

Understanding and mitigating attrition

Daniel Friend, Avery Hennigar, Brandon Hollie, and Rebecca Piatt

Even the most well-designed and well-implemented evaluation is likely to lose sample members over the course of the study because at least a few of the participants will not complete all data collection (for example, will not provide exit or follow-up data). (See, for example, Crutzen et al. 2015.) This sample loss is called attrition. Attrition can weaken a Healthy Marriage and Responsible Education (HMRE) evaluation by introducing bias. That bias, known as attrition bias, in turn affects the evaluator's ability to form rigorous conclusions. This brief describes (1) what attrition is and why it can be a problem; (2) how to calculate and assess it using guidance from the [What Works Clearinghouse](#) (WWC)¹ and (3) steps evaluators can take to mitigate it.

? What is attrition bias?

Although attrition is a problem for any evaluation, it is particularly problematic for evaluations using experimental designs like randomized control trials (RCTs) (Box 4.1). In an RCT design, participants are randomly assigned into one of two or more groups or conditions—typically a treatment group and a control group. The process of random assignment balances any differences between the groups in their observed and unobserved characteristics. Therefore, in an RCT, study groups are considered to be equivalent at the time of study enrollment (Box 4.2). Because the two groups are equal on other factors at baseline (that is, study enrollment), evaluators can attribute any observed differences between the outcomes of the treatment group and the outcomes of the control group to the HMRE program (Hariton and Locasio 2018; Shadish and Galindo 2010). However, when an RCT has a high rate of attrition, there is a risk that the study will no longer have equivalent groups and may be subject to attrition bias. Attrition bias occurs when the loss of sample through attrition creates an imbalance or inequivalence between the research groups (Gustavson et al. 2012; Miller and Hollist 2007; WWC 2022).

■ Box 4.1. Should attrition only be a concern for RCTs?

No. Attrition is concerning for any type of study. Attrition threatens an RCT's main strength—creating equivalent groups at baseline through random assignment—but it can also threaten other research designs (such as descriptive or quasi-experimental). For example, attrition can reduce the statistical power to detect effects or outcomes because it reduces the sample size for analysis (Button et al. 2013; Shadish and Luellen 2014). Additionally, nonresponse bias—which happens when people who did respond systematically differ from those who did not—can negatively affect any study design (Dong et al. 2011; Miller and Hollist 2007).

¹ The WWC is operated by the U.S. Department of Education, Institute of Education Sciences. The WWC guides program evaluators using causal designs to provide rigorous evidence of program efficacy. The WWC contains information on when attrition is problematic for RCTs and on appropriate next steps. The Administration for Children and Families adapts clearinghouse standards, like those from the WWC, to provide evaluators with guidance on analysis and reporting of HMRE local evaluations.

The Administration for Children and Families (ACF) provides grants to fund healthy marriage and relationship education (HMRE) programs to strengthen and improve the quality of relationships. The programs offer a range of services from relationship education for high school students to marriage and relationship skills building for adult couples. Grant recipients may be funded to also conduct descriptive or impact evaluations of their funded programs. Independent local evaluators support grant recipients in conducting their local evaluations. This brief is part of a larger evaluation technical assistance (TA) toolkit developed by Mathematica to help HMRE local evaluators understand key program evaluation concepts, common evaluation challenges, and strategies to prevent or overcome challenges. The briefs are standalone documents that can be read in any order. The TA toolkit was developed with HMRE program staff, their local evaluators, and other partners in mind, but it is also relevant to other program areas and organizations.

Box 4.2. Key terms

Attrition. Occurs when outcome data for a participant or participants are not available.

Baseline equivalence. Refers to the assumption that research groups are equal on observed and unobserved characteristics before they enroll in the evaluation and before they receive the HMRE program.

Bias. Any systematic error in a study.

Source: WWC 2022.

