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Why Randomize?
Lecture & Case Study

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June 9, 2020

Session Overview

I. Background

II. Why randomize case study

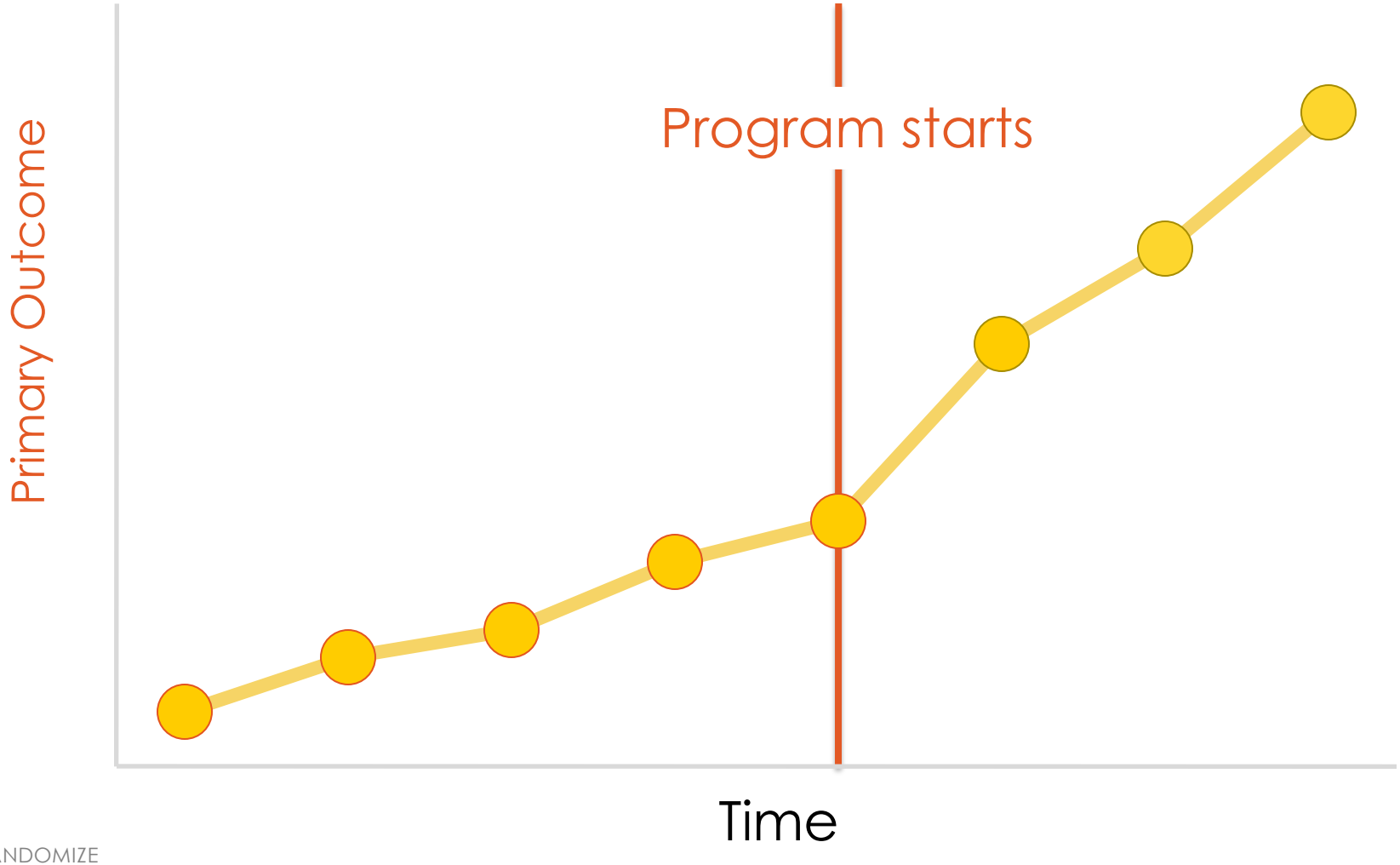
    I. Non-experimental methods

    II. Randomized evaluations

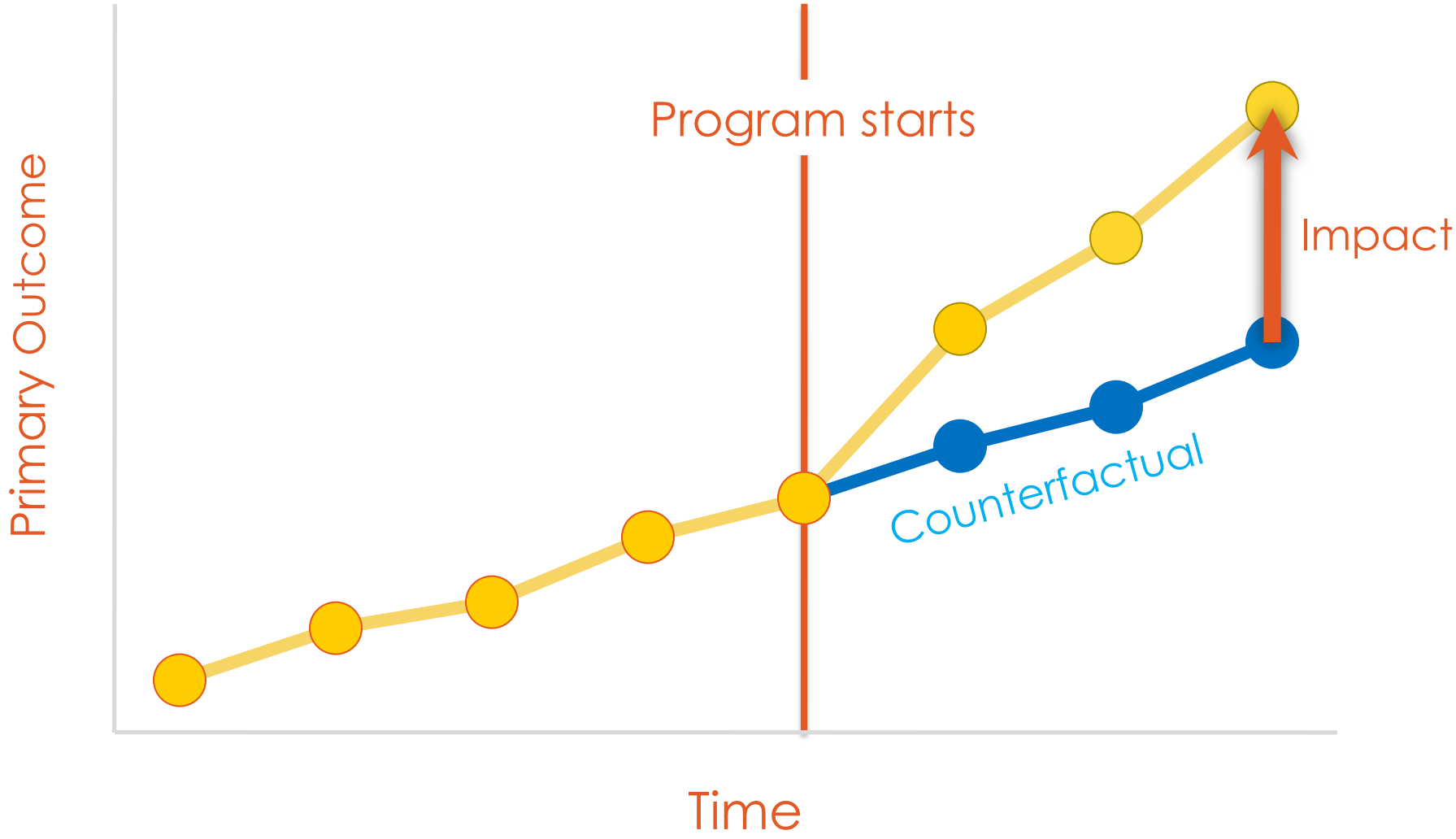
III. Conclusions

I - BACKGROUND

What is the impact of this program?



What is the impact of this program?



How to measure impact?

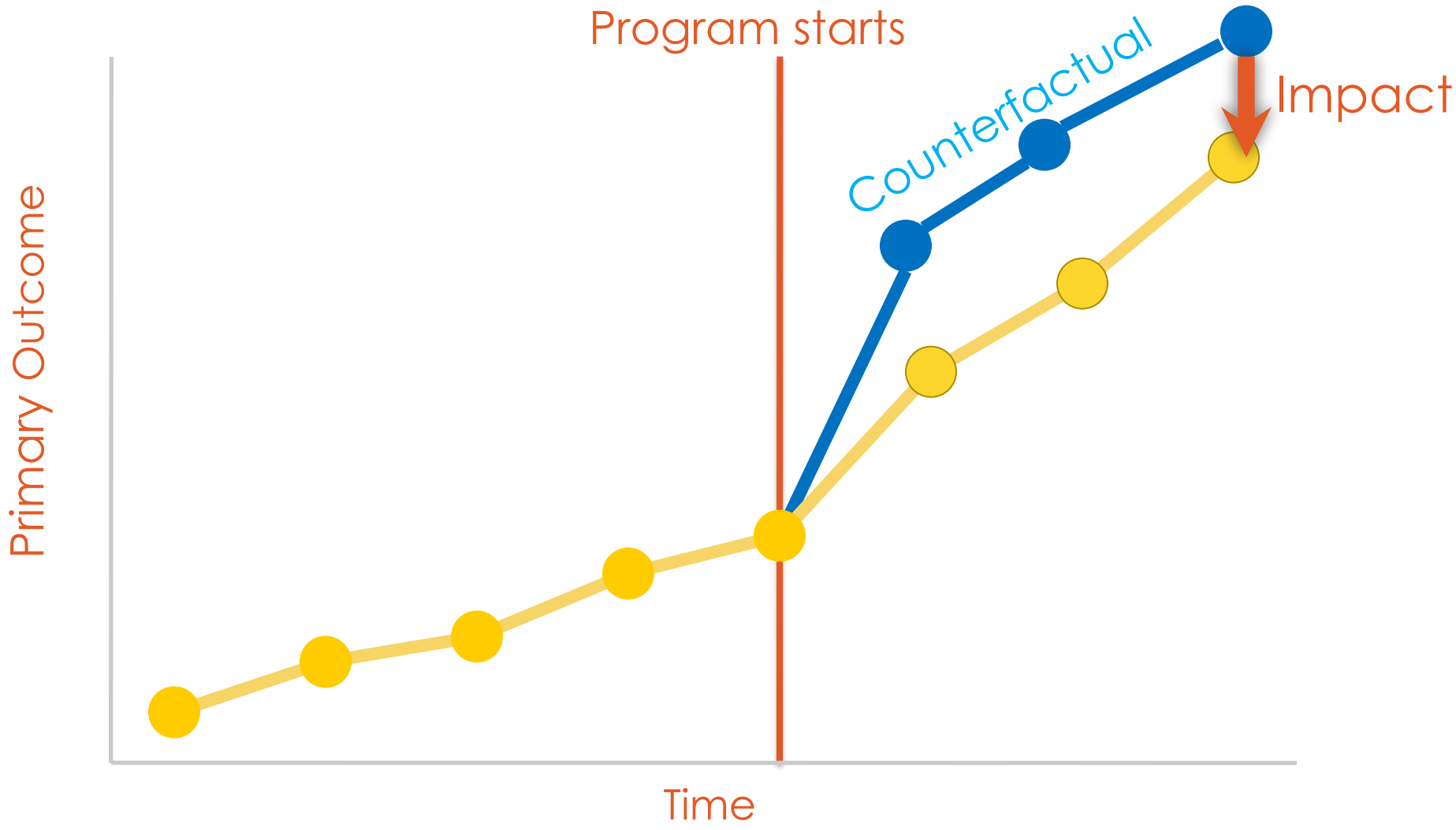
Impact is defined as the difference between:

1. the outcome some time after the program has been introduced (the *"factual"*)

