Practice Problem 1: Research Design

In 2016, a researcher in a health product company in Toronto wanted to test whether a new health drink he had developed is effective in improving the general health of their customers. He sent emails to all their customers asking for volunteers to participate in the study. It took one month to organize the study. A total of 100 customers wanted to participate. From this group, he asked for volunteers who wanted to join the treatment group and consume the new health drink daily, with 65 customers responding that they wanted to try the drink. The remaining 35 customers formed the control group and were not given the health drink. After six months, the researcher measured heartbeat rates (in beats per minute), cholesterol levels (in milligrams per deciliter), and fitness level (on a scale of 1-15, based on performance in several exercise tests) of all participants.
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(a) Identify the study units.

The study units are the customers of this company who participated in this study.

(b) What is the population of interest?

The population of interest is all the customers of this company.

(c) What is/are the explanatory variable(s)? State the type of data scale used (e.g., categorical, ordinal, etc.) for recording the explanatory variable(s).

The explanatory variable was whether the participants receive the health drink or not, which is a categorical variable.

(d) What is/are the response variable(s)? State the type of data scale used (e.g., categorical, ordinal, etc.) for recording the response variable(s).

There are three response variables as follows:

1. Heartbeat rates – may be considered as a discrete or continuous quantitative variable,
2. Cholesterol levels, which is a continuous quantitative variable, and
3. Fitness level – ordinal variable.

(e) Give details of where the study was conducted.

It was conducted in a health product company in Toronto.

(f) Give details of regarding temporal aspects of the study.

It was conducted in 2016 and it took one month to organize it. The data was recorded after 6 months

(g) Is this an observational or experimental study? Very briefly explain your answer.

This is an experimental study since there was manipulation of an explanatory variable and there was an experimental group and a control group. There is assignment of the study units to the two groups, though it was not done at random, but rather, by volunteering.

(h) Based on this study, will it be possible to make either population inferences or causal inferences or both? Briefly explain your answer.

It is not possible to make population inferences since the participants were not randomly selected from the population of interest; but rather, they were volunteers. It is not possible to make causal inferences since the participants were not randomly assigned to the experimental and control groups; instead, they were volunteers.

(i) Based on the description of the study given above, what are the possible weaknesses of this study. There are at least six weaknesses.

1. No random selection from the target population, which leads to voluntary response bias.

2. No random assignment to the experimental and control groups, which again leads to voluntary response bias.

3. The control group did not receive a placebo. They should have received some sort of inert drink of the same appearance so that neither group would know what they are getting.

4. No indication of the control of extraneous variables such as lifestyle, gender, age, etc.

5. This was only post-test, not pre-test – post-test, which could have helped to control extraneous variables.

6. The study seemed to be motivated by commercial aims (advertisement), rather than aimed at scientific rigor; therefore, the results are likely to be biased.

7. There was no paired design, which could have helped to eliminate the effects of variation between participants and control the extraneous variable.
   (This last point about the paired design will be covered later in this section.)

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