Illinois Workplace Wellness Study evaluates the workplace wellness program's effectiveness at the University of Illinois Urbana Champaign. The study is done through a randomized controlled trial to remove the selection bias that was observed in the previous studies. The study includes 4838 employees, with 3300 belonging to the treatment group and 1534 belonging to the control group. The treatment group members were allowed to complete the two-year long workplace wellness program called iThrive which included annual health screening, annual health risk assessment, and weekly wellness activities. The evaluation of the program is done through data collected through online surveys, university employment records, health insurance claims, visits to campus gyms, and running event records.

Q1: To establish a causal effect of wellness programs on healthcare spending, firms with wellness programs and firms without wellness programs have to be very similar in many aspects. This means that the employees at both of firms have to be very similar when it comes to demographics, workplace environment, motivation levels, company policies, etc. This is not easily achievable as firms that have wellness programs may prioritize employee health in all aspects or have funds to invest in employees or attract healthier employees as compared to the firms without wellness programs.

Q2: For the comparison between eligible and ineligible employees to establish a causal effect of wellness programs to be valid, the two groups of employees have to be very similar in all aspects except for their eligibility. This means that the employees should not have major differences between them except for their eligibility. Hence, this condition is not likely to be satisfied as eligibility may be dependent on one of the variables and that would result in the groups being different from each other and hence selection bias.

Q3: "Treatment" refers to the group of employees who were randomly assigned to be eligible for the iThrive wellness program. "Control" refers to the group of employees who were randomly

assigned to be ineligible for the program. The study included a total of 4,834 employees (3,300 employees were assigned to the treatment group, 1,534 employees were assigned to the control group).

The distinction between "participants" and "non-participants" is different from the treatment-control distinction. Participants are the employees in the treatment group who actually took part in the wellness program activities and non-participants are the employees in the treatment group who were eligible but chose not to participate in the program activities. Number of people in the treatment group who participated in the initial screening segment is 1900.

Q4: Since the majority of p-values in Table 4 for each outcome variable are greater than 0.05, we can safely assume that there weren't any pre-existing differences between the treatment and control groups. This supports the claim that the assignment of the participants in treatment and control groups was random, as we should expect balanced characteristics between both groups in a randomized assignment. Had the p-values been less than 0.05 we could assume that the randomization process was flawed since this would show significant differences in the assignment of both groups hence hinting that they were assigned on some predetermined basis or pattern.

Equation: $\textbf{Outcome} = \beta 0 + \beta 1 \times \textbf{Treat} + \varepsilon$

Q5: For our data to show accurate causal effects, everything else has to be similar, which means that the demographics should not have any causal effects. If there are differences between the two columns, it would indicate that there is selection bias present in the data. If the data is properly randomized, there should be no difference between the two columns as that would mean no selection bias. In our case in Table 5, we can see that the two columns are similar to each other and there aren't any significant differences between them. Hence, we can conclude that **randomization has been done correctly to our data and there is no selection bias** as adding the demographic variables does not change the treatment effect significantly.

Equation: No_controls -> **Outcome** = β0 + β1 × **Treat** + ε

With_controls -> **Outcome** = β0 + β1 × **Treat** + β2 x **male** + β3 x **white** + β4 x **age37_49** + β5 x **age50** + ε

Q6: To answer the first part of the question, since the estimates do not change much between the two columns, it would suggest that demographic factors do not explain much of the difference, depicting that the participation effect might be more casual. If the difference between both columns was large, it would indicate selection bias. This would mean that differences in outcome variables between participants and non-participants might be affected by inherent demographic differences, instead of participation itself.

In our case in Table 6, the two columns are similar to each other and there aren't any significant differences between them, this indicates that the randomization is done correctly and there is no selection bias as adding the demographic variables does not change the treatment effect significantly. The estimates should not differ between the two columns if participation is truly random as in that case, demographic controls would not significantly impact the estimand treatment effect.

