Handling Multiple Aims

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 1

Learning Objectives

Define multiple aims.

Describe the challenges that arise from multiple aims.

Describe how to plan for multiple aims.

2

Studies often have multiple aims

Aims typically represent different hypotheses.

Each aim requires its own power analysis.

3

Multiple aims usually present a challenge in power and sample size calculation

Sample size may be adequate for one aim but too large or too small for others.

Power may be adequate for one aim but too large or too small for others.

The goal is to balance harms and benefits for the sample size chosen.

4

Choosing a sample size that accommodates all aims in the study

1. Calculate the sample size required for each aim individually
2. Choose the **largest sample size** of all calculated

Warning: the approach ignores any ethical concerns, if present.
Costs are also ignored.

5

For practice, we discuss a grant proposal that includes three aims

Aim 1

Determine whether community gardening leads to increased intake of fruits and vegetables and thus increased intake of fiber, lower total energy intake, and higher Healthy Eating Indices.

6

For practice, we discuss a grant proposal that includes three aims

Aim 2

Determine whether community gardening leads to reduced sedentary time, increased moderate-to-vigorous physical activity (MVPA), and reduced age-associated weight gain.

7

For practice, we discuss a grant proposal that includes three aims

Aim 3

Elucidate the mechanisms underlying the differences found in diet, activity, BMI and waist circumference between gardeners and non-gardeners.

8

Each aim requires its own sample size section describing the following factors

1) Type of test

2) Type I error rate

3) Estimated power

9

Each aim requires its own sample size section describing the following factors

4) Description of clusters
   - nature of clusters
   - number of clusters
   - people per cluster

10

Each aim requires its own sample size section describing the following factors

5) Expected loss to follow-up
6) Total sample size, adjusted for loss
7) Sample size per randomization arm, adjusted
8) Correlations accounted for in analysis

11

When writing your grant proposal, give a preface for your analyses

We conducted a separate power analysis for each aim. A detailed analysis for Aim 1 appears in Section 4.F.1, Aim 2 in 4.F.2, and Aim 3 in 4.F.3. The final sample size for the study is the maximum of the three sample sizes found to provide sufficient power for each aim.

12

Next, identify and describe your overall sample size

With 156 per randomization arm, and a total sample size of 312, the study will have greater than 0.80 power for each aim. This estimate reflects an adjustment for 30% loss to follow-up.

13

Then, provide a detailed sample size summary for each aim

Aim 1

"Estimates of means and variances for fruit and vegetable intake were based on our cross-sectional study in Denver. We conducted a power analysis for the overall test of time by treatment."

14

Then, provide a detailed sample size summary for each aim

Aim 1, continued

At a Type I error rate of 0.04, power for the Hotelling-Lawley test is estimated at 0.98 with 30 neighborhoods, and 109 people per randomization arm, for a total sample size of 218.

15

Then, provide a detailed sample size summary for each aim

Aim 1, continued

"Assuming loss to follow-up of 30%, the total sample size required will be 312 people in 39 neighborhoods, or 156 per randomization arm group. The power analysis accounts for correlation within gardens, and within neighborhoods."

16

Next, provide a detailed sample size summary for each aim

Aim 2

"Estimates for the power analysis were taken from a population-based Neighborhood Environments and Health Survey (NEHS) of 470 residents of Denver (Litt, PI).

17

Next, provide a detailed sample size summary for each aim

Aim 2, continued

Community gardeners in the study (N=63) reported an average of 146.6 (std. dev = 12.1) hours of sedentary time per week, while non-gardeners reported an average of 153 hours (std. dev. = 9.6).

18

Next, provide a detailed sample size summary for each aim

Aim 2, continued

Community gardeners in the study (N=63) had an average BMI of 24, while non-gardeners had an average BMI of 27.

Power analysis was conducted both for sedentary time and for BMI.

19

Next, provide a detailed sample size summary for each aim

Aim 2, continued

With a Type I error rate of 0.04, we calculated the power for a Hotelling-Lawley test of the group by time interaction reflecting a decrease in sedentary time of 6.4 hours per week in midsummer for gardeners (std. dev. = 12).

20

Next, provide a detailed sample size summary for each aim

Aim 2, continued

Under these conditions, power will be more than 0.99 for 30 neighborhoods and 130 people per randomization arm, for a total sample size of 260 people.

21

Next, provide a detailed sample size summary for each aim

Aim 2, continued

Assuming loss to follow-up of 30%, the total sample size required to achieve that power will be 312 in 39 neighborhoods, 156 per randomization arm.

22

Next, provide a detailed sample size summary for each aim

Aim 2, continued

The power analysis accounts for correlation within gardens and within neighborhoods. The power analysis proposed is conservative, since it is used with the larger of two possible variance estimates.

23

Next, provide a detailed sample size summary for each aim

Aim 2, continued

For the outcome of moderate-to-vigorous physical activity, we estimate adequate power, based on the difference in means from the NEHS (Litt, Pl).

24

Next, provide a detailed sample size summary for each aim

Aim 2, continued

Community gardeners reported an average of 2.5 more hours a week of moderate to vigorous physical activity, compared to non-gardeners."

25

Next, provide a detailed sample size summary for each aim

Aim 3

"Power calculations considered the magnitude of individual paths, as well as power to test the mediated effect. Power was calculated in Mplus using Monte Carlo simulation.

26

Next, provide a detailed sample size summary for each aim

Aim 3, continued

Estimates driving the power analyses are shown in Figure 4 (presented as standardized beta coefficients) and are based on data from the GGHC study.

27

Next, provide a detailed sample size summary for each aim

Aim 3, continued

This example estimate used social involvement as the mediator between assuming a neighborhood level ICC of 0.012 for physical activity and 0.0886 for fruit and vegetable intake.

28

Next, provide a detailed sample size summary for each aim

Aim 3, continued

Assuming a two-sided alpha=0.05, the sample size of 240 participants will provide 0.80 power to detect the mediated effect for fruit and vegetable intake and 0.95 in all instances."

29

Your final grant submission should describe the sample size required for each aim individually

Aim	N total	N per randomization arm
1	312	156
2	312	156
3	240	120

30

Your grant proposal should then identify the largest sample size per aim as the overall sample size

Aim	N total	N per randomization arm
1	312	156
2	312	156
3	240	120

31

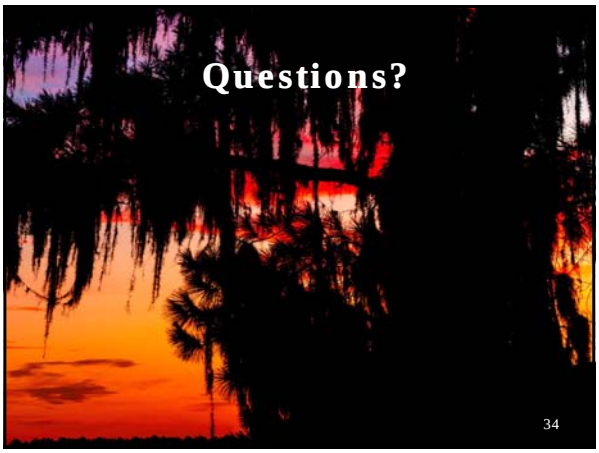
REVIEW OF LEARNING OBJECTIVES

32

What two steps should an investigator take to plan for multiple aims?

1. Conduct power and sample size analysis for each aim individually.
2. Choose the highest sample size needed for any aim, as long as there are no ethical concerns from doing so.

33


Questions?
34