

Gender-Based Analysis in Sample Size and Power for Binomial Proportions

Developed in Women, Gender and Health 207:
Advanced Topics of Women, Gender, and Health,
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Appropriate HSPH Core Courses:

This teaching example could be used in BIO 201: Introduction to Statistical Methods. This teaching example should be given after students have learned about power and sample size calculations for binomial data.

Brief Background:

Students are expected to have attended class lectures up to lecture 12 (power and sample size). Students will therefore be able to describe and differentiate between the binomial and normal distribution, and will understand the use of the normal approximation of binomial data. Students will also know that power is defined as the probability that a statistical test will correctly reject a false null hypothesis, and can also be described as $1-\beta$, where β refers to the probability of a Type 2 error.

Learning Objectives for Students:

The learning goals for students include:

- To be able to perform power and sample size calculations for binomial data
- To appreciate that transgender (see **Glossary**) populations may be at increased risk of eating disorders
- To be able to parse potential risk factors that might explain why transgender populations are at increased risk of eating disorders
- To understand that the term “transgender” encompasses a wide range of gender identities

Teaching Methods:

The assignment asks students to use their knowledge of power and sample size for binomial proportions to design an exploratory analysis of the relationship between gender affirmation from family members and eating disorders in a transgender population. Gender affirmation refers to acknowledgment of and respect for an individual’s gender identity, including the use of the individual’s pronouns and preferred name.

Assignment:

Previous research suggests that transgender people, whose sex assigned at birth does not match their gender identity, are at increased risk of eating disorders and disordered eating compared to cisgender people, whose sex assigned at birth matches their gender identity (Algars 2012, Diemer 2015). However, it is unclear why transgender men (assigned female at birth and identify as men), transgender women (assigned male at birth and identify as women), and genderqueer people (who do not identify as women or men) may suffer from an increased prevalence of eating disorders and

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disordered eating. Recent qualitative studies have suggested this difference in eating disorder prevalence may be due to differences in the extent to which transgender people feel supported and affirmed in their gender, especially by friends and family. Two national studies of transgender adults have found that less than half of those surveyed felt their families supported their transgender identity (Grant 2011, Bockting 2013). Lower family support has been associated with increased odds of attempting suicide and using drug or alcohol to cope with maltreatment (Grant 2011). We are interested in designing a study to investigate whether transgender men, women, and genderqueer people who reported feeling affirmed in their gender by their family are more or less likely than transgender men, women, and genderqueer people who do not report feeling affirmed in their gender by their family to have an eating disorder.

1. Let's assume that the prevalence of eating disorders in transgender people who report low family support was 15.82% (data derived from Diemer 2015). If the true prevalence of eating disorders in transgender people who report high family support was 8% or lower, and we want to risk no more than a 10% chance of failing to correctly reject H_0 , how many participants would we need to detect a difference at the 0.05 level?
2. Samples of transgender people have been difficult to obtain. Another research group is conducting a study of this same topic in a sample of 100 transgender participants. What is the power of their study?
3. Transgender is an umbrella term that encompasses many gender identities. Do you think that gender identity would bias the estimates we've obtained in this example? How could you address this issue in this study?

References:

Ålgars M, Alanko K, Santtila P, Sandnabba NK. Disordered eating and gender identity disorder: a qualitative study. *Eat Disord.* 2012;20(4):300-11.

Bockting WO, Miner MH, Swinburne Romine RE, Hamilton A, Coleman E. Stigma, mental health, and resilience in an online sample of the US transgender population. *Am J Public Health.* 2013 May;103(5):943-51.

Diemer EW, Grant JD, Munn-Chernoff MA, Patterson DA, Duncan AE. Gender Identity, Sexual Orientation, and Eating-Related Pathology in a National Sample of College Students. *J Adolesc Health.* 2015 Aug;57(2):144-9.

Grant, Jaime M., Lisa A. Mottet, Justin Tanis, Jack Harrison, Jody L. Herman, and Mara Keisling. *Injustice at Every Turn: A Report of the National Transgender Discrimination Survey.* Washington: National Center for Transgender Equality and National Gay and Lesbian Task Force, 2011.