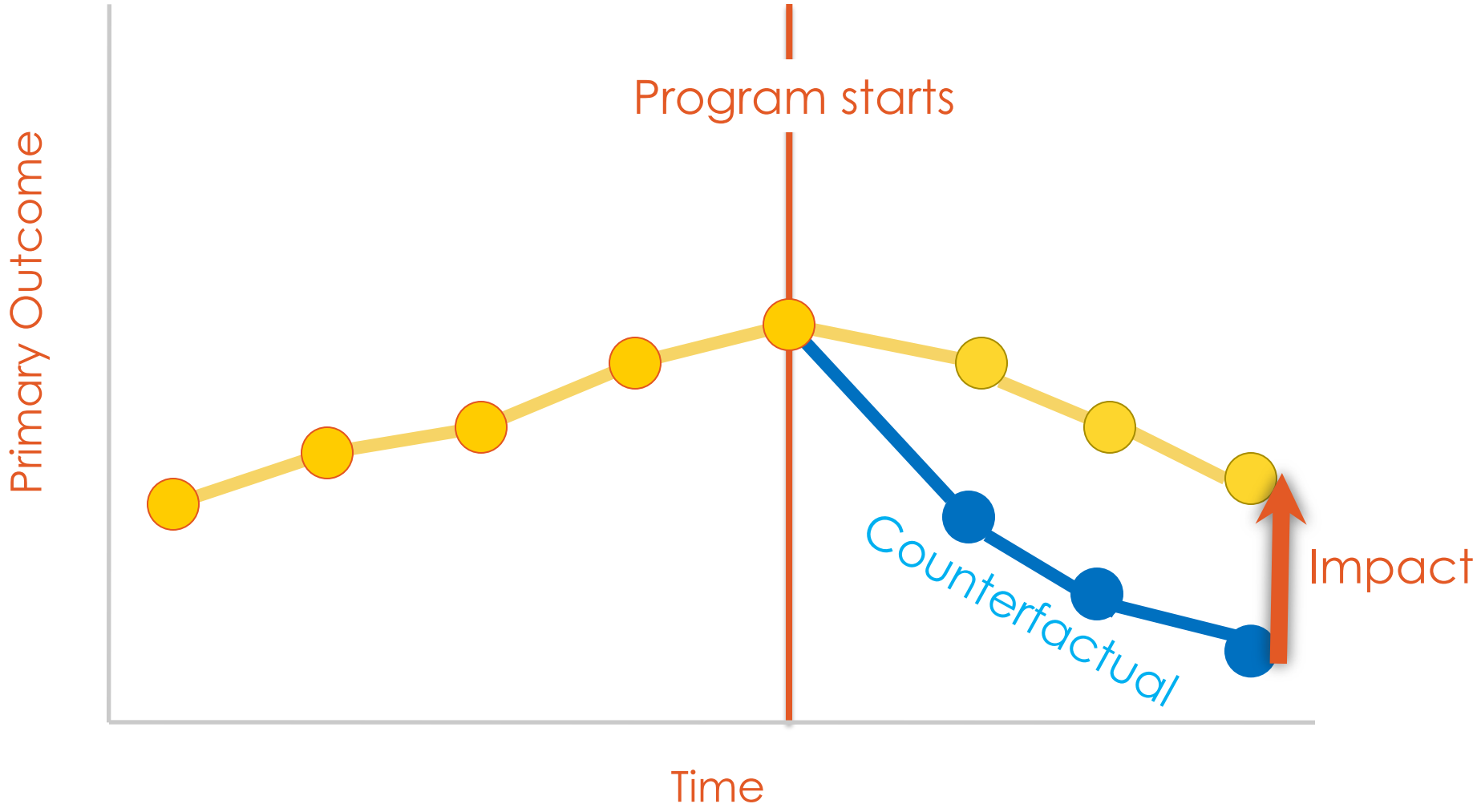
2. the outcome at that same point in time had the program not been introduced (the *"counterfactual"*)

$$factual - counterfactual = impact$$

Impact: What is it?



Impact: What is it?



Counterfactual

The ***counterfactual*** represents the world that program participants would have experienced in the absence of the program

Problem: Counterfactual cannot be observed

Solution: We need to "mimic" or construct the counterfactual

Constructing the counterfactual

- Usually done by selecting a group of individuals that ***did not*** participate in the program
- This group is usually referred to as the ***control group*** or ***comparison group***
- How this group is selected is a **key decision** in the design of any impact evaluation

Selecting the comparison group

- Idea: Comparability

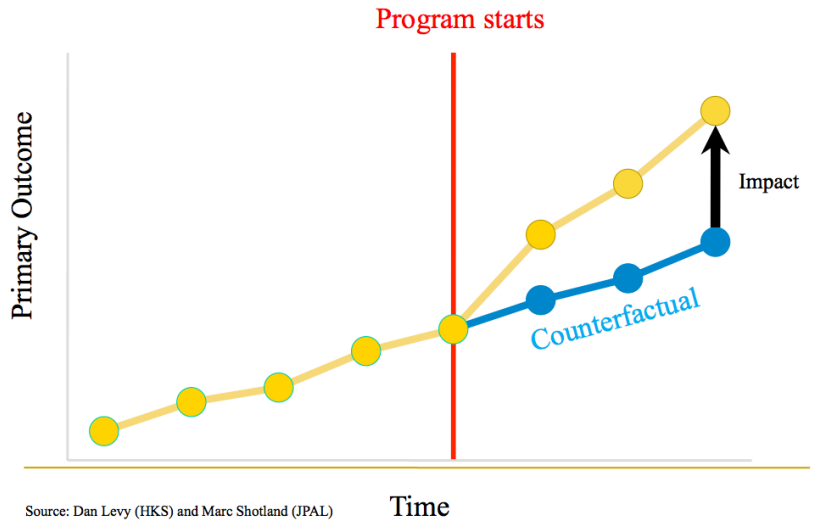
Treatment

Comparison

- Goal: Attribution

3 Key Ideas about Impact

1 - Counterfactual



Source: Dan Levy (HKS) and Marc Shotland (JPAL)

2 – Comparison group mimics the counterfactual

Treatment

Comparison

3 - Goal of Impact Evaluations: Attribution

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II – Why randomize case study

Workplace Wellness Programs

Problem: Medical spending has risen rapidly over the past several decades, especially in the U.S.

Proposed solution: Employer-sponsored workplace wellness programs

- *Goal: reduce costs by improving employee health*
- Activities include:
  - Health screenings
  - Fitness programs
  - Classes on leading healthy lifestyles

Source: Illinois Workplace Wellness Study

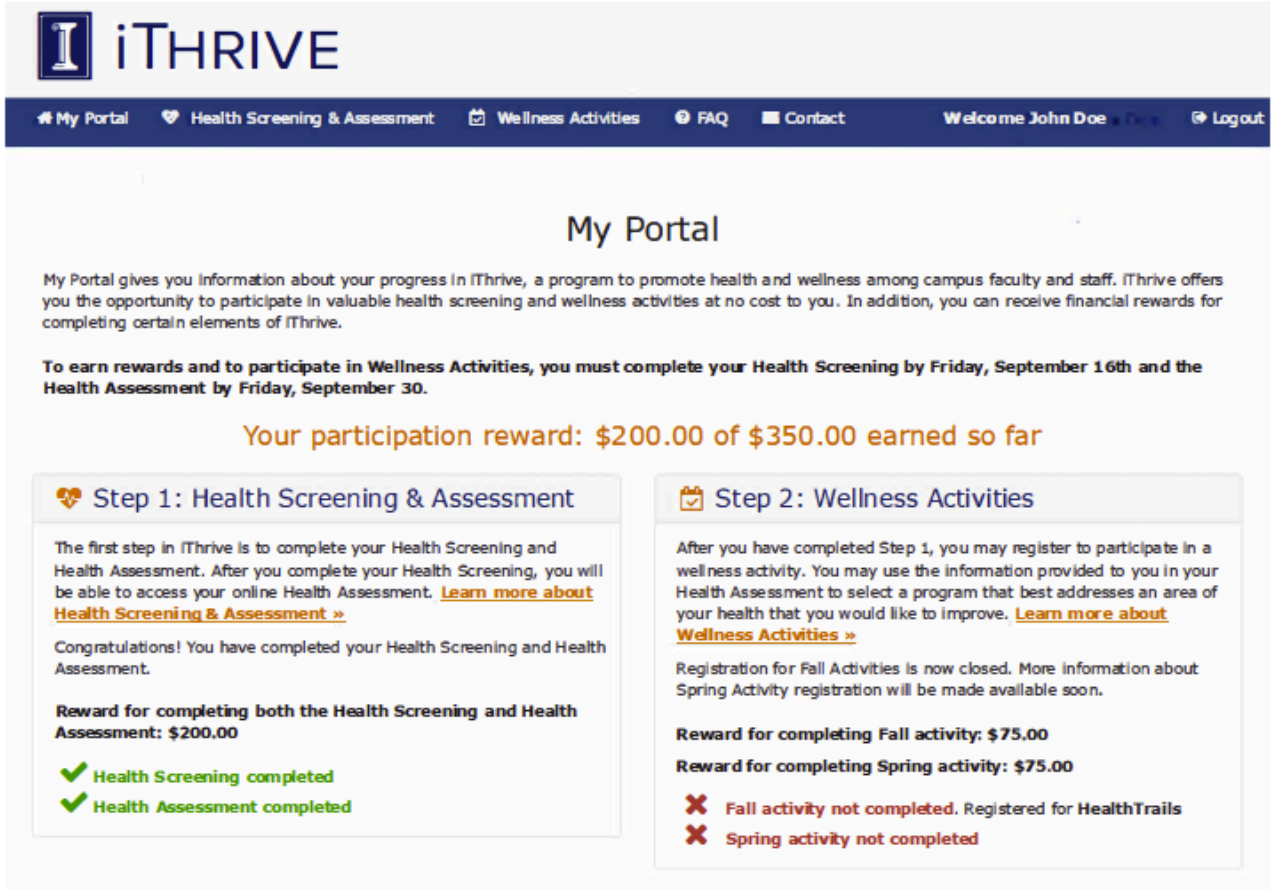
Relevance to other settings

- This is a U.S.-based example, but the takeaways translate to any setting where some people participate in a program, and some do not
- Examples include evaluations of:
  - Low-interest microfinance loans on business growth
  - Vouchers for fertilizer on crop yields
  - Subsidized meals for school children on learning
  - Subsidized chlorine dispenses on water quality and child health
  - Subsidized vaccination programs on child health
  - Subsidized bed-nets on malaria
- Challenge is the same: find a valid counterfactual for participants

The Illinois Workplace Wellness Study

In 2016, University of Illinois launched the *iThrive* Wellness Program

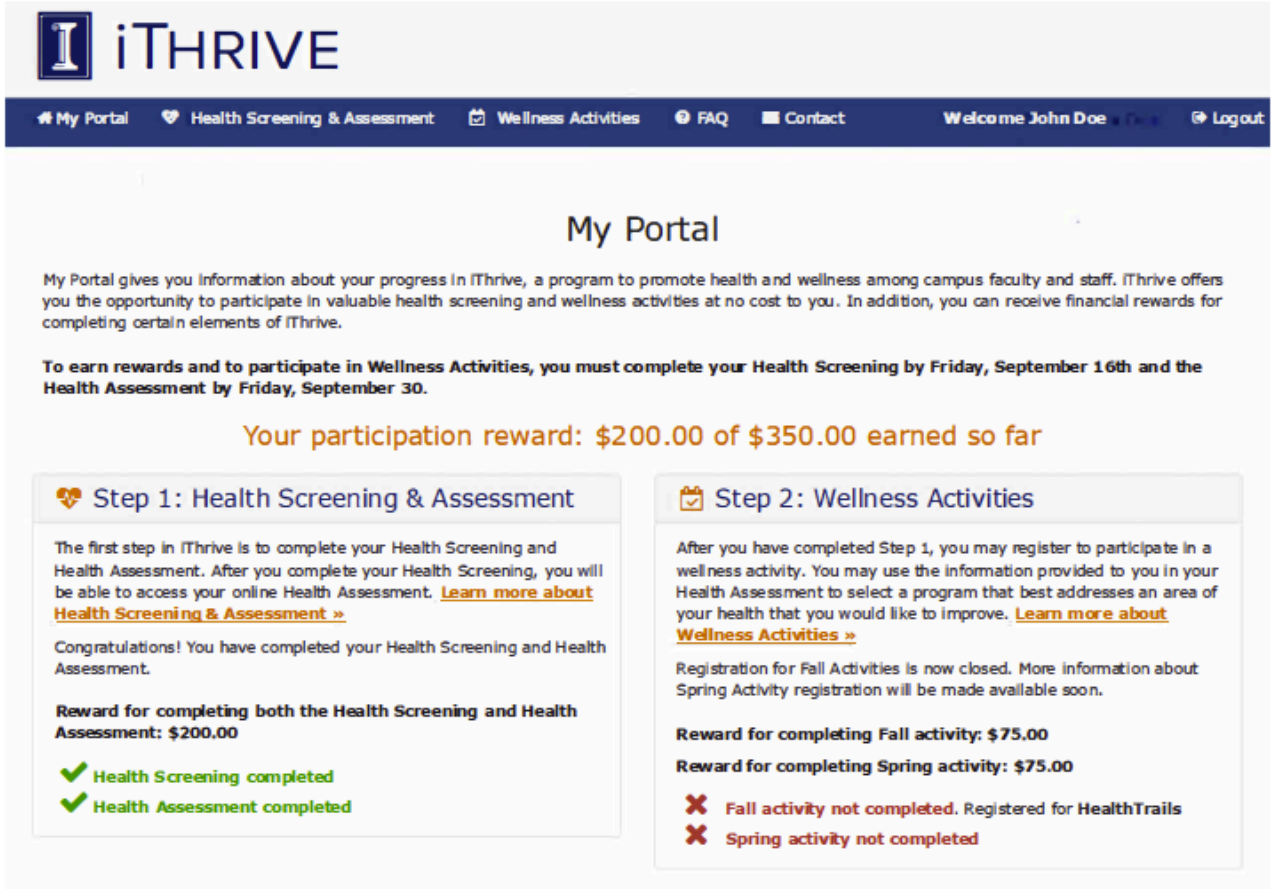
- Biometric screening and health risk assessment
- Wellness activities such as:
  - Exercise classes
  - WeightWatchers
  - Smoking cessation
  - Stress management



