

Complete Title: Online Randomized Experiment Evaluating Ultra-Processed Food Warning Labels on Social Media Posts Among Teens and Young Adults

Short Title: Effects of UPF Warning Labels on Social Media Among Teens and Young Adults

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Introduction

The goal of the analyses described here is to use data collected through an online randomized experiment to examine teens' and young adults' responses to ultra-processed food (UPF) warning labels on social media posts. These analyses assess the effect of a highly visible UPF warning label displayed beneath social media posts, compared to a control condition with no label, on consumer understanding and purchase intentions. This analysis plan pre-specifies the analyses before collecting data and therefore serves as our ex-ante planned analysis.

Study Protocol

Participants will complete an online randomized experiment. After providing informed consent, they will be randomized to one of two trial arms: (1) UPF warning labels or (2) no-label control. Participants will view four social media posts (presented in random order; all feature UPF) based on real Instagram posts from leading food and beverage companies. Labels will be shown according to participants' assigned trial arm. Participants will then respond to survey questions assessing consumer understanding, purchase intentions, perceived healthfulness, perceptions of control over healthy eating, and policy support for ultra-processed food warning labels. At the end of the UPF survey, participants will also answer an open-ended question on their understanding of the term "ultra-processed food."

Statistical Considerations

General Principles

We will use a two-sided critical alpha of 0.05 for all statistical tests. All confidence intervals will be two-sided and set at the 95% level. Analyses will be conducted on an intent-to-treat basis and will not be adjusted for any covariates, given the randomized design. Missing data will be handled in linear mixed models through maximum likelihood estimation (assumes missing at random [MAR]). Given the exploratory nature of the study, we will not adjust p-values for multiple comparisons.

Primary Outcome

The primary outcomes are consumer understanding and purchase intentions, each analyzed as repeated measures at the post level:

1. **Consumer understanding** will be measured by whether participants correctly identify the product featured in each post as UPF. Responses will be coded as correct if participants select "Yes" when asked whether they think the product featured in the post is UPF; "No" and "*I don't know*" will be coded as incorrect.
2. **Purchase intentions** will be measured for each social media post by asking participants how likely they would buy the product in the next week using a 1–5 Likert scale, with 5 indicating "*very likely*" (treated continuously).

Secondary Outcomes

The secondary outcomes are perceived healthfulness (analyzed as a repeated measure at the post level), and perceptions of control over healthy eating and policy support (both analyzed at the participant level as each participant answered these questions only once after viewing all posts):

1. **Perceived healthfulness** will be measured for each social media post by asking participants how healthy the product seems to them using a 1–5 Likert scale, with 5 indicating “*very healthy*” (treated continuously).
2. **Perceptions of control over healthy eating** will be measured by participants’ categorical responses to how an UPF warning label would make them feel. Response options will be coded as follows: “*More in control of making healthy eating decisions*” will be coded as 1, while “*Less in control of making healthy eating decisions*” and “*Neither less nor more in control of making healthy eating decisions*” will be coded as 0.
3. **Policy support for ultra-processed food warning labels** will be measured by asking participants, “Would you oppose or support a policy requiring these labels on social media advertisements for ultra-processed foods and beverages?” using a 1–5 Likert scale, with 5 indicating “*strongly support*” (treated continuously).

Statistical Methods

1. We will describe participant characteristics by trial arm. We will use means and standard deviations to characterize continuous variables and frequencies and percentages to characterize categorical variables. For the open-ended question on the participants’ understanding of the term “ultra-processed” (UPF understanding) we will develop a codebook using a hybrid inductive-deductive approach, and two independent reviewers will categorize the responses into ‘low,’ ‘moderate,’ and ‘high’ understanding.
2. Analyses of the primary outcome:
 - a. We will evaluate the effects of UPF warning labels on consumer understanding using a linear probability mixed model with random intercepts to account for repeated measures within participants. Consumer understanding (binary indicator) will be regressed on trial arm (warning label vs. no-label control). We will report the marginal predicted probability of consumer understanding in each group, as well as the average differential effect (ADE), defined as the risk difference (i.e., the difference in predicted probability between the warning label group and the control group). We opted for a linear probability mixed model rather than a logistic mixed model because we are interested in estimating risk differences.
 - b. We will evaluate the effect of UPF warning labels on purchase intentions using linear mixed models with random intercepts to account for repeated measures within participants. Purchase intention will be regressed on trial arm, and we will estimate and report the average purchase intention for each group, as well as the ADE.

c. We will test whether the effects of UPF warning labels on the co-primary outcomes (consumer understanding and purchase intentions) differ by age group (teens vs. young adults) and gender (male vs. female). To test for moderation, we will regress each primary outcome on intervention assignment and include interaction terms between intervention assignment and each moderator, using separate mixed models. We will test the significance of the interaction terms and, if significant, report the marginal effects of the UPF warning labels at each level of the moderator.

3. Analyses of secondary outcomes:

- a. We will use the same model from 2b to evaluate the effects of UPF warning labels on perceived healthfulness. Perceived healthfulness will be regressed on trial arm (warning label vs. control), and we will estimate and report the average perceived healthfulness for each group, as well as the ADE.
- b. We will describe the percentage of participants (pooled across trial arms) who report increased control over healthy eating. Similarly, we will describe the percentage of participants who report supporting requiring UPF warnings. We will additionally describe these percentages stratified by age group (teens vs. young adults) and gender (male vs. female).

4. Exploratory Analysis:

- a. We will use chi-square tests to compare the distribution of UPF understanding categories (low/moderate/high) between trial arms. If the distributions do not differ significantly, we will proceed to test participants' understanding of the term "ultra-processed food" as a moderator in section 4b. This step is to make sure that being exposed to the warning labels does not influence their understanding of the term.
- b. We will examine whether participants' understanding of the term "ultra-processed food" moderates the effect of the label on consumer understanding, purchase intention, perceived healthfulness, perceptions of control over healthy eating, and policy support for UPF warning labels. Moderation will be tested by adding UPF understanding and its interaction with trial arm to the mixed models described in sections 2 and 3. If interactions are significant, we will report stratified effects.

5. Additional considerations and sensitivity analyses:

- a. If models fail to converge for the repeated measures (unlikely), we will test simpler covariance structures.
- b. For repeated measures, we will additionally add fixed effects for social media posts in the mixed models to adjust for any systematic differences across the social media posts.

- c. For consumer understanding (binary), we will conduct sensitivity analyses using Poisson GEE models with a log link (to estimate risk ratios for consumer understanding) and robust standard errors.

Sample Size Needs

We plan to collect data from 1,000 participants. With 80% power and a two-sided alpha of 0.05, we can detect an effect size of approximately Cohen's $d = 0.18$ for non-repeated-measures outcomes. For repeated measures, assuming four repeated measures per participant, the minimal detectable d is approximately 0.13–0.16, assuming within-person correlation $\rho=0.4–0.7$. These represent small effect sizes, but ones that are meaningful at the population level.

Exclusions and Outliers

We will exclude participants who complete the survey implausibly quickly (defined as completing in less than one-third of the median completion time).