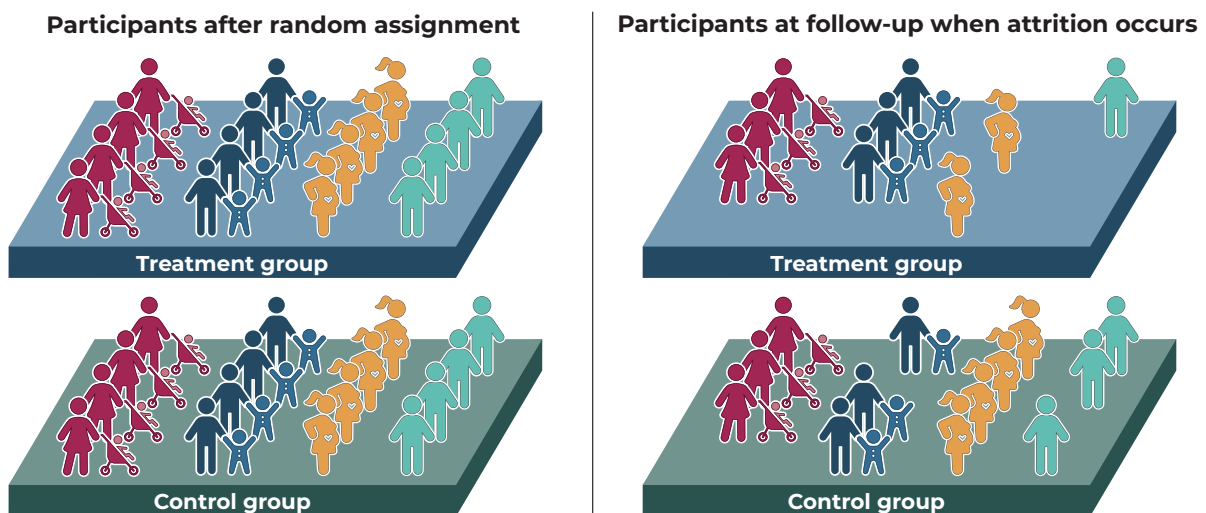
Attrition can happen for a variety of reasons. For example, a participant could:

- Not be located at the time of follow-up data collection
- Be unavailable at the time of data collection
- Decide to drop out of the study
- Refuse to participate in evaluation activities or withdraw their consent from the study

Regardless of the reason, it is important to closely monitor and mitigate attrition in the study to reduce the risk of bias.

Figure 4.1 is a visual example of attrition in an HMRE program using an RCT evaluation design.² The figure shows the composition of the research groups immediately following randomization at the start of the evaluation before they receive the HMRE program (the left column) and again six months later after a follow-up survey (the right column). After random assignment, the intervention and comparison groups are equivalent in terms of demographic and other characteristics at baseline. At the six-month follow-up, only a subset of participants completed the survey. As a result, the intervention and control group now have different characteristics. For example, the treatment group only has two pregnant individuals at follow-up, whereas the control group has four. Additionally, the treatment group only has one single person at follow-up, whereas the control group has three. In other words, because the groups are no longer similar, there is no certainty that any differences in outcomes at the six-month follow-up were caused by the HMRE program.

Figure 4.1. Example of attrition in an HMRE program



Key: The different icons signify participants with different demographic characteristics. The red icons in the first row are female participants with children. The blue icons in the second row are male participants with children. The yellow icons in the third row are pregnant women. The teal icons in the fourth row are single men.

² This figure shows an HMRE program that serves adult individuals. However, many HMRE programs served paired partners simultaneously. For more information on challenges that evaluators face in analyzing data from paired partners, and strategies they can consider to address these challenges, see this brief: <https://www.acf.hhs.gov/opre/report/analyzing-data-paired-partners-program-evaluation-strategies-overcome-common-challenges>.

Attrition is outcome and time specific, meaning it is possible to have low attrition for some outcomes or time points and high attrition on others (WWC 2022). As a result, it is important to calculate attrition for *each* time point and for *each* outcome (Box 4.3).

Box 4.3. Examples of attrition, varied across multiple outcomes and time points

Multiple time points. An HMRE local evaluator noticed high attrition at the first follow-up after baseline. After investigating the issue, they learned participants preferred to complete surveys online. In later follow-up periods, the HMRE program offered participants the chance to complete the survey by phone or online, which led to improved response rates at subsequent follow-ups. As a result, the first follow-up had higher attrition than the later follow-ups.

Multiple outcomes. An HMRE evaluation examined the program’s impact on several outcomes: communication, relationship satisfaction, and intimate partner violence. However, some participants skipped the section on intimate partner violence because they thought the questions were too sensitive. In this instance, attrition for this outcome was higher than it was for the others, making the outcome variable on intimate partner violence challenging to analyze.



How to calculate and assess attrition

Evaluators need to calculate two types of attrition: overall and differential (Box 4.4). Overall attrition is the total number of participants across both research groups with missing data—in other words, the total number of participants that did not participate in data collection divided by the total number of participants enrolled in the evaluation or randomized (Box 4.5).

Differential attrition compares the differences in the attrition rates of the research groups. To calculate differential attrition, compute the attrition rate for both research groups, and take the absolute value of the difference between the two rates (Box 4.5). In Figure 4.1, the treatment group had more attrition than the control group, which can affect study quality (Gustavson et al. 2012; Miller and Hollist 2007). For example, participants who did not find the HMRE program relevant and stopped attending after a few sessions might not have responded to the follow-up survey. This would lead to the treatment group consisting of only people

Box 4.4. Key terms, continued

Overall attrition. Refers to attrition for the whole sample (treatment and control groups) calculated as the percentage of randomly assigned units for which the evaluators do not observe outcome data.