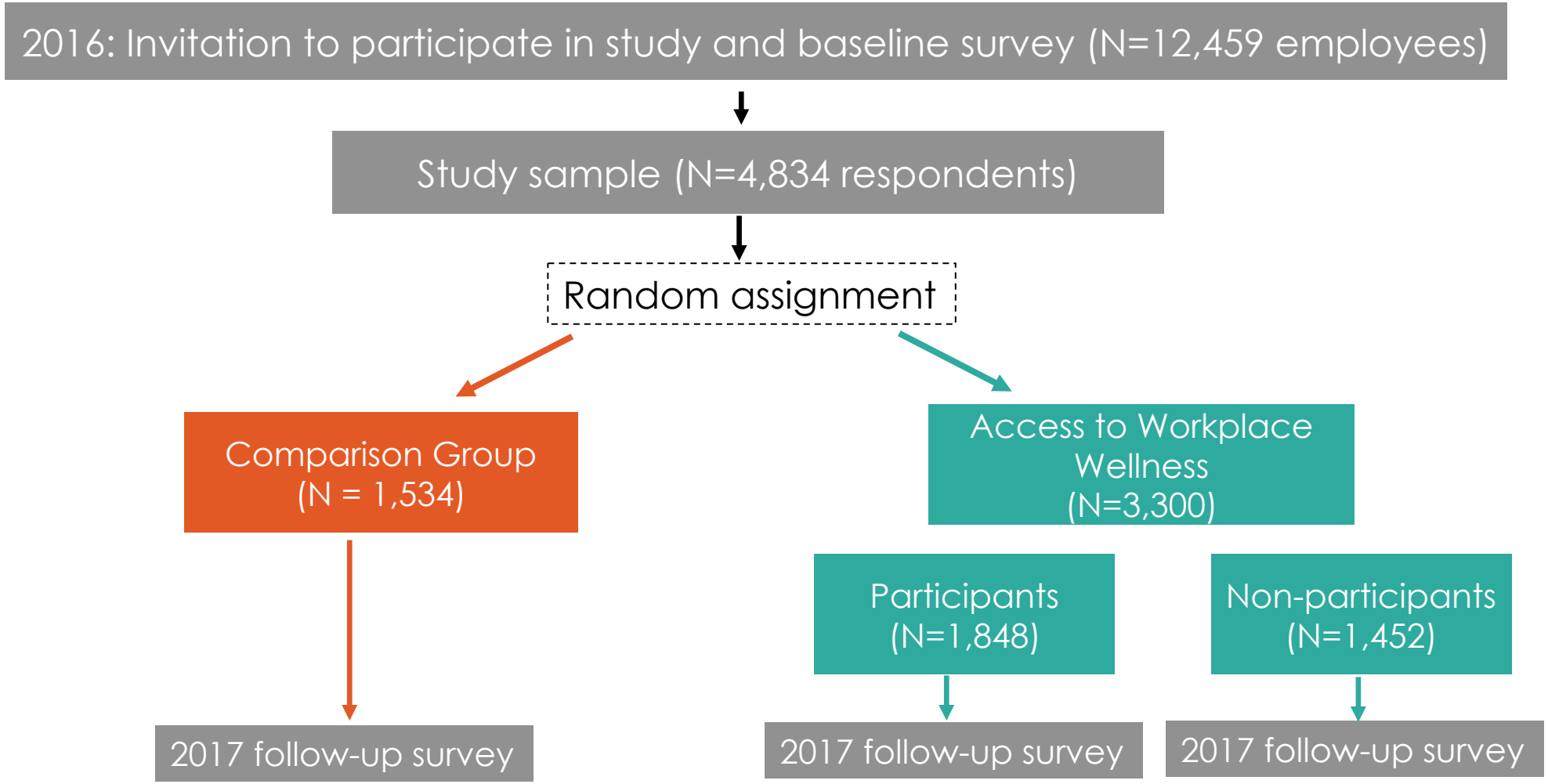
The Illinois Workplace Wellness Study

Research team focused on three key questions:

- Do wellness programs help employees live healthier lifestyles?
- Are these changes sufficient to lower medical spending?
- Can they also improve employee productivity?



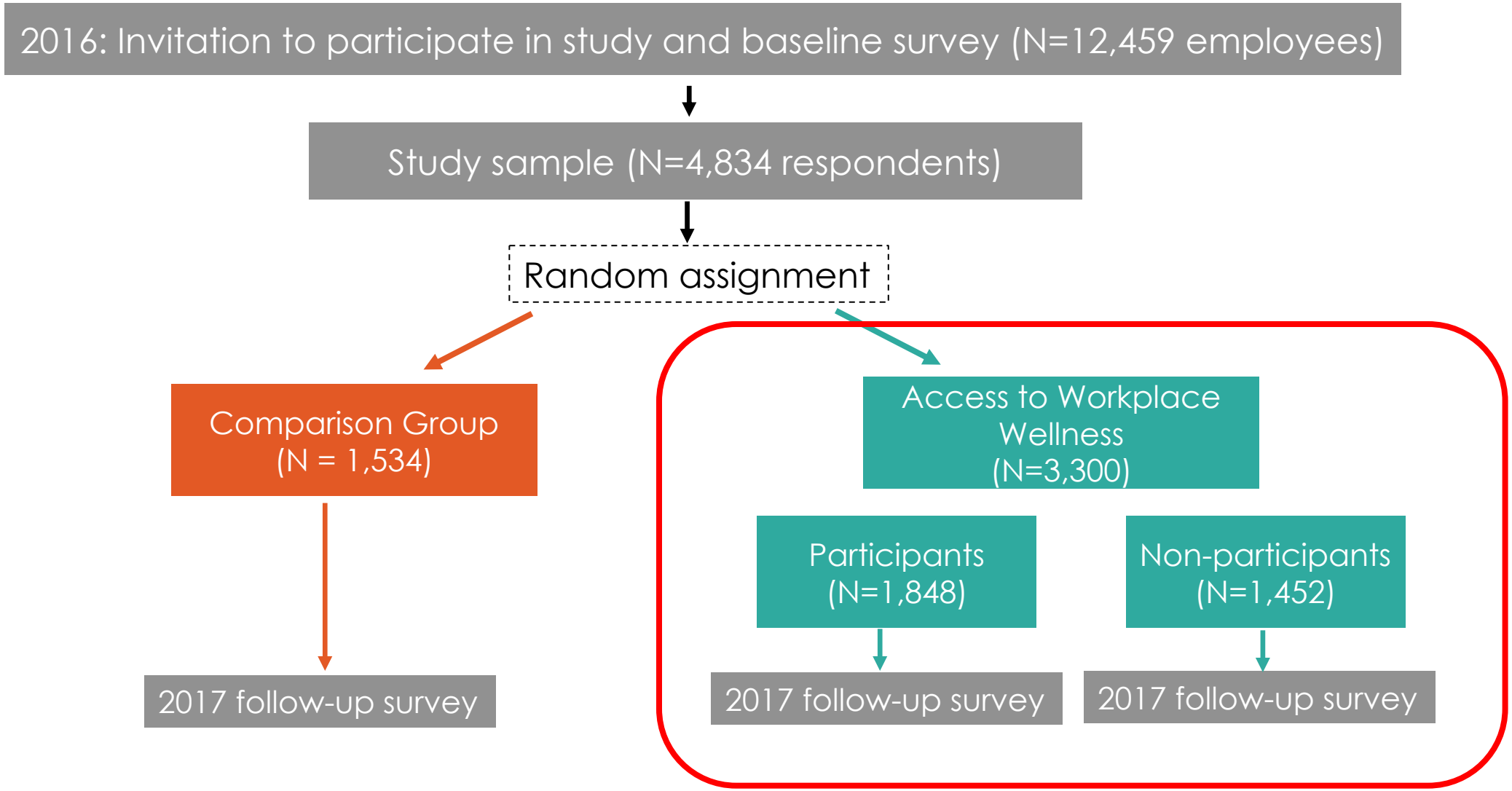
The Illinois Workplace Wellness Study



Outcomes and Data

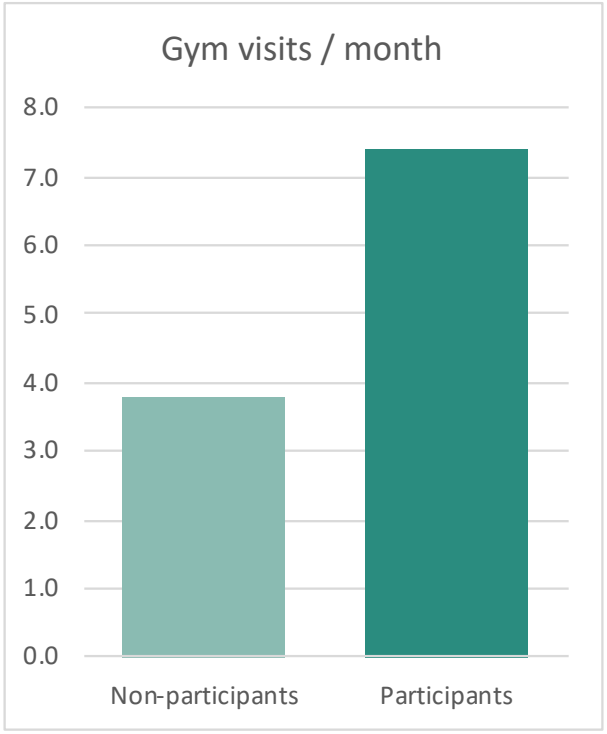
- Employee fitness
  - Campus gym visits per month
- Medical spending
  - Insurance claims of in-patient, out-patient, and pharmaceutical spending
- Employee productivity
  - Index of: Promotion, job retention, sick leave taken, hours worked per week, and self-reported job satisfaction and productivity
- Background data
  - Age, gender, race, and socio-economic status

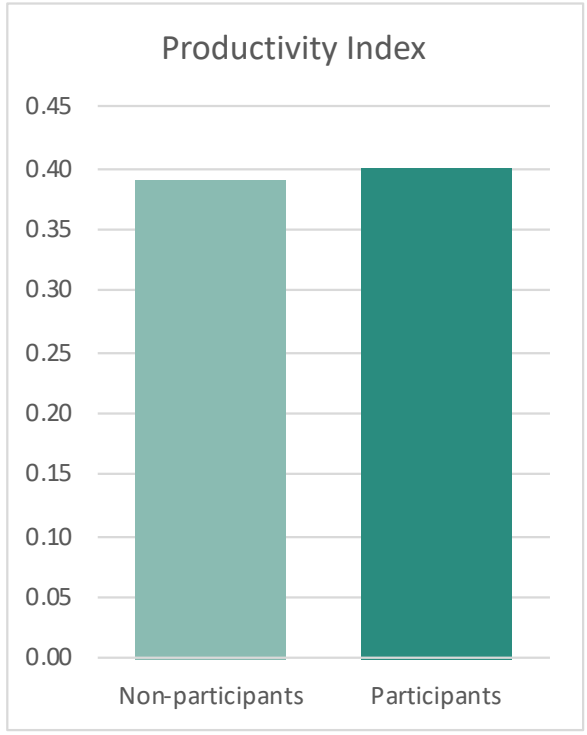
The Illinois Workplace Wellness Study



Simple difference

Compare employees who participated in the program to those that did not





Simple Difference

Counterfactual: Non-participants' frequency of gym visits, levels of spending, and productivity

Key assumption: Participants' would have had the same levels of these outcomes as non-participants *if they had not received the program*

Which of these scenarios would make the simple difference comparison misleading? (select all that apply)

- A: Healthcare costs tend to increase overtime
- B: Participants *live closer to campus* than non-participants
- C: Participants are *younger* than non-participants

Simple Difference

Counterfactual: Non-participants' frequency of gym visits, levels of spending, and productivity

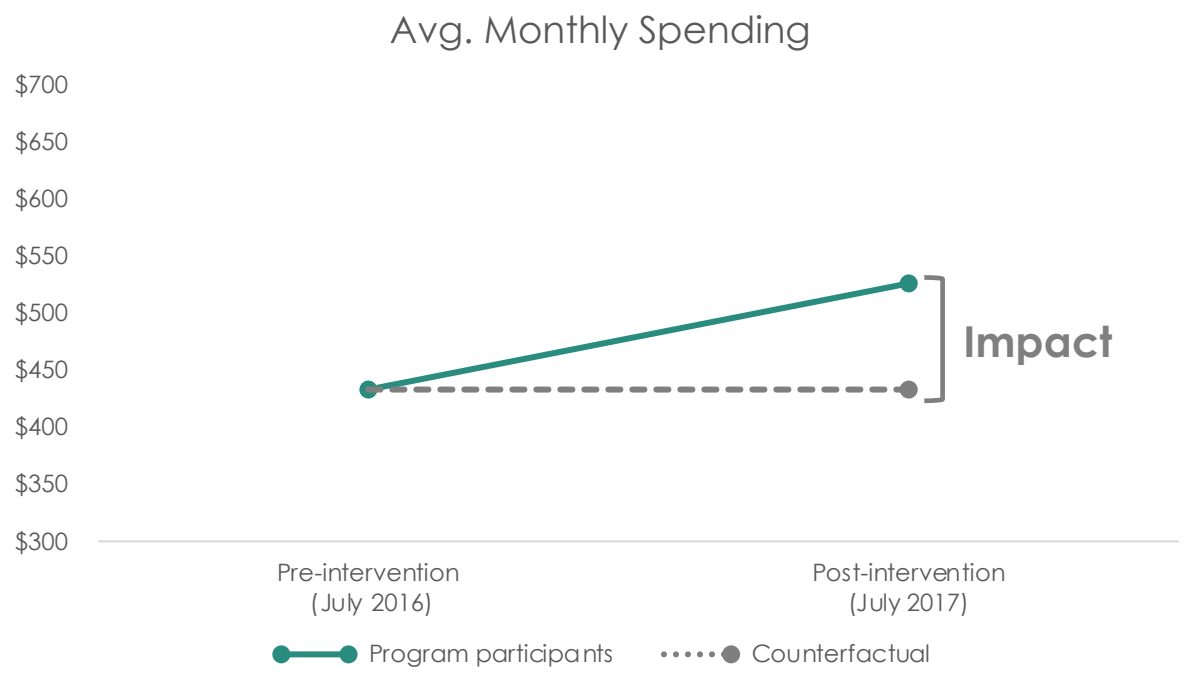
Key assumption: Participants' would have had the same levels of these outcomes as non-participants *if they had not received the program*

What might threaten this assumption: Any systematic difference between participants and non-participants that influences our outcomes

