lesbians and heterosexual women in terms of perceived lack of support. More heterosexual women (69%) than lesbians (55%) reported an absence of social support (P<0.001).

Coping strategies and response to stress. Overall, use of positive coping strategies was far more among lesbians than heterosexual women (36.9% vs 29.2% on the 12-point scale, P<0.05). Lesbians (50%) were more likely to report using thinking as a coping strategy (40% vs 35% for heterosexual women, 95% CI: 3.0-9.9, P<0.05).


due to lower rates of childhood sexual abuse and higher rates of positive coping strategies in response to stress. However, the differences were not statistically significant (P>0.05).

**Multivariate Predictive Models of Depressive Distress**

Only variables significantly related to at least 1 of the indicators of depressive distress in the bivariate analyses were included in the multivariate analyses. Demographic characteristics remained included in the multivariate analyses. Educational level (it—

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<table>
<thead>
<tr>
<th>TABLE 3—Study Predictor Variables, by Sexual Orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Dependent variables, Ns, (%):</td>
</tr>
<tr>
<td>Ever received therapy</td>
</tr>
<tr>
<td>429 (78)**</td>
</tr>
<tr>
<td>Ever treated for depression</td>
</tr>
<tr>
<td>284 (50)</td>
</tr>
<tr>
<td>Suicidal ideation</td>
</tr>
<tr>
<td>280 (51)**</td>
</tr>
<tr>
<td>Suicide attempts</td>
</tr>
<tr>
<td>91 (22)*</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Predictor variable</td>
</tr>
<tr>
<td>Childhood sexual abuse, No. (%):</td>
</tr>
<tr>
<td>105 (30)**</td>
</tr>
<tr>
<td>Physical abuse, No. (%)</td>
</tr>
<tr>
<td>246 (45)</td>
</tr>
<tr>
<td>Moderate or extreme stress level, No. (%):</td>
</tr>
<tr>
<td>451 (85)</td>
</tr>
<tr>
<td>Emotionality in response to stress (sometimes or often), No. (%)</td>
</tr>
<tr>
<td>367 (59%)</td>
</tr>
<tr>
<td>Global stress index, mean (SE)</td>
</tr>
<tr>
<td>35 (6.8)</td>
</tr>
<tr>
<td>Positive coping strategies, mean (SE)</td>
</tr>
<tr>
<td>3.3 (1.3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lesbians (n = 650)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heterosexuals (n = 279)</td>
</tr>
</tbody>
</table>

Note. Numbers on which percentages are 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 ≤ .01; **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: \[ F = \frac{s_1^2}{s_2^2} \]
   \[ n_1 = 279, s_1^2 = 49.0 \quad n_2 = 550, s_2^2 = 46.2 \]

5. The critical region: Reject if \( F > F_{0.025}(278, 549) \approx 1.20 \)

6. The result: \[ F = \frac{49.0}{46.2} = 1.06 \]

7. The conclusion: Accept \( H_0: \frac{\sigma_1^2}{\sigma_2^2} = 1 \)