Differential attrition. Calculated by taking the absolute value of the percentage point difference between attrition rates for the treatment group and the comparison group.

Source: WWC 2022.

Box 4.5. How to calculate overall and differential attrition

Overall attrition calculation	
$\frac{\text{\# of participants without observed outcome data in the analysis}}{\text{\# of participants randomized}}$	
Differential attrition calculation	
$\frac{\text{\# of treatment participants without observed outcome data in the analysis}}{\text{\# of treatment participants randomized}}$	$- \frac{\text{\# of control participants without observed outcome data in the analysis}}{\text{\# of control participants randomized}}$

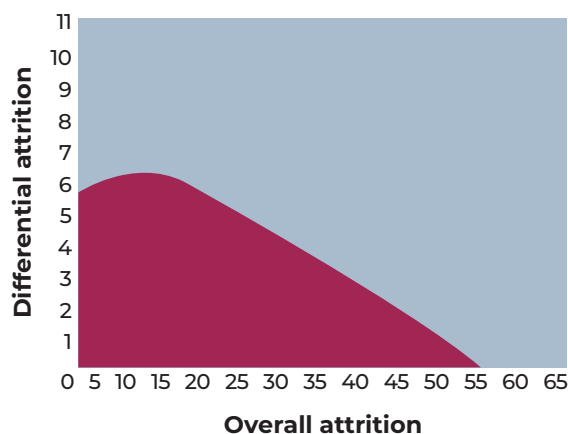
who completed the program, and the evaluation would therefore find favorable outcomes when none exist simply because only participants who found the program relevant to them were included in the outcome measures (Miller and Hollist 2007).

When evaluating an HMRE program, evaluators can follow the guidance published by the WWC to ensure they are conducting analysis in a rigorous and systematic way. WWC standards for causal design studies require that researchers conducting an RCT calculate both overall and differential attrition and use a ratio of the two to determine if the attrition is within an acceptable threshold range (WWC 2022). The WWC developed two threshold ranges—the cautious and optimistic threshold. The Administration for Children and Families (ACF) recommends that most HMRE studies use the cautious threshold, which is a more conservative approach to assessing the potential influence of attrition bias on study results. Under the cautious threshold, higher rates of attrition are considered unacceptable.

According to the WWC attrition standard, evaluations are classified as having either “high” or “low” attrition based on both overall and differential attrition. Figure 4.2 shows this threshold in different colors: low attrition rates fall within the maroon threshold, and high attrition rates fall within the blue threshold.

The WWC standards also account for an important trade-off between overall and differential attrition—namely, that a study can have a higher overall rate of attrition if it has a low rate of differential attrition and still be deemed acceptable. As shown in Figure 4.2, overall attrition could be approximately 50 percent and still be considered low if differential is minimal (1 percent or less). If an evaluation has low attrition, attrition bias is not a concern, and the evaluator can proceed with their planned analyses. If an evaluation has high attrition, the evaluator is required to demonstrate baseline equivalence of participants in the final analytic sample. In other words, the evaluator should show that the research groups are still similar for those who completed data collection (WWC 2022) ([See the seventh brief in this toolkit on creating equivalent research groups](#)).

Figure 4.2. WWC attrition threshold for HMRE local evaluations



Source: WWC 2022.



Mitigating attrition

The best way to mitigate the effects of attrition bias in an evaluation is to ensure high response rates. See the second brief in this toolkit on improving survey response rates, which focuses on response rates and discusses strategies for maximizing response rates, including clearly explaining the importance of surveys to participants, obtaining several modes of contact information, offering participants different ways to complete surveys, and using motivating and well-timed incentives.

Evaluators should also consider how to minimize differential attrition, as that is often more important than minimizing overall attrition. For example, as shown in Figure 4.2, having low overall attrition but high differential attrition can put an evaluation in the “high” attrition category and require the evaluator to demonstrate baseline equivalence. Evaluators can minimize differential attrition by striving to collect data at equal rates from all participants, regardless of the treatment condition or baseline characteristic. Evaluators should consider that reaching people in one group could require more effort than reaching people in another group. For example, it may be easier to contact participants in the treatment group because they are continuing to receive services from the HMRE program.

Regularly monitoring attrition by examining response rates at each follow-up period during and after data collection and examining missing data across outcomes can help evaluators and HMRE program staff proactively address it. For example, identifying particular subgroups of participants who are not responding to follow-up data collection could inform a strategy to improve response rates. Regularly calculating overall and differential attrition throughout data collection can help evaluators monitor whether the study is on track to meet WWC attrition thresholds. Early monitoring of attrition rates can also help evaluators be proactive about demonstrating baseline equivalence if the study is at risk of attrition that falls outside the acceptable threshold.