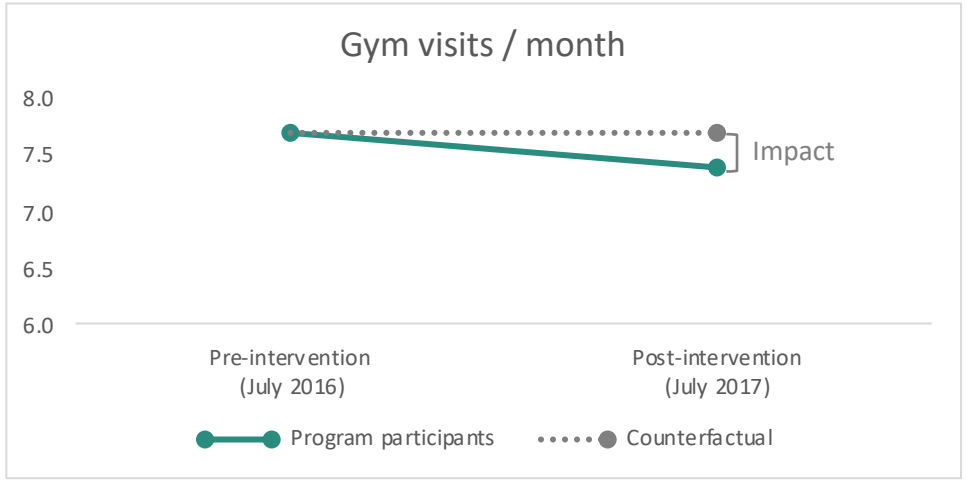
Statisticians call this ***selection bias***, because those who "select in" to a program are different from those who do not in terms of their pre-program outcomes

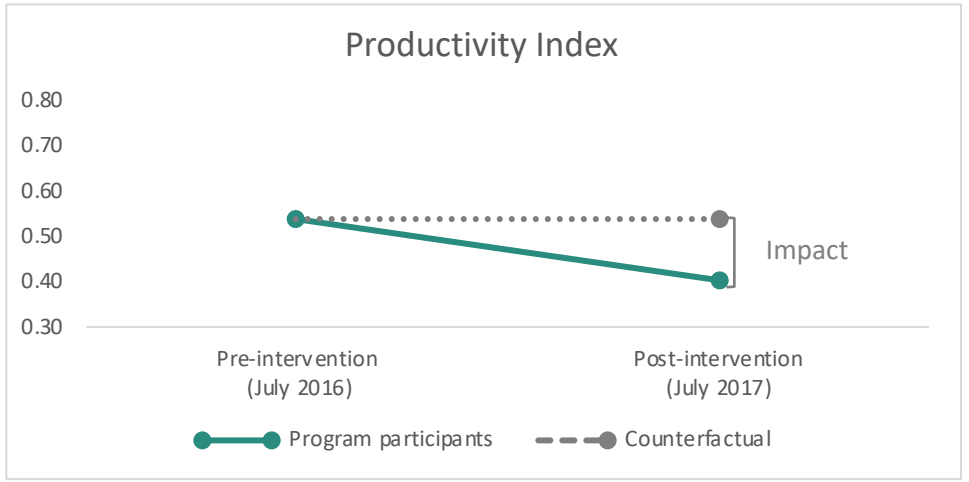
Pre-Post (Before vs. After)

Compare participants' outcomes before the program to their outcomes after the program



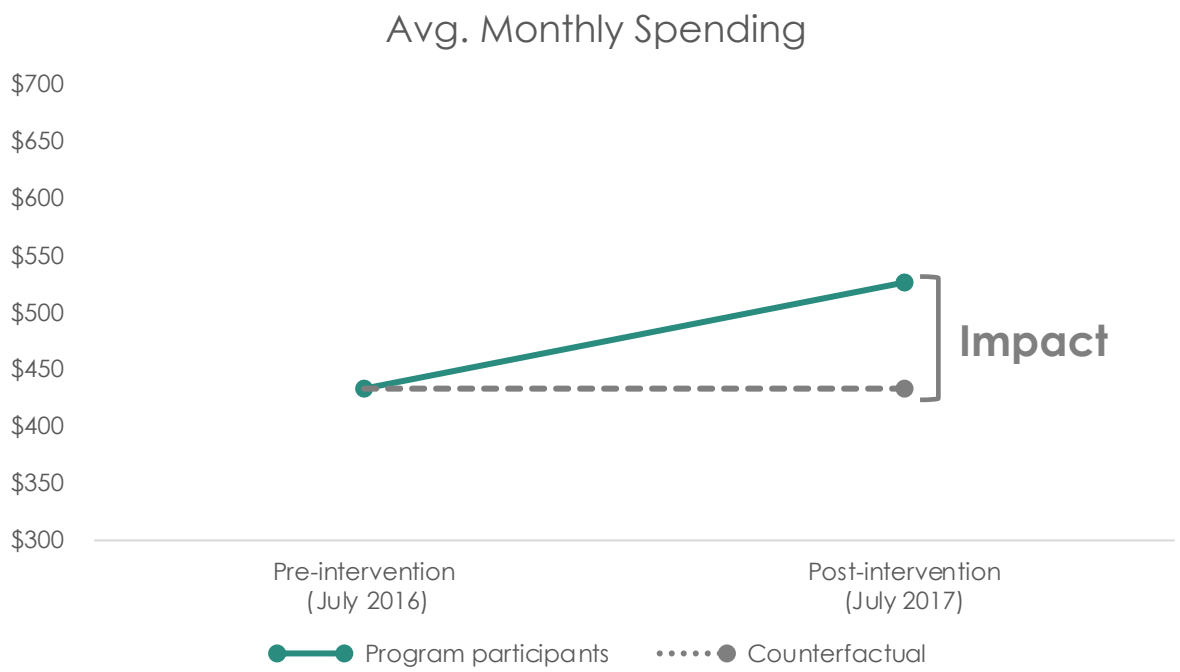
Pre-Post (Before vs. After)





Pre-Post (Before vs After)

Counterfactual: Participants' average levels of fitness, spending, and productivity *before the program*



Pre-Post (Before vs After)

Counterfactual: Participants' average levels of fitness, spending, and productivity *before the program*

Assumptions: Participants' fitness, spending, and productivity would not have changed over time in the absence of the program

Which of these scenarios would make the pre-post comparison misleading? (select all that apply)

- A: Healthcare costs tend to increase overtime
- B: Participants *live closer to campus* than non-participants
- C: Participants are *younger* than non-participants

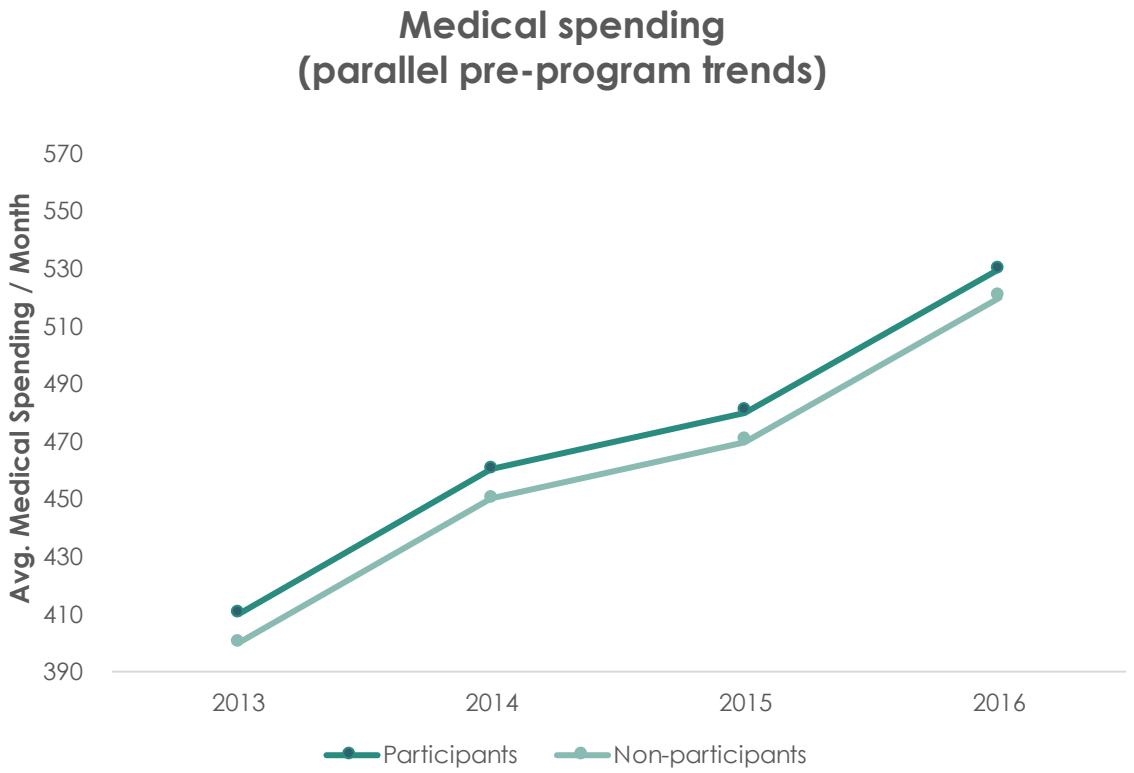
Pre-Post (Before vs After)

Counterfactual: Participants' average levels of fitness, spending, and productivity *before the program*

Assumptions: Participants' fitness, spending, and productivity would not have changed over time in the absence of the program

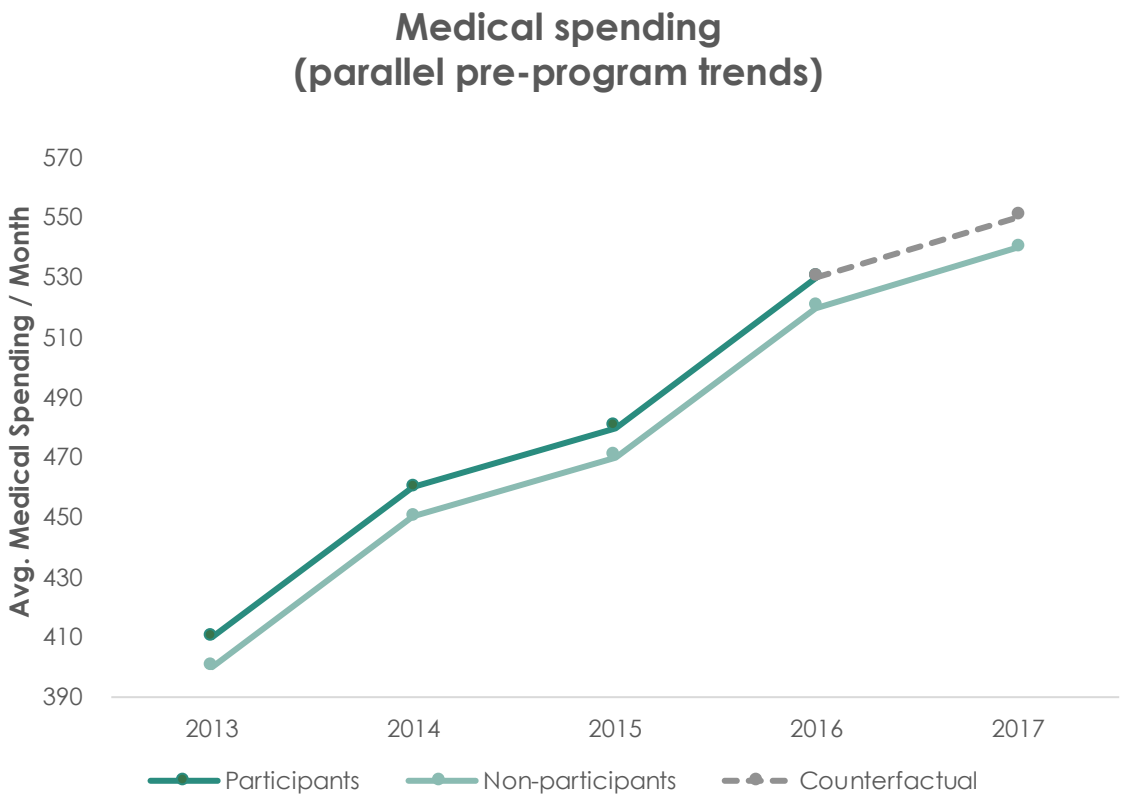
What might threaten this assumption: Any factor that influences these outcomes overtime