Supplemental Materials

Answer Key:

1. Difference between p_0 and $p_1 = 15.82 - 8.00 = 7.82\%$

power = $1 - 0.10 = 0.90$

Under H_0 : $p_0 = .1582$, $q_0 = 0.8418$

Under H_A : $p_1 = .08$, $q_0 = 0.92$

$\alpha = 0.05$, $z_{1-\alpha} = 1.96$

$\beta = 0.10$, $z_{1-\beta} = 1.28$

Using the sample size formula:

$$n = \frac{p_0 q_0 \left(z_{1-\alpha/2} + z_{1-\beta} \sqrt{p_1 q_1 / p_0 q_0} \right)^2}{(p_1 - p_0)^2}$$

$$n = \frac{(.1582) * (.8418) * (1.96 + 1.28 \sqrt{(.08 * .92 / 0.1582 * 0.8418)})^2}{(.1582 - .08)^2}$$

$.13317 * (8.4773) / 0.0061 = 185.069 \cong 186$ participants

2. Using the formula for power

$$\text{power} = \Phi \left(\sqrt{\frac{p_0 q_0}{p_1 q_1}} \left[z_{\alpha/2} + \frac{|p_0 - p_1| \sqrt{n}}{\sqrt{p_0 q_0}} \right] \right)$$

$$\text{power} = \Phi \left(\sqrt{(.1582 * .8418 / .08 * .92)} * (-1.96 + (|.1582 - 0.08| * \sqrt{100} / \sqrt{(.1582 * .8418)}) \right) = \Phi(0.246) = 0.5948$$

NOTE: To use this test, we assume that $np_0q_0 \geq 5$

$$100 * (.1582) * (.8418) = 13.32$$

3. The following are key points that could be raised in quality student responses:

- If the prevalence of eating disorders or family support were different in transgender individuals with different gender identities, heterogeneity in the sample might limit our ability to detect a true difference between groups
- To address this issue, the authors could restrict the study sample to people of a specific gender identity category. For example, people who were assigned a female sex at birth but currently identify outside of the gender binary (e.g., genderqueer), or people who were assigned a female sex at birth, but currently identify as men, male, or transmasculine
- To address this issue, the authors could stratify their study by gender identity category
- To address this issue, the authors could conduct multiple logistic regression

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Glossary:

Gender Identity: How someone perceives and refers to their experience of themselves as male, female, some mix of the two, or neither.

Transgender: People whose current gender identity does not match the sex they were assigned at birth.

Cisgender: People whose current gender identity matches the sex they were assigned at birth.

Transgender man: Someone who was assigned female sex at birth but currently identifies as a man or male.

Transgender woman: Someone who was assigned male sex at birth but currently identifies as a woman or female.

Gender binary: The assumption that there are two genders: woman/female and man/male.

Genderqueer: Someone who was assigned a male or female sex at birth, but currently does not identify as male or female. This term can include a wide range of different identities.

Sex assigned at birth: Assignment of female or male at birth, based typically on biological characteristics such as genitalia, hormones, or chromosomes.

Transfeminine: Someone who currently identifies as a woman, female, or has a nonbinary identity and identifies more with femininity than masculinity.

Transmasculine: This term refers to someone who currently identifies as a man, male, or has a nonbinary identity and identifies more with masculinity than femininity.

Additional Resources:

1. <https://www.genderspectrum.org/>
2. Ålgars M, Alanko K, Santtila P, Sandnabba NK. Disordered eating and gender identity disorder: a qualitative study. *Eat Disord.* 2012;20(4):300-11.
<https://www.ncbi.nlm.nih.gov/pubmed/22703571>
3. Bockting WO, Miner MH, Swinburne Romine RE, Hamilton A, Coleman E. Stigma, mental health, and resilience in an online sample of the US transgender population. *Am J Public Health.* 2013 May;103(5):943-51.
<https://www.ncbi.nlm.nih.gov/pubmed/23488522>
4. Diemer EW, Grant JD, Munn-Chernoff MA, Patterson DA, Duncan AE. Gender Identity, Sexual Orientation, and Eating-Related Pathology in a National Sample of College Students. *J Adolesc Health.* 2015 Aug;57(2):144-9.
<https://www.ncbi.nlm.nih.gov/pubmed/25937471>
5. Grant, Jaime M., Lisa A. Mottet, Justin Tanis, Jack Harrison, Jody L. Herman, and Mara Keisling. *Injustice at Every Turn: A Report of the National Transgender Discrimination Survey.* Washington: National Center for Transgender Equality and National Gay and Lesbian Task Force, 2011.
http://www.thetaskforce.org/static_html/downloads/reports/reports/ntds_full.pdf