# Effect of marriage on the efficacy of interventions designed to increase mammography screening

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## Background

**Aim:** assess the comparative effectiveness of interventions in enhancing mammography screening, specifically examining how marital status influences the efficacy of these interventions

**Data source:** a randomized controlled trial evaluating interventions to boost mammography screening in nonadherent women over 50

**Primary response:** mammography compliance ($resp6$) was measured by whether screening was done 6-months before enrollment — binary

**Secondary response:** mammography cognitive stage ($stagefwup$) was measured by a summary of 3, 11, and 23-month screening behavior — ordinal (*levels*: precontemplation, contemplation, action)

**Explanatory variable:** intervention (*treatment*) was measured by the type of intervention — nominal (*levels*: control, phone, mail, and phone and mail)

**Adjustment covariates:** age (mean-centered), income, marital status, family history, baseline mammography screening behavior

## Exploratory data analysis

- 92% of the dataset was complete, comprising 958 individuals
- Only a third of the study participants were married
- Age distribution was right-skewed
- Irrespective of treatment, those who precontemplated at the follow-up stage rarely screened at the 6-month mark

### Barplot of intervention stratified by responses
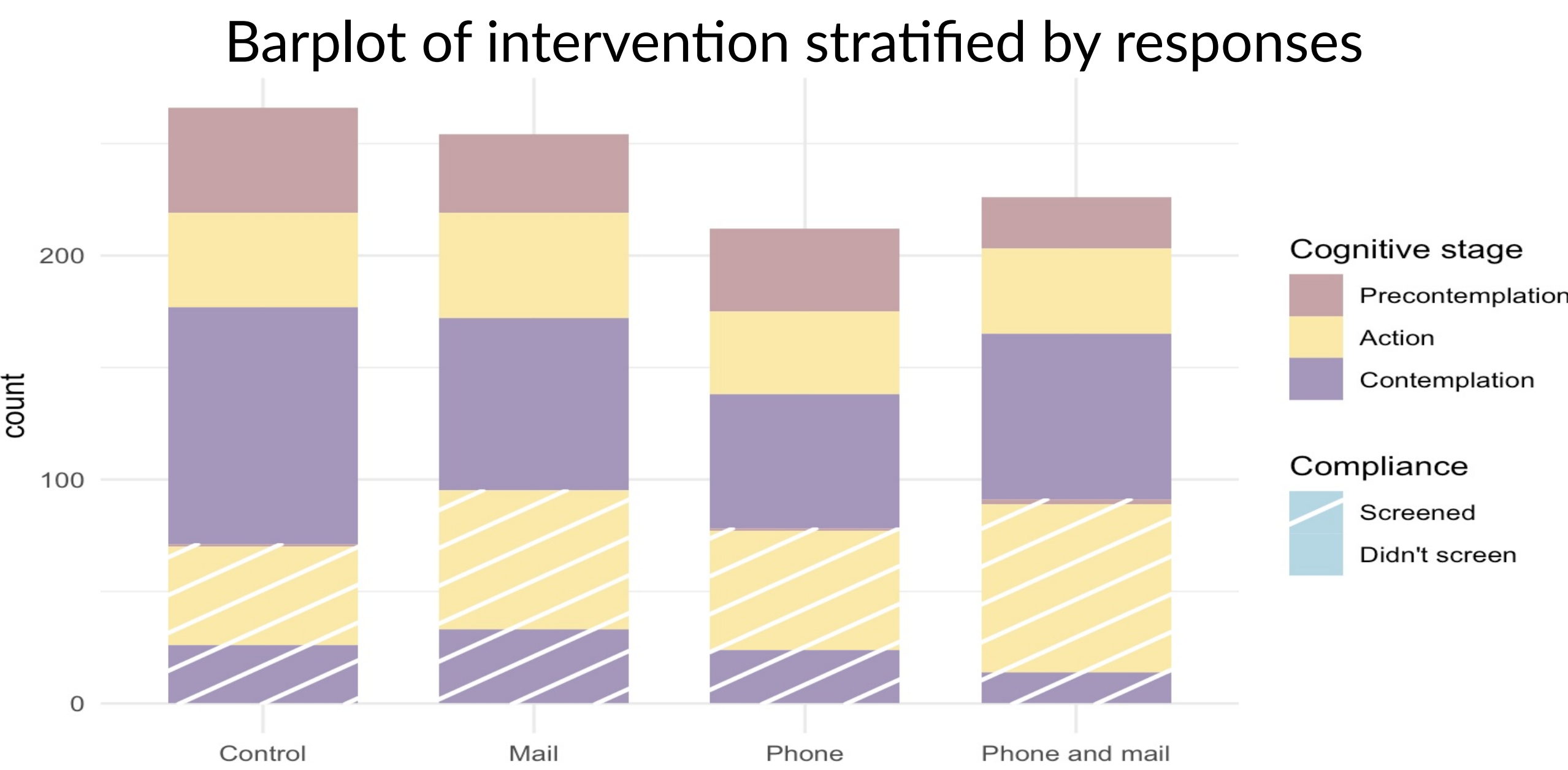


### Chi-squared test for independence

1. Compliance vs. cognitive stage $\Rightarrow$ significantly dependent ($\chi^2 = 190.227$, $df = 2$, $p$-value $< 2.2 \times e^{-16}$ )
2. Marital status vs. compliance $\Rightarrow$ significantly dependent ($\chi^2 = 6.807$, $df = 1$, $p$-value $= 0.009$)
3. Marital status vs. cognitive stage $\Rightarrow$ independent ($\chi^2 = 4.917$, $df = 2$, $p$-value $= 0.086$)
