

Do Health Risk Assessments Change Eating Habits at the Workplace?

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ABSTRACT

We test whether cholesterol screenings provided through a health risk assessment affect the eating behavior of hospital employees at the workplace cafeteria. We find that employees with high-risk levels of cholesterol make small, short-term reductions in their spending at the cafeteria, while there are no statistically significant changes among employees with healthy levels of cholesterol. We combine screening results with survey responses regarding past diagnoses to identify individuals at high risk who were previously undiagnosed, i.e. unaware of their high cholesterol. Even within this subgroup, however, changes in spending patterns are modest and temporary.

JEL codes: I12, I18, D8

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1. Introduction

Nearly half of U.S. adults have a risk factor for heart disease such as high cholesterol, high blood pressure, or diabetes, which could be improved with lifestyle modifications. But since these conditions often don't produce symptoms, approximately one-third of cases are undiagnosed (Fryar et al., 2010). U.S. employers, who bear a large share of the healthcare costs of their employees, are increasingly offering health risk assessments (HRAs) in hopes of tracking and addressing such risky conditions. HRAs could greatly benefit workers, especially the large share who do not visit primary-care physicians annually, by informing them of their undiagnosed conditions.¹ Among large firms, the prevalence of HRAs has increased from 38% in 2012 to 62% in 2017, and nearly half of adopting firms spend over \$500 per employee to incentivize participation (Kaiser Family Foundation, 2017).

Yet despite their widespread adoption, there is only scarce evidence that HRAs and wellness programs improve employees' health (Mattke et al. 2013). Prior studies have found that HRA completion increases physician visits as well as actions ordered by physicians such as other preventive screenings and prescription drug usage (Huskamp and Rosenthal 2009, Gowrisankaran et al. 2013). Two recent randomized-controlled trials find no short-term changes in health outcomes (Jones et al. 2018; Song and Baicker 2019). Our study contributes to this literature by using high frequency, objectively measured data from cafeteria receipts to investigate a health behavior that is closely related to the HRA-measured biometrics. Documenting behavior changes is important because improvements in health outcomes may take time to follow and require large samples to detect.

In this paper, we test whether cholesterol information provided in HRAs changes eating behavior in a sample of employees of a large regional hospital. Our sample includes 2,196 hospital

¹In 2010, 22 percent of working age women and 33 percent of working age men made no visits to any medical provider (O'Hara and Caswell, 2013).

employees who make purchases at the employee cafeteria, of whom 1,223 took the cholesterol test through the HRA. Our dataset combines digitized receipts of cafeteria purchases with results from the health questionnaire and biometric portions of the HRA. We exploit variation in the date the cholesterol test was taken to estimate its effect on weekly spending and the nutritional content of food purchases.

We study the effects of the cholesterol test on cafeteria purchases of the 1,223 HRA participants, overall and grouped by cholesterol test results (low risk: N=869, and high risk: N=354). We also estimate the effect on individuals at high risk who were previously undiagnosed (N=236), who we hypothesize are most likely to change their behavior in response to this new health information. In theory, test results could also motivate changes by previously-diagnosed high-risk individuals by reminding them of their risks (i.e. a salience effect). For individuals who are found to have low-risk levels of cholesterol, however, there is no clear prediction for how the test result should affect eating behavior.

We find that high-risk individuals and undiagnosed high-risk individuals reduced their weekly cafeteria spending by \$0.49 and \$0.69, respectively, in the first month after their cholesterol tests. These reductions are concentrated in items classified by a nutritionist as unhealthy. While these changes represent a 7-10% decrease in spending, they are short-lived for both groups, no longer significant by the third month after the test. No significant changes in spending are observed among the low-risk individuals or in the full (aggregate) sample of all screening participants.

A limitation of our study is that we only observe eating behavior at workplace eateries. Hence, we cannot measure the effect of the cholesterol test on an employee's overall diet. Studies find, however, that food purchased away from home is associated with higher total calories and saturated fat than food prepared at home (Nguyen and Powell, 2014). Our descriptive evidence

also indicates that employees who spend more at the cafeteria tend to be in worse health. Together, these facts suggest that the temporary decrease in weekly spending at the cafeteria may reflect a renewed effort to maintain a healthier diet. Nonetheless, these modest, temporary changes are unlikely to lead to any measurable impact on health.