Equation: No_controls -> **Outcome** = β0 + β1 × **completed_screening_nomiss_2016** + ε

With_controls -> **Outcome** = β0 + β1 × **completed_screening_nomiss_2016** + β2 x **male** + β3 x **white** + β4 x **age37_49** + β5 x **age50** + ε

Conclusion: Given the findings of this study, I would not recommend adopting the program to employers considering adopting a wellness program in their workplace. This is due to our in-depth analysis of the case especially Table 4 and Table 5 which shows that the treatment effect of the program on multiple outcome variables that we set, is not significant, showing that the inclusion of a wellness program does not have a significant effect on general health outcomes of the employees. Furthermore, employers must take into account that the efficacy of a wellness program may differ for employees with different demographics such as age and race.

APPENDIX

Q4 Table:

```
> print(results_q4)
# A tibble: 16 × 4
   Variable_Description           Control_Group_Mean Treatment_Group_Mean P_Value
   <chr>                                       <dbl>                <dbl>   <dbl>
 1 covg_0715_0716                              0.635                0.632   0.822
 2 covg_1015_0716                              0.641                0.636   0.744
 3 diabetes_1015_0716                          6.39                 4.85    0.071
 4 hyperlipidemia_1015_0716                   16.6                 15.4     0.415
 5 hypertension_1015_0716                     14.6                 13.2     0.286
 6 spendHosp_0715_0716                       283.                 259.      0.387
 7 spendOff_0715_0716                         66.7                 58.0     0.377
 8 spendRx_0715_0716                         103.                 101.      0.909
 9 spend_0715_0716                           506.                 465.      0.306
10 pcp_any_office_1015_0716                   10.3                 10.5     0.846
11 pcp_any_visits_1015_0716                   34.1                 31.0     0.085
12 pcp_total_office_1015_0716                  0.404                0.423   0.765
13 pcp_total_visits_1015_0716                  0.837                0.785   0.469
14 pos_er_critical_1015_0716                   0.0987               0.103   0.798
15 pos_hospital_1015_0716                      0.0484               0.0522  0.912
16 pos_office_outpatient_1015_0716             2.56                 2.37    0.064
```

Q5 Table:

```
> print(results_q5)
# A tibble: 11 × 3
   Variable_Description       No_Controls      With_Controls
   <chr>                      <chr>            <chr>
 1 covg_0816_0717             0.004 (0.015)    0.005 (0.015)
 2 diabetes_0816_0717         -1.161 (0.882)   -1.009 (0.868)
 3 hyperlipidemia_0816_0717   -0.597 (1.456)   -0.089 (1.380)
 4 hypertension_0816_0717     -2.688 (1.366)   -2.271 (1.300)
 5 nonzero_spend_0816_0717    -0.008 (0.011)   -0.006 (0.011)
 6 pcp_any_office_0816_0717   0.020 (1.197)    0.039 (1.189)
 7 pcp_total_office_0816_0717 -0.055 (0.076)   -0.052 (0.075)
 8 spendHosp_0816_0717        -10.298 (40.259) -5.731 (39.965)
 9 spendOff_0816_0717         -7.844 (8.832)   -7.609 (8.803)
10 spendRx_0816_0717          -10.419 (24.629) -9.089 (24.626)
11 spend_0816_0717            -31.182 (54.256) -24.286 (53.768)
```

Q6 Table:

```
> print(results_q6)
# A tibble: 11 × 3
   Variable_Description       No_Controls       With_Controls
   <chr>                      <chr>             <chr>
 1 covg_0816_0717             0.100 (0.014)     0.102 (0.014)
 2 diabetes_0816_0717         -1.471 (0.831)    -1.252 (0.820)
 3 hyperlipidemia_0816_0717   0.137 (1.373)     0.898 (1.303)
 4 hypertension_0816_0717     -3.802 (1.287)    -3.308 (1.227)
 5 nonzero_spend_0816_0717    0.037 (0.011)     0.034 (0.010)
 6 pcp_any_office_0816_0717   0.268 (1.129)     -0.159 (1.123)
 7 pcp_total_office_0816_0717 -0.045 (0.071)    -0.065 (0.071)
 8 spendHosp_0816_0717        -75.357 (37.930)  -80.039 (37.718)
 9 spendOff_0816_0717         3.985 (8.327)     1.989 (8.315)
10 spendRx_0816_0717          -27.415 (23.214)  -25.950 (23.253)
11 spend_0816_0717            -102.632 (51.119) -109.879 (50.745)
```