4. Marital status vs. treatment $\Rightarrow$ independent ($\chi^2 = 0.617$, $df = 3$, $p$-value $= 0.893$) — tests for confounding

## Method

### Logistic regression model

$$logit(resp6_i) = \beta_0 + \beta_1 I(mail)_i + \beta_2 I(phone)_i + \beta_3 I(phone\ \&\ mail)_i$$
$$+ \beta_4(age - 65.56)_i + \beta_5 income_i + \beta_6 married_i$$
$$+ \beta_7 history_i + \beta_8 stagebase_i$$
$$+ \beta_9 I(mail : married)_i + \beta_{10} I(phone : married)_i$$
$$+ \beta_{11} I(phone\ \&\ mail : married)_i \tag{1}$$

### Multinomial regression model

$$\log\left(\frac{\pi_{ij}}{\pi_{i0}}\right) = \beta_{0j} + \beta_{1j} I(mail)_i + \beta_{2j} I(phone)_i + \beta_{3j} I(phone\ \&\ mail)_i$$
$$+ \beta_{4j}(age - 65.56)_i + \beta_{5j} income_i + \beta_{6j} married_i$$
$$+ \beta_{7j} history_i + \beta_{8j} stagebase_i$$
$$+ \beta_{9j} I(mail : married)_i + \beta_{10j} I(phone : married)_i$$
$$+ \beta_{11j} I(phone\ \&\ mail : married)_i \tag{2}$$

$i = 1, 2, ..., 958; \quad j = 1, 2$
$\pi_{i0} = P(stagefwup = \text{precontemplation}|\mathbf{x_i})$
$\pi_{i1} = P(stagefwup = \text{contemplation}|\mathbf{x_i})$
$\pi_{i2} = P(stagefwup = \text{action}|\mathbf{x_i})$

## Statistical analysis

- **Variable selection:** tested whether the effect of some variables (education, workpay, medical pro's recommendations) was zero simultaneously — failed to provide any evidence that the full model fit better than the reduced model
  - Logistic regression: deviance 1143.590; AIC 1167.590
  - Multinomial regression: deviance 1608.002; AIC 1656.002
  - — comparable goodness of fit w.r.t full model
- **Model fit:** Hosmer-Lemeshow fails to reject the hypothesis that the two models fit the data well

| Model | LRT | Wald's test | Score test | Hosmer-Lemeshow test | Nagelkerke's $R^2$ |
|---|---|---|---|---|---|
| Logistic | 0.346 | - | 0.344 | 0.963 | 0.132 |
| Multinomial | 0.527 | 0.533 | - | 0.285 | 0.340 |