Difference-in-differences



Note: Figure is illustrative and not based on actual study data

Difference-in-differences



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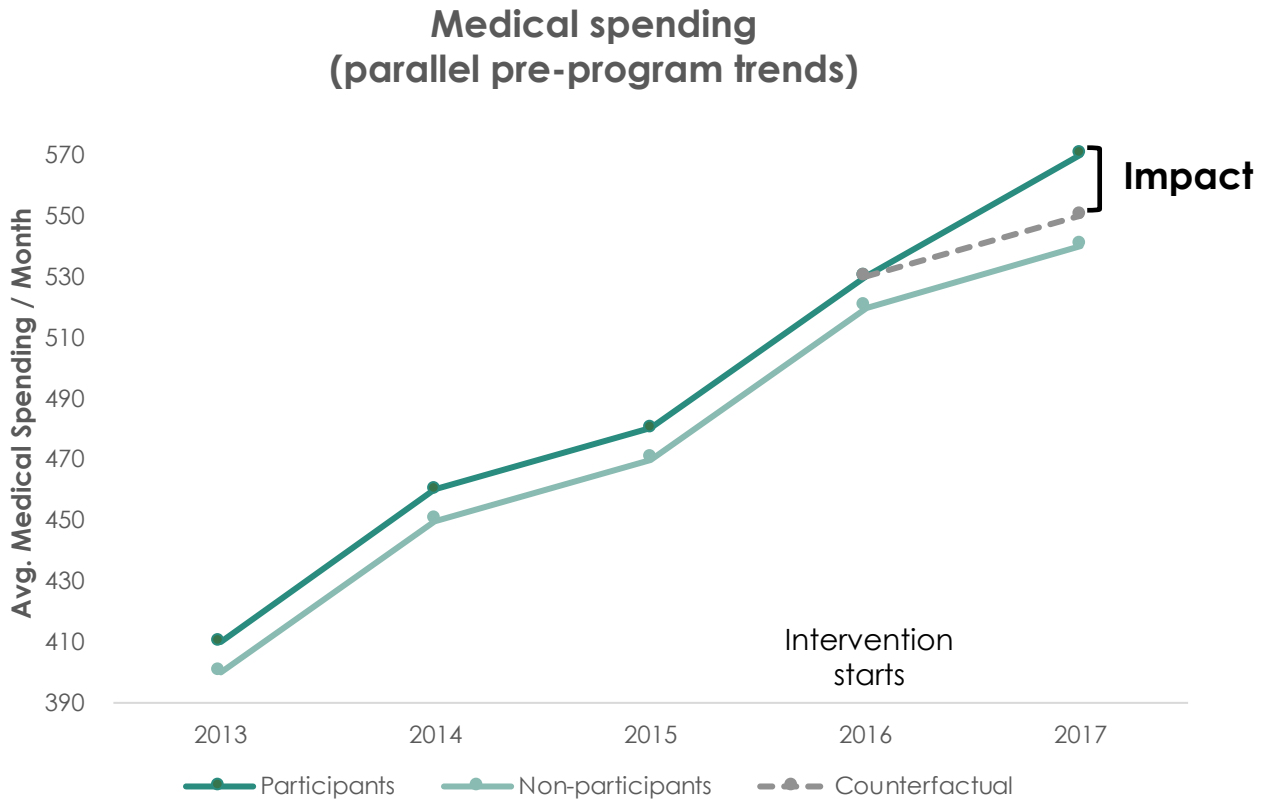

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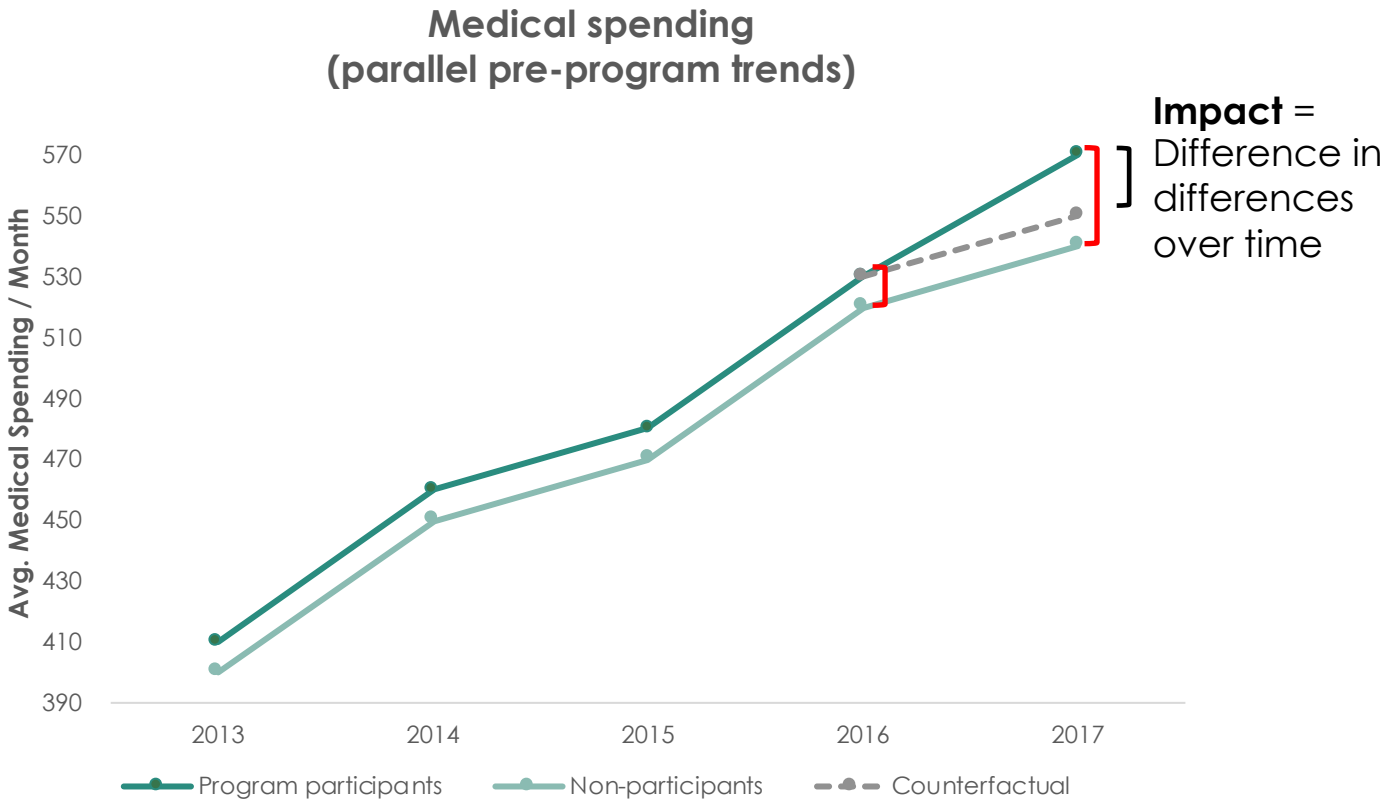

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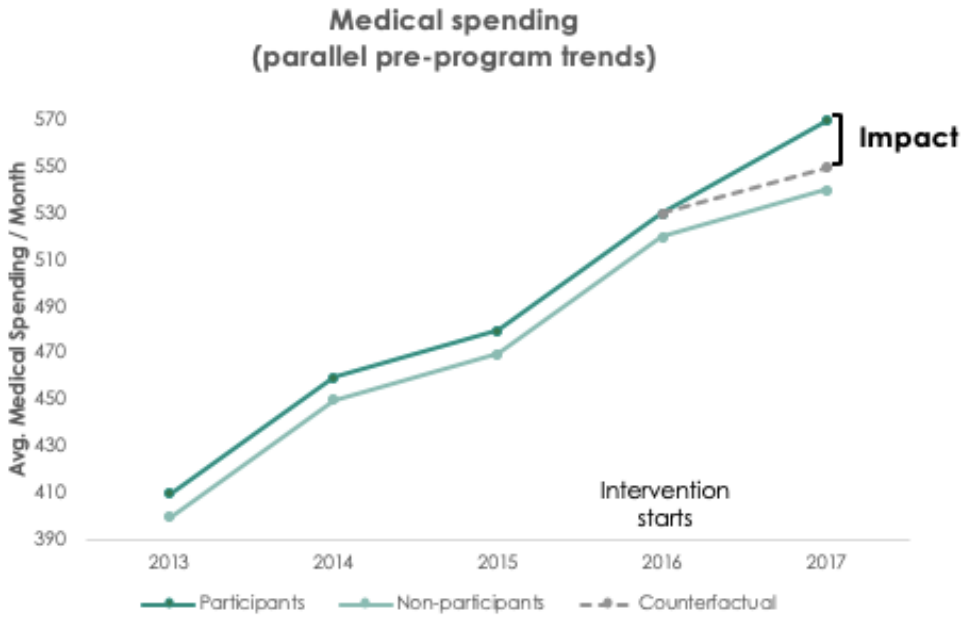
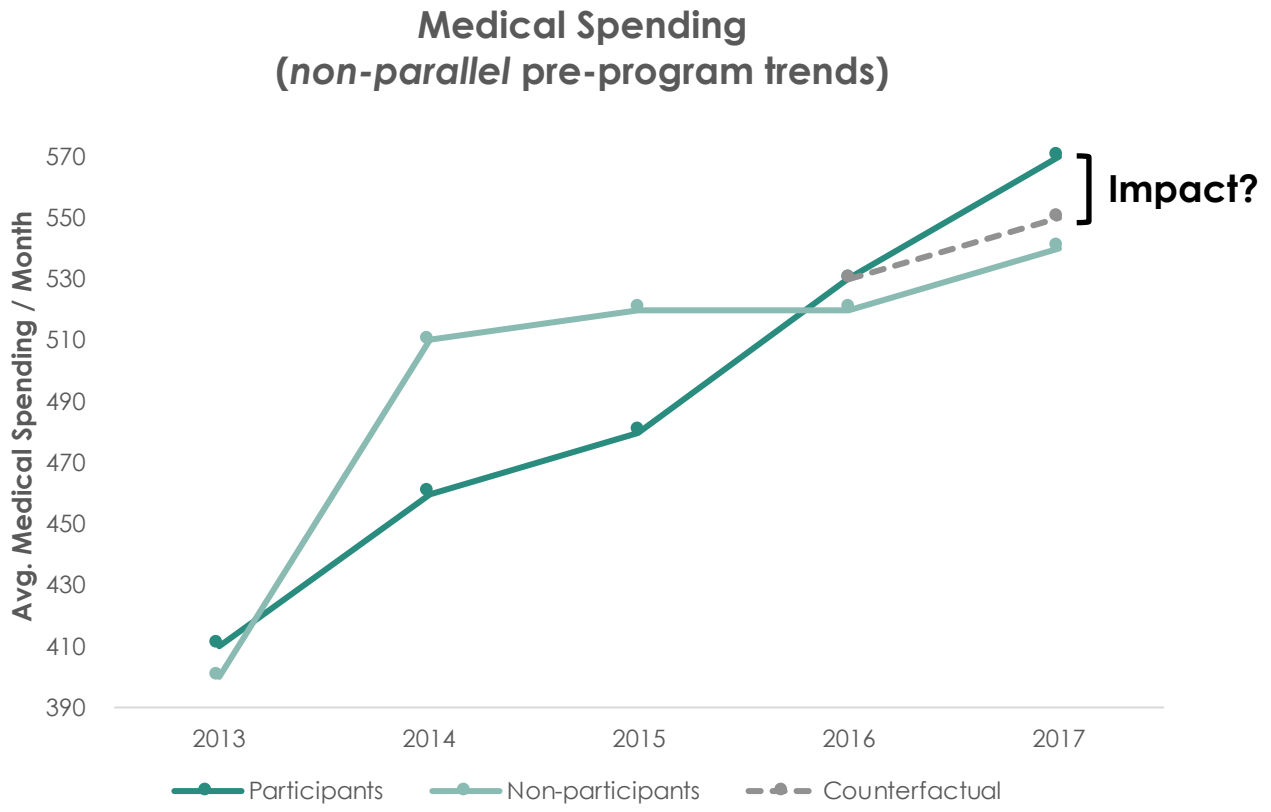
Difference-in-differences

What's the counterfactual? Pre / post change over time in medical spending among *non-participants*

Assumptions: Absent the program, participants and non-participants would have the same trajectory over time with respect to medical spending ("**parallel trends**" assumption)



Difference-in-differences

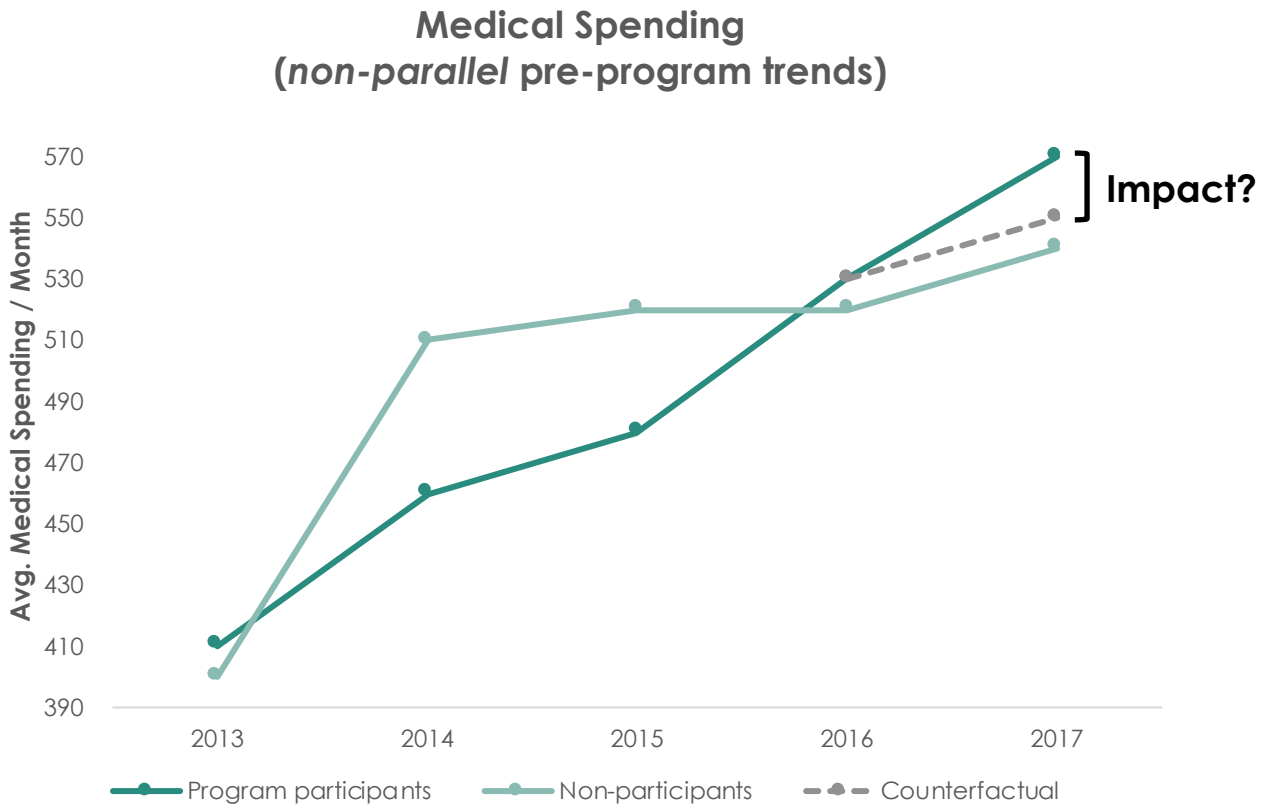


Note: Figure is for instructional purposes only and not based on actual study data