References

- Abshire, Martha, Victor D. Dinglas, Maan Isabella A. Cajita, Michelle N. Eakin, Dale M. Needham, and Cheryl Dennison Himmelfarb. "Participant Retention Practices in Longitudinal Clinical Research Studies with High Retention Rates." *BMC Medical Research Methodology*, vol. 17, no. 1, 2017, pp. 1–10.
- Button, Katherine S., John P.A. Ioannidis, Claire Mokrysz, Brian A. Nosek, Jonathan Flint, Emma S.J. Robinson, and Marcus R. Munafò. "Power Failure: Why Small Sample Size Undermines the Reliability of Neuroscience." *Nature Reviews Neuroscience*, vol. 14, no. 5, 2013, pp. 365–376.
- Cole, Russell, and Seth Chizeck. "Sample Attrition in Teen Pregnancy Prevention Impact Evaluations." Mathematica Policy Research, 2014.
- Crutzen, Rik, Wolfgang Viechtbauer, Mark Spigt, and Daniel Kotz. "Differential Attrition in Health Behaviour Change Trials: A Systematic Review and Meta-Analysis." *Psychology & Health*, vol. 30, no. 1, 2015, pp. 122–134, DOI: [10.1080/08870446.2014.953526](https://doi.org/10.1080/08870446.2014.953526).
- Dong, Nianbo, and Mark W. Lipsey. "Biases in Estimating Treatment Effects Due to Attrition in Randomized Controlled Trials and Cluster Randomized Controlled Trials: A Simulation Study." *Society for Research on Educational Effectiveness*, 2011.
- Dorey, Frederick J. "In Brief: Statistics in Brief: Statistical Power: What Is It and When Should It Be Used?" *Clinical Orthopedics and Related Research*, vol. 469, no. 2, 2011, pp. 619–620.
- Fleiss, J.L. *Statistical Methods for Rates and Proportions*. 2nd ed. John Wiley & Sons, 1981.
- Gustavson, Kristin, Tilmann von Soest, Evalill Karevold, and Espen Røysamb. "Attrition and Generalizability in Longitudinal Studies: Findings From a 15-Year Population-Based Study and a Monte Carlo Simulation Study." *BMC Public Health* vol. 12, 2012, p. 1–11.
- Hariton, Eduardo, and Joseph J. Locascio. "Randomised Controlled Trials—The Gold Standard For Effectiveness Research." *BJOG: An International Journal of Obstetrics and Gynaecology*, vol. 125, no. 13, 2018, p. 1716.
- Kost, Rhonda G., and Joel Correa da Rosa. "Impact of Survey Length and Compensation on Validity, Reliability, and Sample Characteristics for Ultrashort-, Short-, and Long-Research Participant Perception Surveys." *Journal of Clinical and Translational Science*, vol. 2, no. 1 2018, pp. 31–37.
- Miller, Richard B., and Cody S. Hollist. "Attrition Bias." Paper 45, Faculty Publications, Department of Child, Youth, and Family Studies, University of Nebraska - Lincoln, 2007.
- Shadish, W.R., and R. Galindo. "Randomized Control Trials." In *The Corsini Encyclopedia of Psychology*, edited by I.B. Weiner and W.E. Craighead, 2010. <https://doi.org/10.1002/9780470479216.corpsy0770>.
- Shadish, W.R., and J.K. Luellen. "Attrition." In *Wiley StatsRef: Statistics Reference Online*, edited by N. Balakrishnan, T. Colton, B. Everitt, W. Piegorisch, F. Ruggeri, and J.L. Teugels. 2014. <https://doi.org/10.1002/9781118445112.stat06672>.
- Yan, Ting, and Richard Curtin. "The Relation Between Unit Nonresponse and Item Nonresponse: A Response Continuum Perspective." *International Journal of Public Opinion Research*, vol. 22, no. 4, 2010, pp. 535–551.
- What Works Clearinghouse. *Procedures and Standards Handbook, Version 5.0*. U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, 2022. <https://ies.ed.gov/ncee/wwc/Handbooks>.

Suggested citation: Friend, Daniel, Avery Hennigar, Brandon Hollie, and Rebecca Piatt (2024). "Understanding and Mitigating Attrition." OPRE Report #2024-142. Washington, DC: Office of Planning, Research, and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services

Acknowledgements: Many people contributed to this toolkit. First, we acknowledge staff at the OPRE in the Administration for Children and Families at the U.S. Department of Health and Human Services. We are particularly grateful for the direction and feedback from Samantha Illangasekare, Rebecca Hjelm, and Kathleen McCoy. We want to extend our gratitude to Sarah Avellar and Angela D'Angelo for reviewing drafts of the briefs. We also extend our appreciation to Effie Metropoulos and Bridget Gutierrez for editing and Yvonne Marki-Korosec and Gwyneth Olson for designing the graphics in this toolkit.