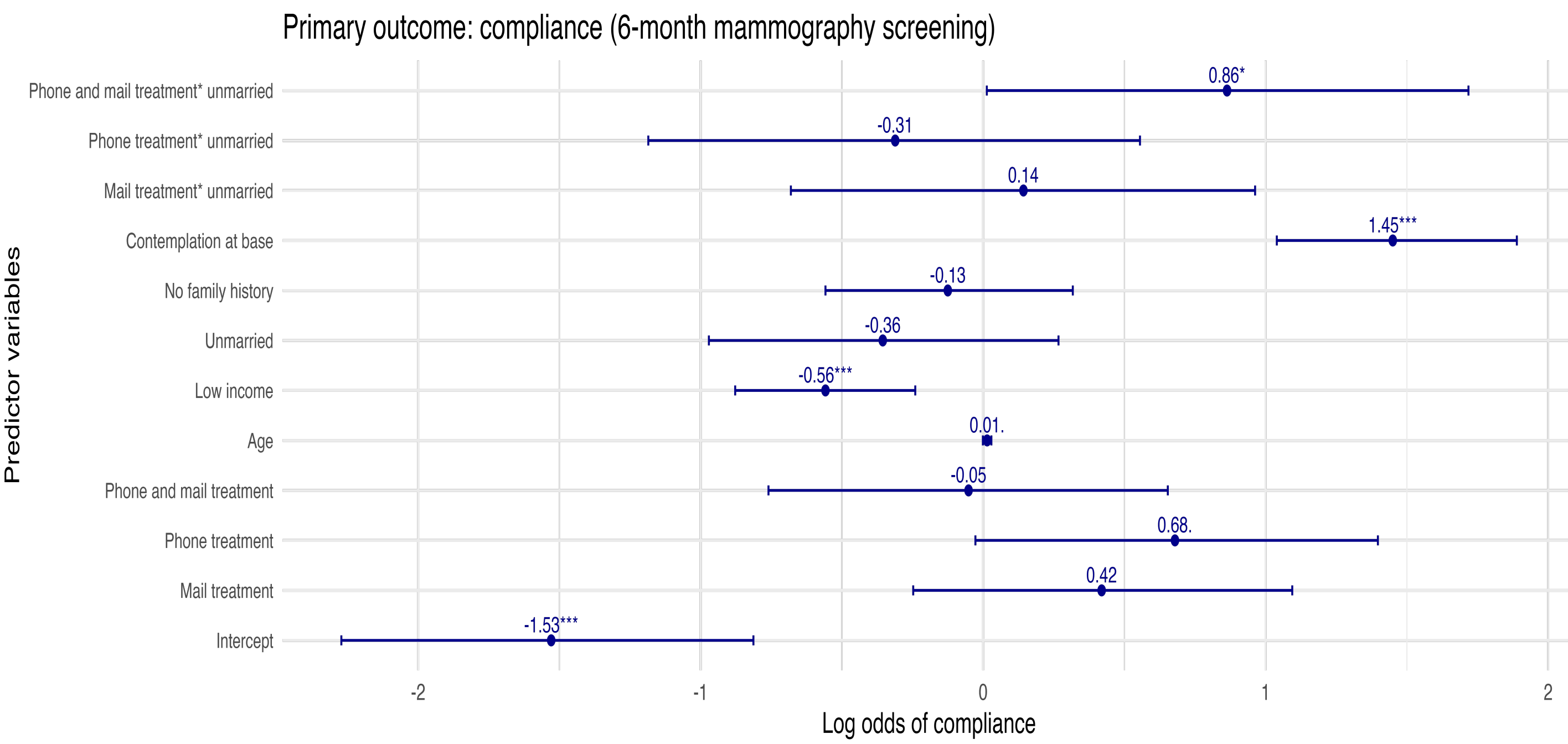Table 1. $p$-values for tests and $R^2$ values

## Results

Marital status does not affect the efficacy of either of the interventions in terms of cognitive stage