Our study adds to a small emerging literature on the effects of medical diagnoses on eating behavior. Zhao et al. (2013) use longitudinal data from an annual Chinese survey and a regression discontinuity design to show that in the year following a hypertension diagnosis, individuals reduce fat intake significantly, and high-income individuals make larger reductions. Also, Oster (2018) uses household scanner data to infer diabetes diagnosis from purchases of glucose testing products and to estimate its effect on food purchases at grocery stores. She finds small calorie reductions concentrated on unhealthy foods. To this emerging literature, our paper brings two contributions. First, high-frequency data along with cholesterol test dates allow us to home in on the precise time period when individuals first learn of a new health condition. Second, we identify effects on food consumed outside of the home, complementing the findings of Oster (2018) pertaining to food purchased for home consumption.

Our paper proceeds as follows. In Section 2 we describe the methods of our study, including the setting, sample, key variables and empirical strategy. Section 3 presents our results, including descriptive statistics, main results, robustness checks, and heterogeneity analysis. Section 4 concludes.

2. Methods

2.1 Setting and Sample

Our study setting is a large regional hospital with an onsite cafeteria and cafés. The USDA Food Access Research Atlas shows that the hospital is located in an area with low income and low

access to food options, with no fast-food or restaurant options within a half-mile.² Hence, the majority of employees eat at the cafeteria and/or bring food from home.

At the hospital cafeteria and cafés, employees pay via payroll deduction using their ID badges.³ Our sample of 2,336 hospital employees includes benefits-eligible employees who made at least one purchase from January-March 2013 and one purchase from January-April 2014 at the hospital's main cafeteria. This restriction ensures that our analysis is limited to those continually employed during the period we study and with the same ID badge number. Our sample excludes all 66 resident and intern physicians, since their patterns of rotation across sites led to unusual seasonal patterns of spending. Appendix Figure 1 shows how cafeteria spending varied week by week over our study period, for our sample and for the excluded residents.

All benefits-eligible employees of the hospital were invited to take the health risk assessment and incentivized with a \$200 health insurance subsidy for the following year. To receive the subsidy, employees had to complete the online health questionnaire and the biometric tests for cholesterol, blood pressure, and glucose, between April 1 and November 15, 2013. The biometric tests could be done during one of several health fairs throughout the year, or at an onsite employee health clinic. After completion, participants received a personal letter informing them of their cholesterol and glucose measures and recommending follow-up with their healthcare provider if their results were in the moderate- or high-risk range.⁴ Among benefits-eligible employees, 44% completed both the health risk questionnaire and all required biometrics, similar to the estimated national average participation rate of 46% (Mattke et al. 2013).

For each employee in the sample, our dataset contains demographic characteristics (age, gender, ethnicity and job category in 2013) and receipts from food purchases at the hospital's

² <http://www.ers.usda.gov/data-products/food-access-research-atlas/go-to-the-atlas.aspx>.

³ Since this form of payment offers a 10% discount and badges are required to be worn at all times, most employees pay exclusively by badge.

⁴ A copy of this letter is provided in the Appendix.

cafeteria and cafes from January 1, 2013-April 28, 2014. We collapse food purchases by week to create a balanced panel dataset at the employee-week level.⁵

Within this sample, we have 1,223 HRA participants who completed both the cholesterol test and the online health questionnaire for the 2013 health risk assessment. Our data includes their biometric measures and questionnaire responses.

2.2 Key Variables and Outcomes

Our primary outcome is total spending: the weekly sum of cafeteria spending by employee. Appendix Figure 1 shows that average weekly spending is noisy, with troughs corresponding to holiday weeks, but has no clear trend over the study time period. Additional outcomes include weekly calories, grams of fat and saturated fat, and milligrams of dietary cholesterol consumed at the cafeteria, summed over the subset of items for which nutritional measures were obtained (see the Appendix for details of the nutritional data collection process and a listing of all food items). We also consider spending on “healthy” and “unhealthy” items as categorized by a nutritionist collaborating with the cafeteria manager and for food items (excluding beverages). We focus primarily on total spending at the main cafeteria, because we limited our search for nutritional facts to items sold there, but also estimate results aggregating all hospital eateries.