Which of these scenarios would lead to non-parallel trends? (select all that apply)

- A: Healthcare costs tend to increase overtime
- B: Participants are *older* than non-participants
- C: An effective but expensive drug for a common chronic condition among older adults enters the market in 2014
- D: Options B and C at once

Difference-in-differences



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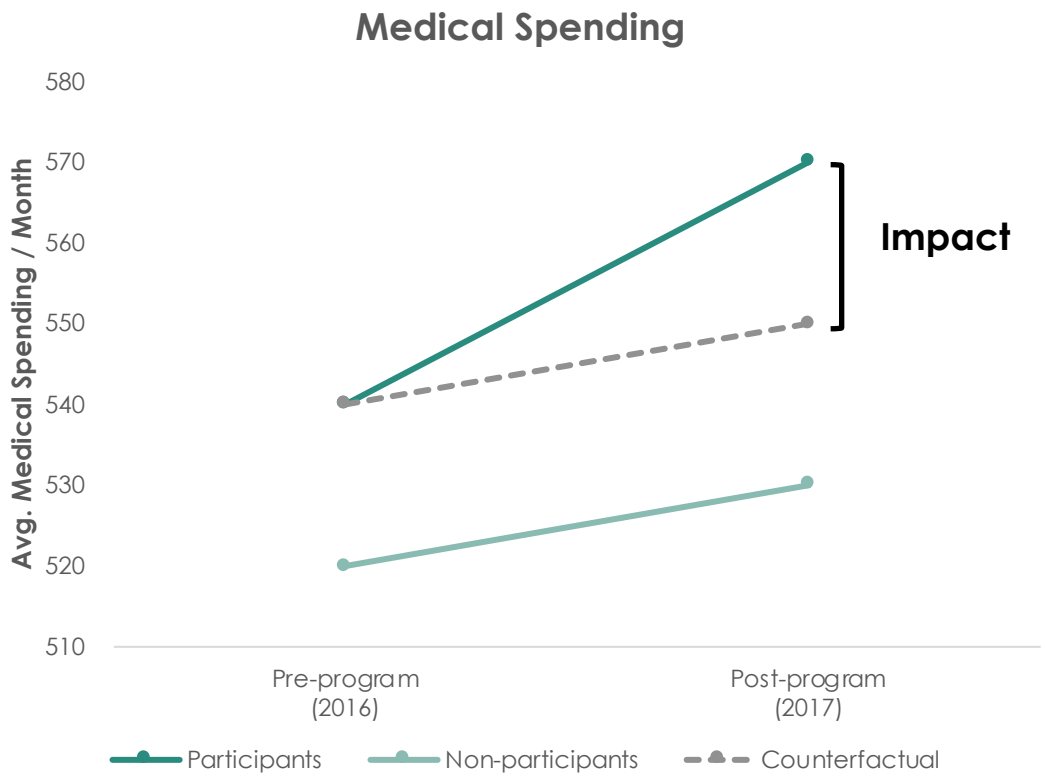
Difference-in-differences



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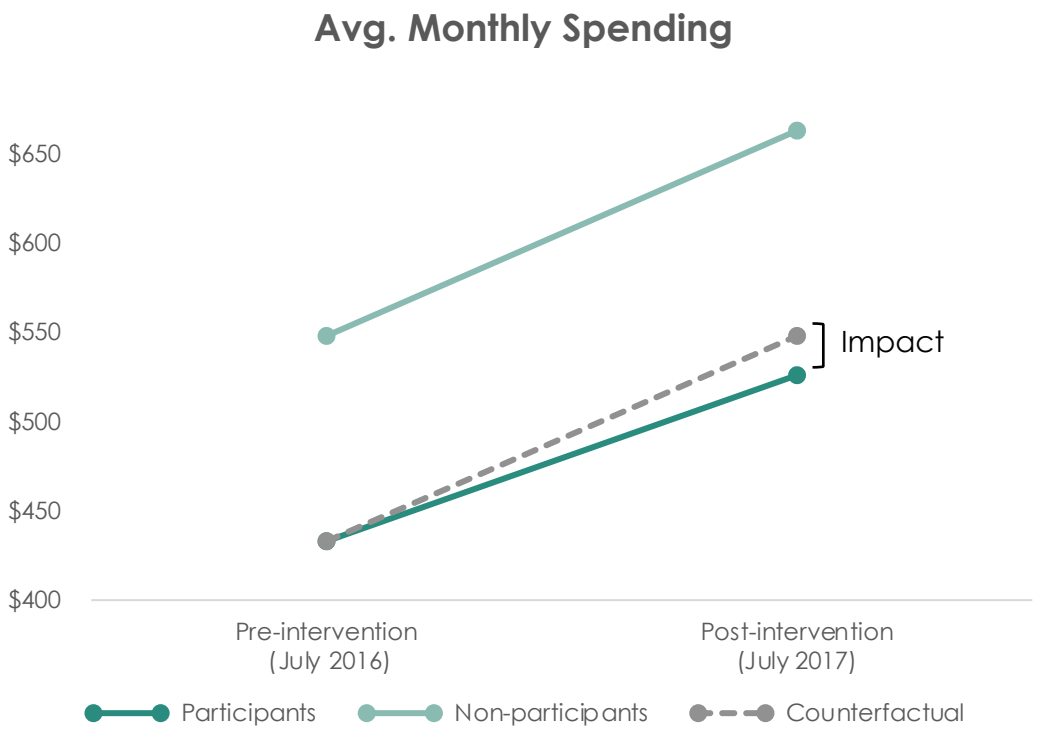
Difference-in-differences

What's the counterfactual? Pre / post change over time in medical spending among *non-participants*

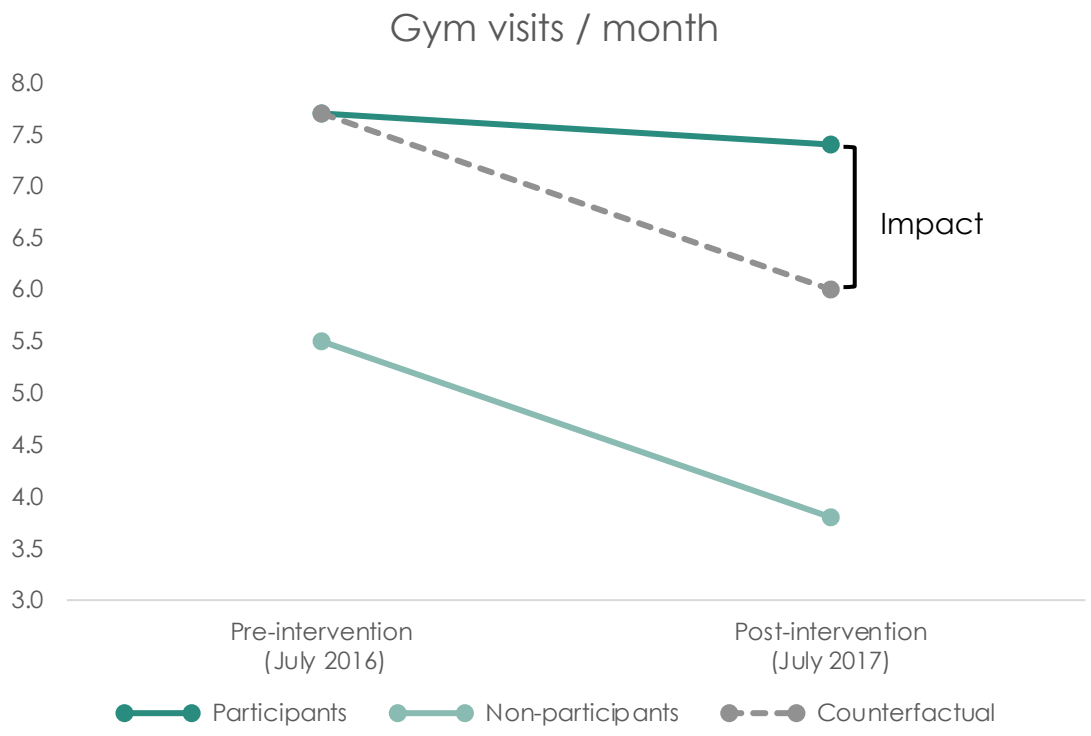
Assumptions: Absent the program, participants and non-participants would have the same trajectory over time with respect to medical spending ("**parallel trends**" assumption)

What might threaten this assumption: Any change over time that disproportionately impacts either group

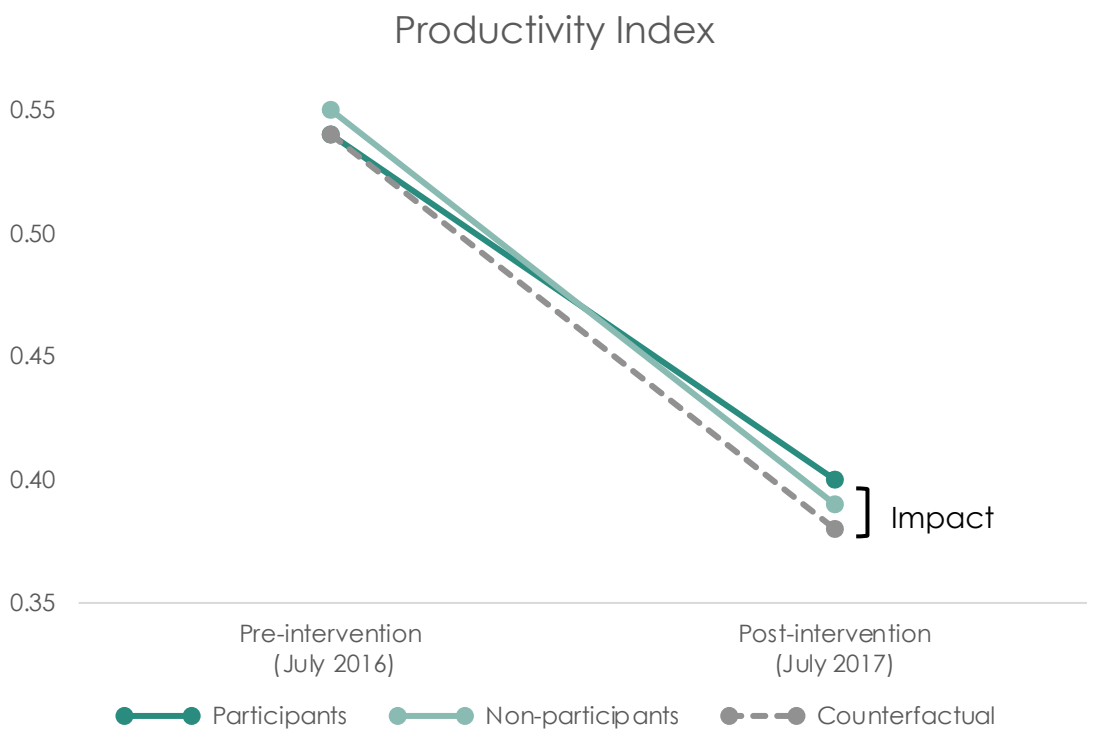
Difference-in-differences - results



Difference-in-differences - results



Difference-in-differences - results



Recap of results so far

Method	Gym visits / month	Medical Spending	Productivity
(1) Pre-Post	3.5**	-$137**	0.01
(2) Simple Difference	-0.4	$100**	-.15**
(3) Difference-in-Differences	1.34**	-$9.6	0.01

Statistical Control - Matching

Motivation: Before the intervention, participants were different from non-participants in various ways

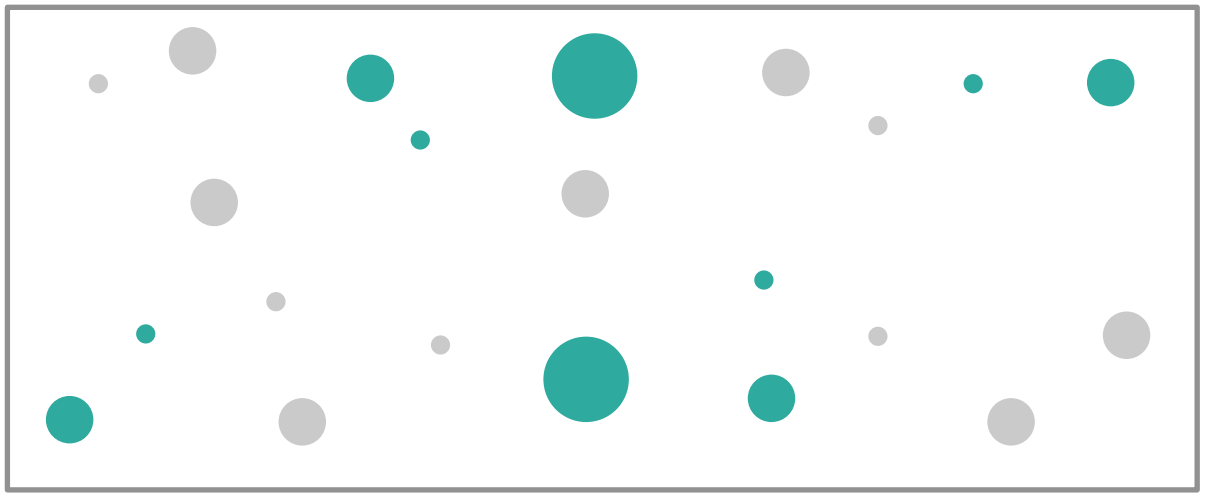
Table 1 - Pre-intervention characteristics by participation status, before matching

	Non-participants	Participants	Difference	N
Avg. monthly spending (pre-intervention)	$527	$423	$103**	2188
Gym visits per month (pre-intervention)	5.6	7.7	-2.2**	3300
Productivity index (pre-intervention)	0.55	0.54	0.01*	3251
Male	46%	40%	6%**	3300
Age	44.1	43.6	0.4	3300
Caucasian	84%	84%	0%	3300
Above median salary	48%	51%	3%*	3300
Faculty	23%	18%	5%*	3300

Notes: ***, **, and * indicate significance at the p-value < .01, .05, and .10 levels. Sample sizes vary across outcomes due to missing data.

