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Answer Key to Suggested Activity Questions for Part 4

Reading: Olson R, Wipfli B, Thompson SV, Elliot DL, Anger WK, Bodner T, Hammer LB, Perrin NA. Weight Control Intervention for Truck Drivers: The SHIFT Randomized Controlled Trial, United States. American Journal of Public Health. 2016:e1-e9.

Questions

1. Olson et al. report their adjusted standardized effect size for BMI was d=-0.14. Using that value, calculate the number of drivers needed to have 80% power to detect an effect of -0.14 standard deviation units in an individually randomized clinical trial with a type 1 error rate of 5%.

$$n = 2\left(\frac{\sigma_y^2}{\Delta^2}\right)\left(t_{critical:\alpha/2} + t_{critical:\beta}\right)^2$$
$$= 2\left(\frac{1.0^2}{-0.14^2}\right)\left(1.96 + 0.84\right)^2$$
$$= 799$$

   This results suggests that 799 participants would be needed per condition for 80% power given a two-tailed type 1 error rate of 5%, an effect of 1.0 BMI unit, and a standard deviation of 7.14, for a total 1598 participants in the study.

2. How do you reconcile that result with the statement in Olson et al. that they had >.9 probability of an effect of the magnitude observed in the pilot with 520 participants?

   Their statement on power in the paper was: "On the basis of an a priori power analysis, we selected a target sample size of 520 drivers to provide a 0.99 probability of detecting a body weight effect of the magnitude observed in the pilot." The effect reported in the pilot was -0.68 sd units. With 260 drivers per condition, they would have had 0.99 power for an effect of that size.

3. How is it possible that Olson et al. observed a significant effect of -0.14 sd units with only 452 participants?

   The observed effect of -0.14 sd units was much smaller that the anticipated effect. So the power for such an effect would have been much less than 99%, but still greater than 0%. In fact, they had 24% power to detect an effect of that small size with 452 participants.

4. The more typical target in a GRT is 0.25 sd units. Calculate the number of terminals needed per condition to have 80% power to detect an effect of 0.25 standard deviation units for BMI in a GRT having 20 drivers per terminal if the ICC reflecting the average correlation for BMI among truckers in the same terminal was 0.01. Start with 11 terminals per condition and continue to iterate until the result converges.

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$$g = 2\left(\frac{\sigma_y^2\left(1+\left(m-1\right)ICC_{m:g:c}\right)}{\Delta^2}\right)\left(t_{critical:\alpha/2} + t_{critical:\beta}\right)^2$$
$$= 2\left(\frac{1.0^2\left(1+\left(20-1\right)0.01\right)}{-0.25^2}\right)\left(2.086+0.860\right)^2$$
$$= 16.5$$

In the first calculation, we set the df based on 11 terminals per condition, or 20 df: 2.086 and 0.860. The result was g=16.5, so we need to replace the initial values for t with values based on 17 terminals per condition or 32 df.

$$g = 2\left(\frac{\sigma_y^2\left(1+\left(m-1\right)ICC_{m:g:c}\right)}{\Delta^2}\right)\left(t_{critical:\alpha/2} + t_{critical:\beta}\right)^2$$
$$= 2\left(\frac{1.0^2\left(1+\left(20-1\right)0.01\right)}{-0.25^2}\right)\left(2.037+0.853\right)^2$$
$$= 15.9$$

In the second calculation, we set the df based on 17 terminals per condition, or 32 df: 2.037 and 0.853. The result was g=15.9, so we need to recalculate based on 16 terminals per condition, or 30 df

$$g = 2\left(\frac{\sigma_y^2\left(1+\left(m-1\right)ICC_{m:g:c}\right)}{\Delta^2}\right)\left(t_{critical:\alpha/2} + t_{critical:\beta}\right)^2$$
$$= 2\left(\frac{1.0^2\left(1+\left(20-1\right)0.01\right)}{-0.25^2}\right)\left(2.042+0.854\right)^2$$
$$= 16.0$$

We can stop at this point, because the result g=16 agrees with the value of g we used to calculate the df and set the critical values for t.

This suggests that if the ICC were 0.01, we would need 16 terminals per condition, with 20 drivers per terminal, for a total of 640 drivers, to have 80% power for an intervention effect of 0.25 sd units.