Our study focuses on the measurement of cholesterol rather than blood pressure, glucose, or BMI, because this measure conveys more reliable and novel information. The blood test used in the HRA to measure cholesterol is not sensitive to fasting, caffeine, or physical activity, and is exactly what physicians use to diagnose high cholesterol (Sidhu and Naugler 2012). In contrast, blood pressure readings can be affected by recent consumption of caffeine, smoking, or physical

⁵ Approximately 30 percent of benefits eligible employees work at a satellite location instead of the main campus, and badges that were replaced due to loss or change in employment could not be retroactively matched.

activity, and accurate glucose readings depend on reliable self-reports of fasting. Furthermore, cholesterol tests are far less frequently conducted than blood pressure readings; the NCEP recommends re-tests after 5 years for healthy adults. Nevertheless, our findings are similar when we broaden our analysis to include those classified as high risk for either cholesterol, blood pressure, or glucose, as we show in the Appendix.

Employees were categorized through the health risk assessment as “high risk” for cholesterol problems (N=354) if either their total cholesterol, LDL cholesterol, or HDL cholesterol reading fell outside the normal thresholds.⁶ We further categorize employees as “undiagnosed high risk” (N=236) if they responded “No” to the question “Do you have, or have you been told that you have high cholesterol?” on the online health risk appraisal.⁷ Employees were instead categorized as “low risk” (N=869) if none of their cholesterol readings fell outside the thresholds. Non-participants⁸ are included in all regressions to help identify week fixed effects and avoid the problems that can arise when a time-varying treatment eventually applies to everyone in the sample (Goodman-Bacon 2019). We analyze outcomes for four groups: the full sample of cholesterol test participants; the subset with low-risk cholesterol; the subset with high-risk cholesterol; and the undiagnosed subset of the high-risk cholesterol group.

2.3 Statistical Analysis

We begin with an event study analysis of employees’ cafeteria spending around the time of their cholesterol test, including week and individual fixed effects throughout. The key

⁶ Specifically, “high risk” means either the total cholesterol value exceeded 240, the LDL cholesterol value exceeded 160, or the HDL cholesterol was lower than 40 for men and 45 for women. This is consistent with the definition employed by the CDC, except the CDC now uses a uniform HDL cutoff of 40 for both men and women.

⁷ We observe only the date of the cholesterol screening, not the precise date of the online questionnaire completion. Thus, it is possible that some people completed the online questionnaire after learning of their cholesterol test results and are misclassified as “previously aware” when they were not. This type of measurement error would lead to attenuation bias in a comparison of the effects among the undiagnosed and the previously diagnosed. However, the large size of the “undiagnosed” group, two-thirds of the high-risk group, suggests that it is unlikely this behavior was prevalent in our sample.

⁸ We exclude from the full sample 140 employees who did not take the cholesterol test but participated in either the glucose or blood pressure screening during this time period.

identification assumption is that the week in which an employee decides to take his or her total cholesterol test is not driven by trends in other factors linked to spending.

Our event study model is specified as:

$$Y_{it} = \sum_{\tau=-15}^{-2} \beta_{i\tau t} S_{i\tau t} + \sum_{\tau=0}^{15} \beta_{i\tau t} S_{i\tau t} + d_i + w_t + \varepsilon_{it} \quad (1)$$

where the event time indicator variables $S_{i\tau t}$ are a set of dummy variables indicating the amount of time by which week t precedes ($\tau < 0$) or follows ($\tau > 0$) the week in which individual i completed her total cholesterol test ($\tau = 0$). We estimate $\beta_{i\tau}$ coefficients for each event week starting from 14 weeks prior to the health assessment and ending 14 weeks afterwards, with the exception of week $t = -1$ which serves as the comparison period. We group weeks 23 (-13) together with all periods more than 23 weeks after (13 weeks before) an employee's cholesterol test and control for week fixed effects (w_t) and individual fixed effects (d_i) throughout.

