



All Our Families Study

Attrition Weights Manual

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ucalgary.ca/allourfamilies

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Acknowledgements

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We also respectfully acknowledge and pay tribute to the traditional territories of the peoples of Treaty 7 on which the University of Calgary operates, which include the Blackfoot Confederacy, the Tsuut'ina First Nation, and the Stoney Nakoda, as well as the lands of the Métis Nation of Alberta, Districts 5 and 6, upon which the City of Calgary is situated.

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About the All Our Families Study

The AOF study began as the All Our Babies (AOB) study in 2008. It is a prospective cohort study of 3,387 women and their children in Calgary, Alberta. AOF was initially designed to examine maternal and infant outcomes during the perinatal period and to identify barriers and facilitators to accessing health care services. Mothers who agreed to participate were asked to complete three surveys: the first during the second trimester (<25 weeks' gestation), the second during the third trimester (34-36 weeks' gestation), and the third at four months postpartum. Participants were also asked to provide consent to the research team to access their obstetrical and birth records.^{1,2}

The sociodemographic attributes of AOF participants at enrollment resembled the population of urban families who had children at the time in terms of age and education in Calgary Alberta and the broader Canadian context.² However, a higher percentage of participants within the AOF cohort reported annual household earnings exceeding \$60,000 (82%), in contrast to their counterparts in Calgary (65%), Alberta (61%), and Canadian figure (56%) at the start of the study. Additionally, the proportion of AOF participants who were married (83%) was elevated when compared with parenting females in Calgary (73%), Alberta (70%), and across Canada (60%).

Subsequent follow-up surveys were developed and administered to consenting and eligible participants to examine child development, parenting and women's health outcomes at 1, 2, 3, 5, and 8 years postnatally. Development of the next study follow-up survey began in August

2018 but was delayed due to the COVID-19 pandemic. Data collection for three women and youth COVID-19 Impact Surveys occurred between May 2020 and January 2022. Survey design for the 12–14-year follow-up resumed in early 2023 and was completed by Spring of 2023. Data collection occurred at the beginning of 2023, concluding in July of 2023 with a 65% response rate of eligible participants to the women’s survey. Participants were also asked to consent to having their youth participate in a youth survey, and among those who consented, 93% of youth completed the questionnaire. Additional information and previous reports can be found at the AOF website: <https://ucalgary.ca/allourfamilies>.

Introduction

Attrition is a common occurrence in longitudinal study design; this refers to participants who originally consent to participation and leave the study over time. Most often, we are unsure as to why individuals choose not to participate in follow-up waves of data collection, commonly referred to as “attrition due to non-response”. The loss of participants over time can bias results if the reason for attrition is related to the exposure-outcome relationship of interest. It can also reduce the generalizability of results if subgroups of participants are lost to follow-up disproportionately to whole study characteristics. Due to the potential bias that attrition may introduce, complete-case analysis or listwise deletion may be inappropriate as these methods assume participant data are missing completely at random; but this assumption is rarely the case.³

As an example, at the 3-year follow-up of AOF participants, we compared sociodemographic factors of the 1,993 participants who continued participation with the 1,394 who did not. We observed that 25% of participants who were lost to follow-up had lower income (<\$60,000), while only 14% of participants who continued in the study had lower income. This suggested that lower income participants are disproportionately lost to follow-up with the AOF study, which could lead to bias. We observed similar differences for home ownership, reported race/ethnicity, smoking status, education, mental health, marital status, immigration status, and age.

Objective

The objective of this report is as follows:

- 1) To describe the reasoning and methods for applying attrition weights to the All Our Families study samples to minimize the risk of bias.

Methods

One method to dealing with attrition is to develop weights where those who continue in the study are weighted so they approximate the original sample. The AOF study has developed attrition weights for each survey wave. The full methodology for how these weights were developed and the results of their application can be found here:

<https://doi.org/10.1186/s12874-023-02121-1>⁴ Briefly, we used machine learning to develop a predictive model (containing 22 variables measured at the first AOB survey) for non-response at each wave and used the predicted probability of drop-out to weight participant responses.

The weights we developed successfully balanced the sociodemographic characteristics of participants at each survey wave such that there are negligible differences between the groups that continued in the study and those that were lost to follow-up. Referring to the example of lower income, the responses of those with lower income who continued to participate in AOF were given a higher weight so their responses represented individuals with lower income who were lost to follow-up.

These attrition weights help to ensure that the sample at the 3-year, 5-year, 8-year, and the three COVID AOF surveys are representative of the original 3,387 participants.

Limitations

It is important to note that these weights only balance the demographic characteristics of the participants at each survey, and do *not* address other forms of missing data. For example, as part of a study, individuals who participated in a survey but chose not to answer certain questions may be excluded in analyses. In such cases, the mechanism for missing data is different from attrition and attrition weights will not address the potential risk of bias introduced in this example. As well, with attrition, there is a loss of statistical power as the sample size decreases over time. The weights described here do not address the statistical power concerns that may occur from attrition.

Application of Weights

We provide weights that correspond to each survey (e.g., *q6weight* to correspond with the 3-year postpartum survey). To use these weights, you will use the appropriate weight that corresponds to your study endpoint. For example, if you are using the cohort at age 3, you would use the *q6weight* variable. The code to apply the weight of choice will vary based on your statistical program; however, major statistical programs are well-suited to support attrition weights, and we provide example code for STATA and R of a univariate cross-sectional association of maternal depression as the outcome and income as the exposure, at the 3-year follow-up, below. In STATA, the *pweight* command is needed for attrition weights. In R, the default command to assign weights refers to frequency weights, which would provide incorrect results. To that end, you will need to install the *Survey Package* in R.

STATA and R code are provided below:

STATA

```
logit q6cedstotal16 i.q6income_r [pweight=q6weight]
```

where:

- *q6cedstotal16* refers to maternal depression at 3-years
- *q6income_r* refers to income at 3-years
- *pweight* refers to a probability weight function used for attrition weights
- *q6weight* is the AOF 3-year attrition weight

R (requires the Survey Package)

```
## Install and use packages
```

```
install.packages("survey")
```

```
library(survey)
```

```
## Set survey design with the relevant weights (in this case q6weight)
```

```
svy_design <- svydesign(ids = ~1, weights = ~q6weight, data = data)
```

```
## Survey weights logistic regression
```

```
model <- svyglm(q6cesdtotal16 ~ q6income_r, design = svy_design, family = binomial() )
```

where:

- *q6cedstotal16* refers to maternal depression at 3-years
- *q6income_r* refers to income at 3-years
- *q6weight* is the AOF 3-year attrition weight

Additional Information

Does application of these attrition weights significantly change effect size?

This will likely depend on the association of interest. AOF has applied these attrition weights to one paper that studied maternal depression and anxiety during the COVID-19 pandemic ([https://doi.org/10.1016/S2215-0366\(21\)00074-2](https://doi.org/10.1016/S2215-0366(21)00074-2)).⁵ We found that while these weights correctly restored baseline characteristics of the sample, the magnitude and direction of the effect were not significantly altered suggesting that, for this study, there was likely little bias due to attrition.

Why were the attrition weights made for the original AOF sample and not for the general population composition?

The intent of the AOF attrition weights was never to weight the AOF cohort to the general population (e.g., Canadian, Albertan) as this is not a population-based cohort. The AOF cohort is a community sample that used a population recruitment strategy that is generally representative of the Albertan parenting population in an urban centre. We are weighting to address attrition in our sample and, therefore, weight back to our original sample.

References

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