Statistical Control - Matching

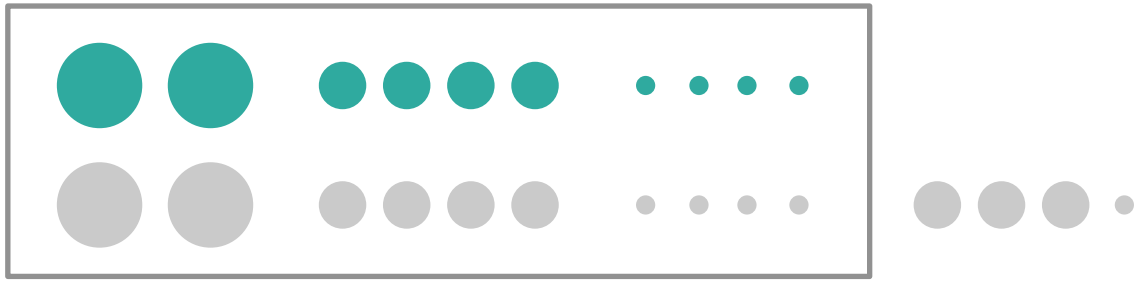
Population with varying characteristics



Treatment

Comparison

Study group with matching



Statistical Control - Matching

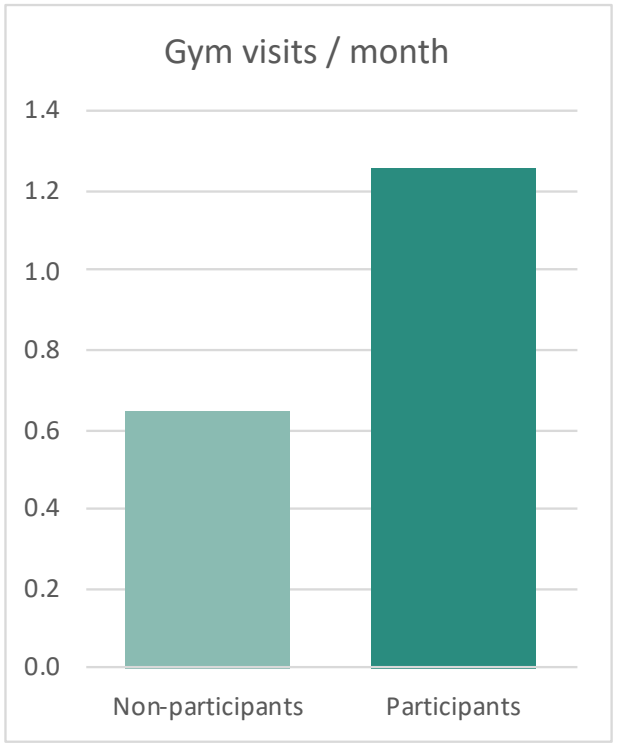
After matching, participants look more similar to non-participants, but sample size is smaller

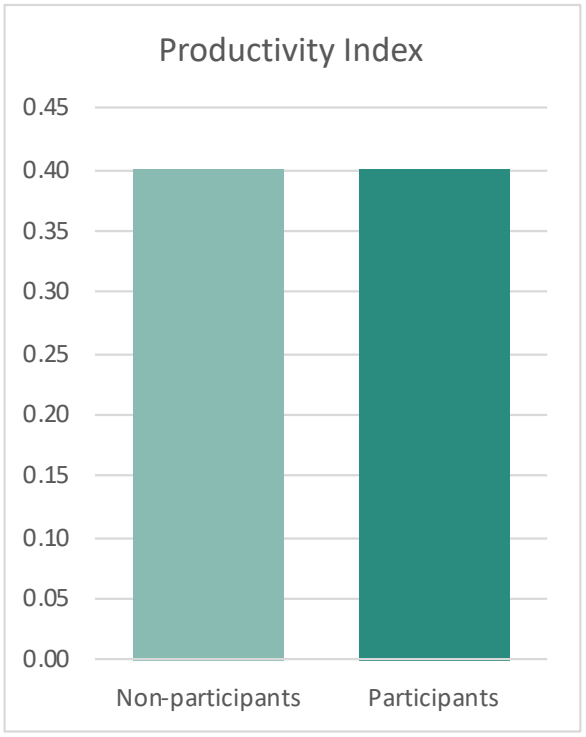
Table 2 - Pre-intervention characteristics by participation status, after matching

	Non-participants	Participants	Difference	N
Avg. monthly spending (pre-intervention)	$203	$184	$19	1109
Gym visits per month (pre-intervention)	0.47	0.33	0.14	1109
Productivity index (pre-intervention)	0.54	0.54	0.0	1109
Male	0.45	0.39	6%**	1109
Age	43.1	42.7	0.4	1109
Caucasian	91%	93%	2%	1109
Above median salary	48%	48%	0%	1109
Faculty	11%	8%	3%	1109

Notes: ***, **, and * indicate significance at the p-value < .01, .05, and .10 levels. Sample sizes vary across outcomes due to missing data.

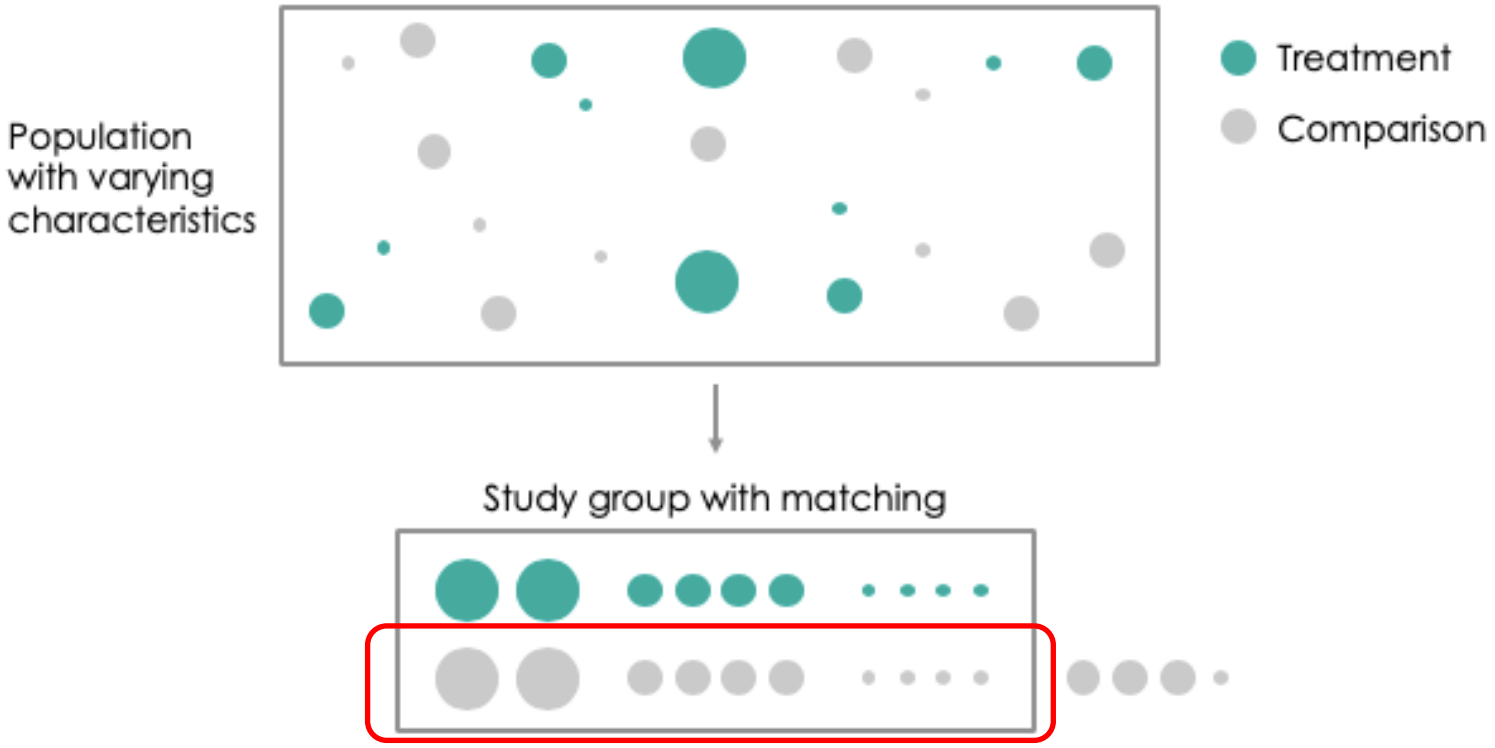
Statistical Control – Matching





Statistical Control - Matching

Counterfactual: Gym visits, levels of spending, and productivity among non-participants for whom there was a comparable participant match



Statistical Control - Matching

Counterfactual: Gym visits, levels of spending, and productivity among non-participants for whom there was a comparable participant match

Key assumption: Participants' would have had the same levels of these outcomes as their non-participant matches *if they had not received the program*

Which of these scenarios would make participant vs. non-participant comparisons within the matched sample misleading? (select all that apply)

- A: Healthcare costs tend to increase overtime
- B: Participants are *older* than non-participants
- C: Participants are more *intrinsically motivated* to improve their health than non-participants

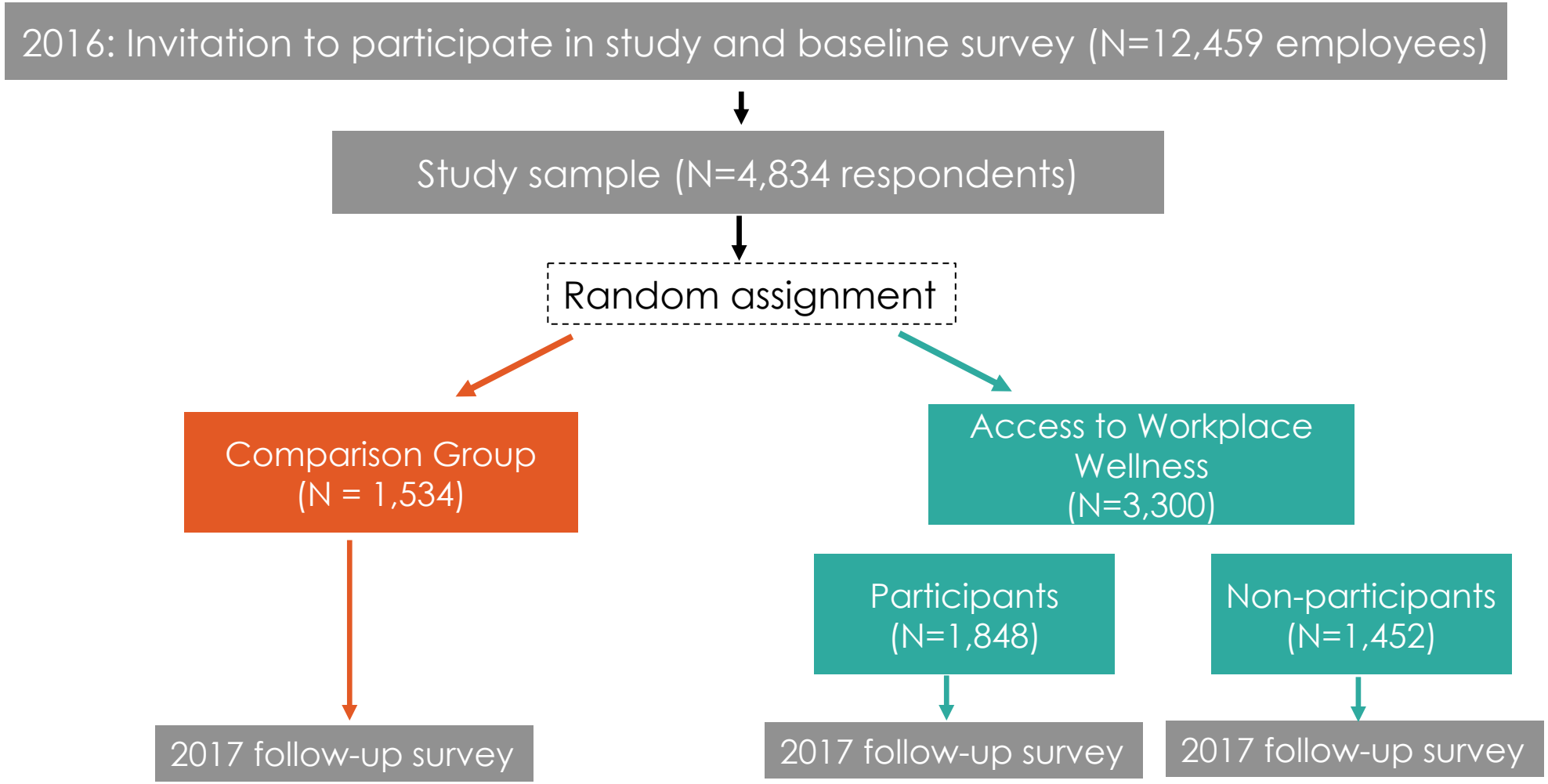
Statistical Control - Matching

Counterfactual: Gym visits, levels of spending, and productivity among non-participants for whom there was a comparable participant match