## Results (continued)
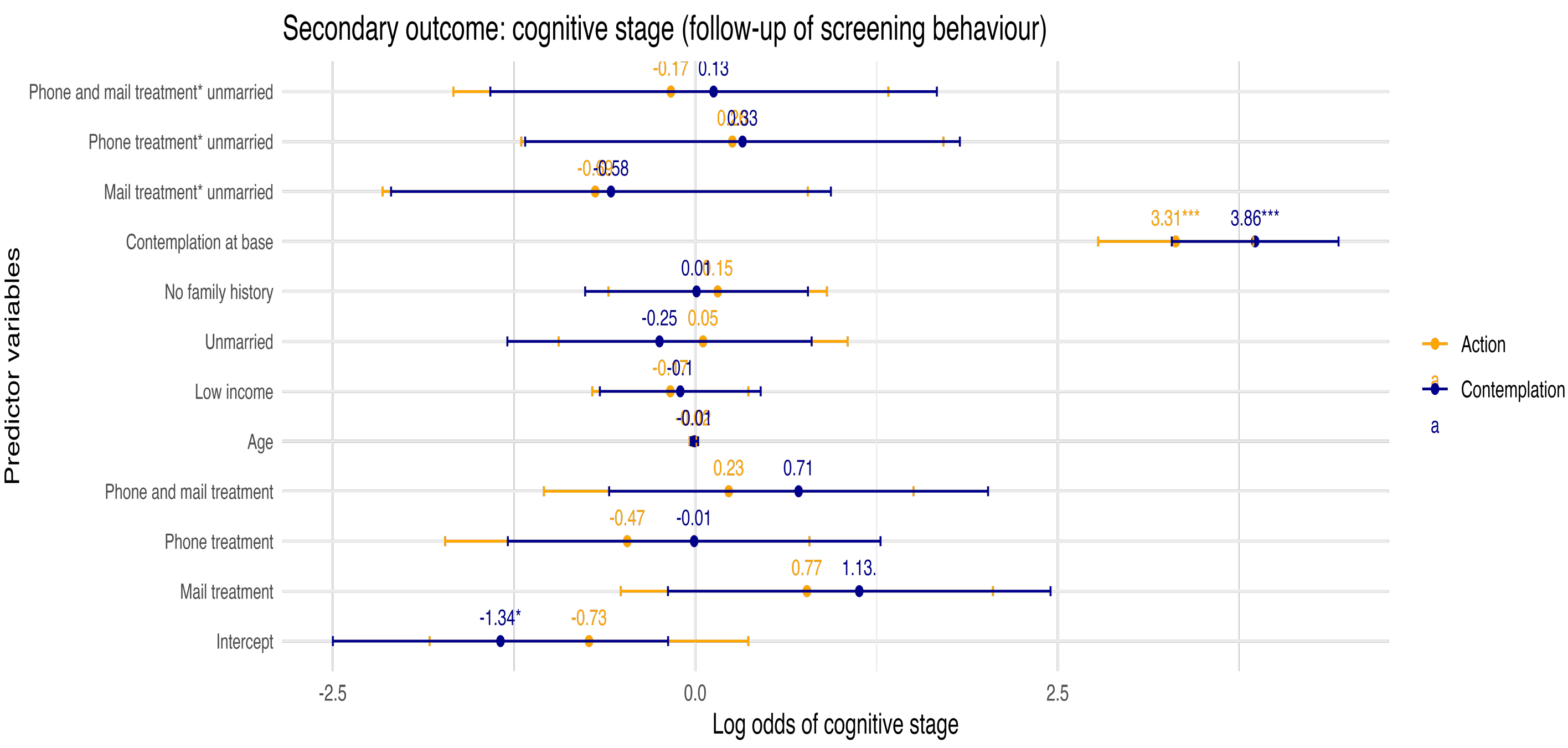


The effect of phone and mail treatment on the log odds of compliance at 6-month mammography screening is additionally increased by 0.86 for unmarried women, adjusting for other covariates



## Discussion

- The interaction between phone and mail treatment and marital status significantly predicts mammography screening compliance
- Higher income and contemplating at the baseline stage significantly increases the likelihood of compliance
- Contemplating at the baseline stage is associated with a higher probability of having had a recent mammogram (action) or planning to have one soon (contemplation) than not considering to have one in the next 6 months (precontemplation)

**Future directions**: examine a tailored approach involving a different set of adjustment covariates for the multinomial model, rather than using the same covariates from the logit model — might reveal varying effects of marital status on intervention efficacy

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