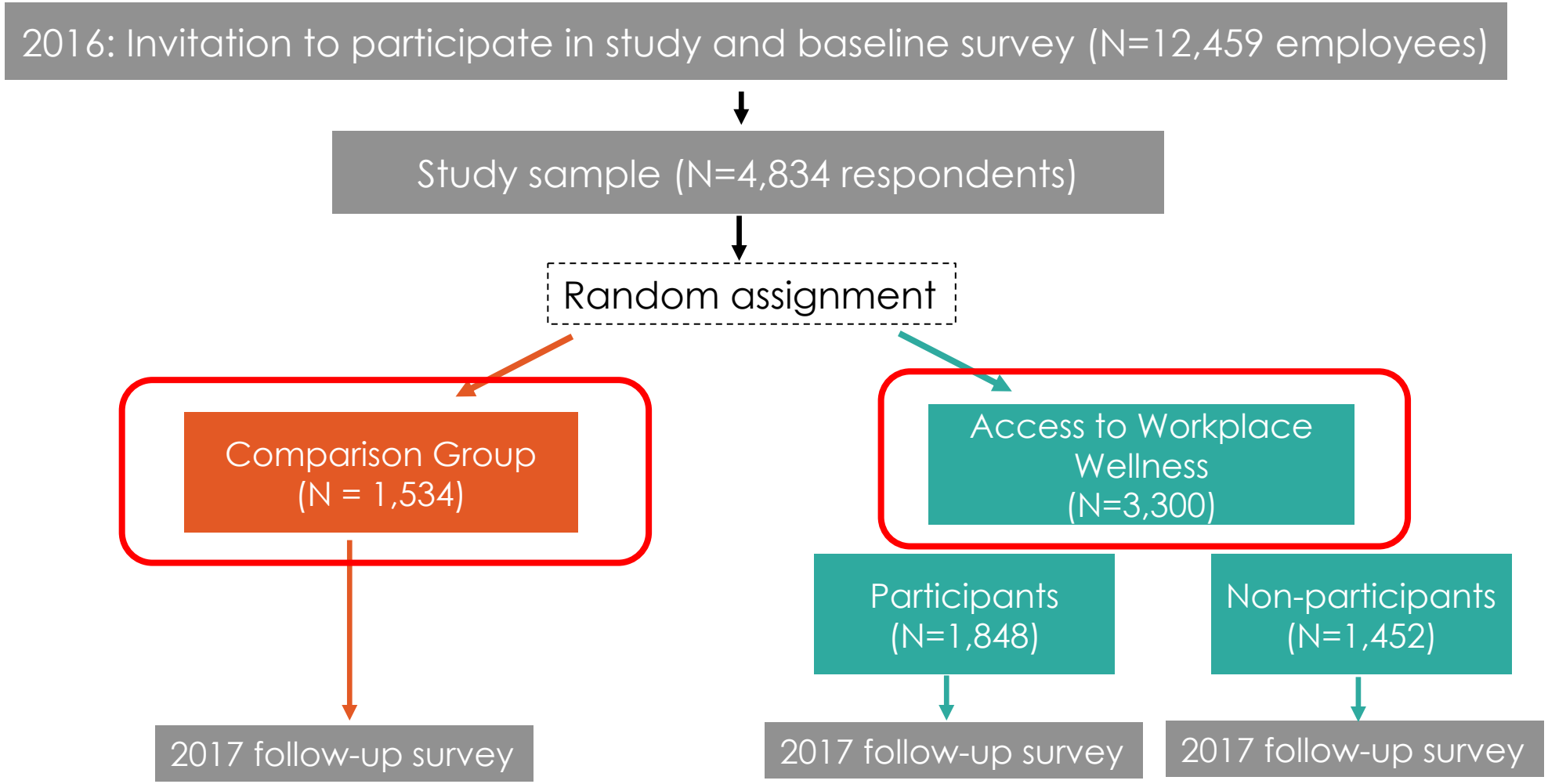
Key assumption: Participants' would have had the same levels of these outcomes as their non-participants matches *if they had not received the program*

What might threaten this assumption: Any systematic difference between participants and non-participants that we can't measure (or forget to measure), that also influences outcomes

Randomized Evaluation



Randomized Evaluation



Randomized Evaluation

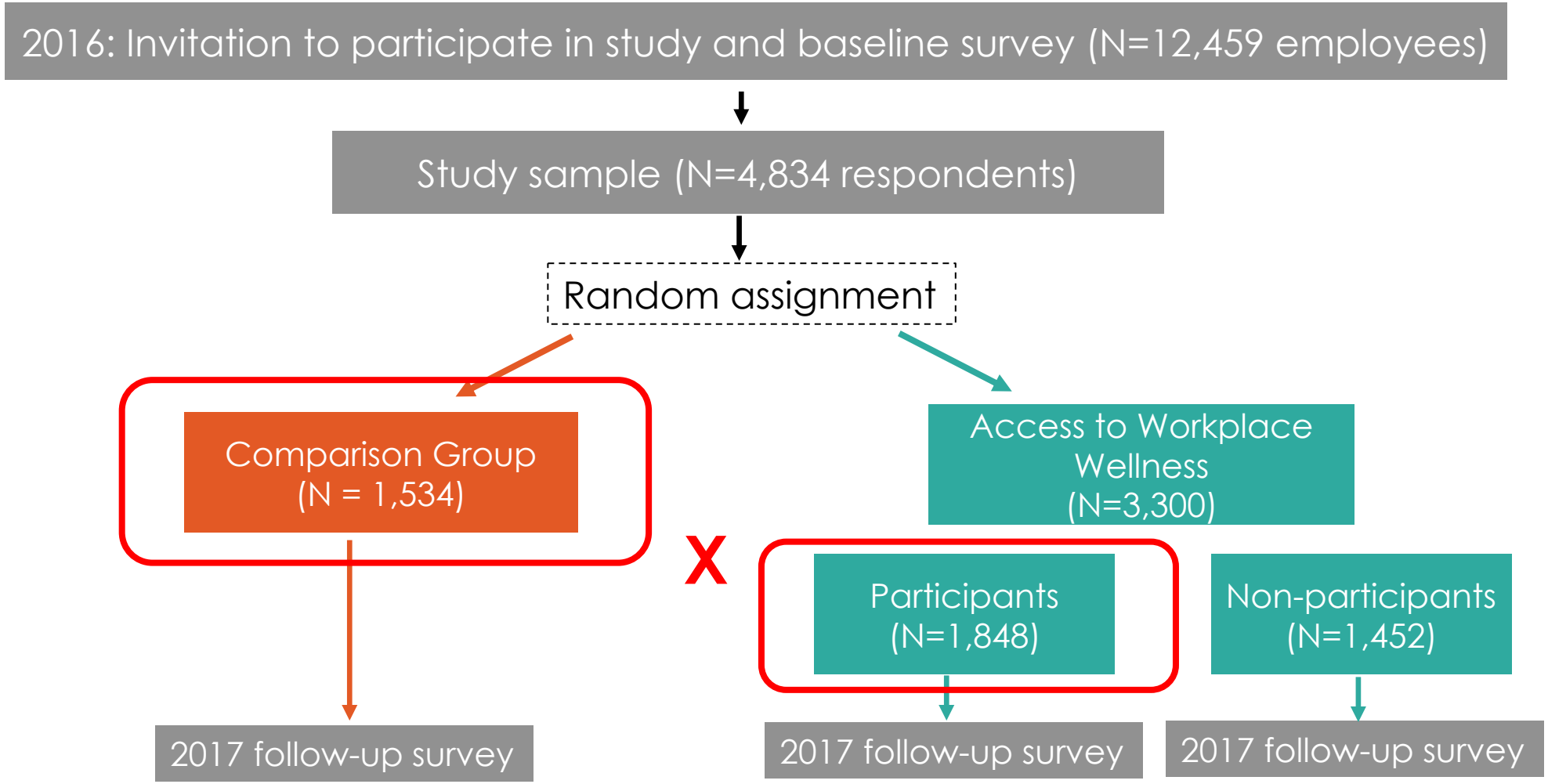
Key advantage: Because members of the groups (treatment and comparison) do not differ systematically at the outset of the evaluation,

any difference that subsequently arises between them can be attributed to the program rather than to other factors.

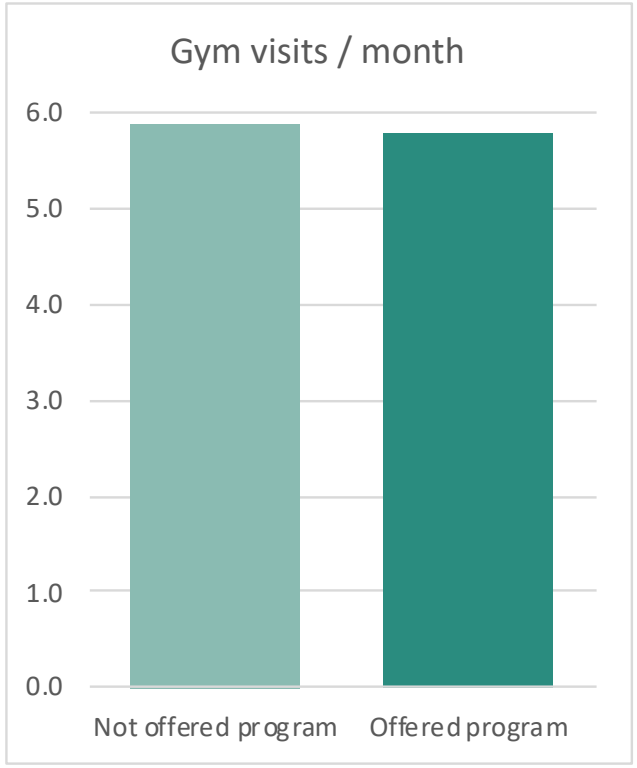
Treatment

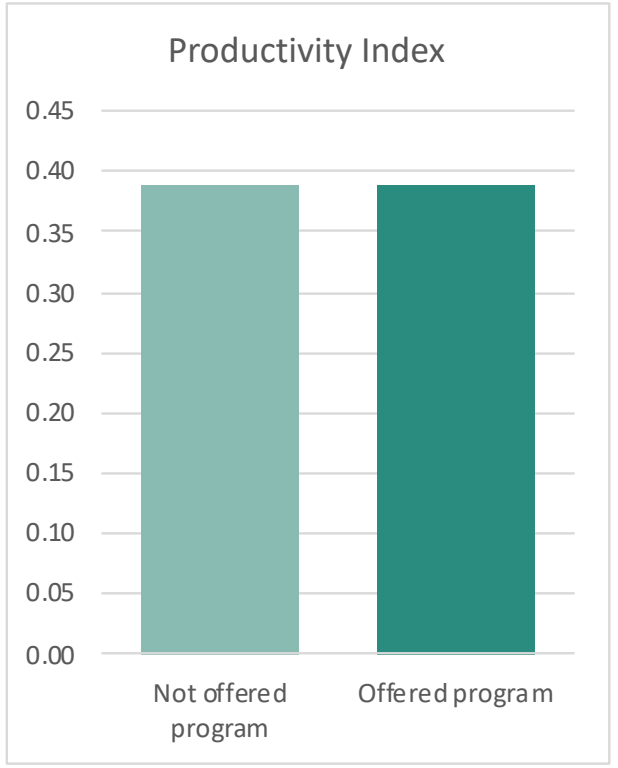
Comparison

Randomized Evaluation



Randomized Evaluation





Comparison of results across methods

Method	Gym visits / month	Medical Spending	Productivity
(1) Pre-post	3.5**	-$137**	0.01
(2) Simple difference	-0.4	$100**	-.15**
(3) Difference-in-differences	1.34**	-$9.6	0.01
(4) Matching	0.61	-$146	0.00
(5) Randomized evaluation	0.06	$10	0.00

Note: *, **, and *** indicate statistical significance at the p-value < .10, .05 and .01.

Session Overview

I. Background

II. Why randomize case study

    I. Non-experimental methods

    II. Randomized evaluations

III. Conclusions

IV – CONCLUSIONS

Conclusions – Why Randomize?

- There are many ways to estimate a program's impact
- This lecture highlights the advantages one: randomized evaluations
  - **Conceptual argument:** If properly designed and conducted, randomized evaluations are the most credible method to estimate the impact of a program
  - **Empirical argument:** Different methods can generate different impact estimates
- When randomized evaluations are impractical, non-experimental methods may be the best option. But being clear about the counterfactual and its underlying assumptions is key.

Thank you!

References

Jones, Damon, David Molitor, and Julian Reif. "What do workplace wellness programs do? Evidence from the Illinois workplace wellness study." *The Quarterly Journal of Economics* 134.4 (2019): 1747-1791. https://doi.org/10.1093/qje/qjz023.

J-PAL Evaluation Summary: The Impact of a Workplace Wellness Program in Illinois

J-PAL Evaluation Summary: Workplace Wellness Programs to Improve Employee Health Behaviors in the United States

The Illinois Workplace Wellness Study Project Page