Estimating event-time effects prior to the health assessment (-2 to -13) allows us to verify that the timing of the cholesterol test is quasi-exogenous to other factors influencing eating habits. If it were the case that individuals decided to do the total cholesterol test at a time when their behavior was trending in a more healthy direction, then the event time coefficients for weeks preceding the total cholesterol test would be increasingly positive (indicating more spending) going further into the past. The event-study framework also allows us to examine whether the effects of the health assessment on eating behavior decline over time, as we consider weeks further in distance from the health assessment.

Next, in our main analysis, we estimate a generalized differences-in-differences equation:

$$Y_{it} = \beta_1 PostTest_{it} + \beta_2 TestWeek_{it} + d_i + w_t + \varepsilon_{it} \quad (2)$$

where the coefficient on the dummy variable *PostTest* captures the average change in employees' spending at the cafeteria from all observed weeks before the test to all observed weeks following the test.⁹ Standard errors are clustered at the individual level.

We also estimate a modified version of equation (2) that allows for the post-test effect to differ in the first (*Post1*), second (*Post2*), and remaining months (*PostBeyond*) following the cholesterol test:

$$Y_{it} = \beta_1 Post1_{it} + \beta_2 Post2_{it} + \beta_3 PostBeyond_{it} + \beta_4 TestWeek_{it} + d_i + w_t + \epsilon_{it} \quad (3)$$

In models (2) and (3), we include *TestWeek*, a separate indicator for the week of the cholesterol test, in effect excluding it from the pre-post comparison. This is because factors that make an employee more likely to complete a biometric screening in a given week (e.g. being present at the workplace) might also be temporary shocks to their use of the workplace cafeteria. Our robustness checks, described and reported in Section 3.3, include checks that vary the length of this excluded time period.

3. Results

3.1 Descriptive Statistics

The demographic characteristics of our sample are summarized in Appendix Table 1, and Table 1 reports the biometric results from the 2013 HRA. Twenty-nine percent of employees have a high-risk level of cholesterol (high total cholesterol, high LDL, and/or low HDL cholesterol). Twenty-

⁹ Note that the reference period here is the entire pre-test period, as opposed to only the week prior to the test, as used in the event study analysis.

two percent have high blood pressure.¹⁰ Only 1.9% are found to have uncontrolled high glucose, but 33% of the sample is overweight and 37% is obese.¹¹ As reported in column three, 19.3% of employees—two-thirds of those with high-risk cholesterol—first learn this from the HRA (the “undiagnosed”).

On these health measures, our sample looks similar to a nationally representative sample (NHANES conducted by the CDC) in 2011-2012. The NHANES data shows that 34.9% of adults over the age of 20 were obese in 2012, 12.9% of U.S. adults over the age of 20 have high total cholesterol and 17.4% have low HDL. In our sample, these fractions are 37%, 10.5%, and 13.8%, respectively, when we use the CDC-equivalent definition for low HDL. Also, in the NHANES data, 12% are reported to have high blood pressure, although several readings were done and 17.8% had a “high” value on the highest of these readings.¹² Therefore, the employees in our sample seem to be of roughly similar health, overall, as the U.S. adult population.

Table 2 shows average weekly cafeteria spending for HRA participants, over the period preceding the HRA, and for non-participants over the entire study period. For HRA participants, average spending was \$7.30 per week overall, and \$11.55 among those who made at least one purchase in a given week. \$11.55 is approximately equal to the average cost of three meals (see Appendix Figure 2 for the distribution of spending per lunchtime transaction). For non-participants, average spending was slightly higher: \$8.47 per week overall, and \$13.26 among those who made at least one purchase in a given week. On average, 64% of the sample made at least one transaction at the hospital’s main cafeteria in a given week. HRA participants consumed,

¹⁰ High blood pressure is based on the same definition used by the CDC: a systolic value at or above 140 or a diastolic value at or above 90.

¹¹ According to the CDC, an individual is classified as overweight with BMI between 25 and 30, and obese with BMI above 30.

¹² The CDC statistics were obtained from CDC Data Briefs No. 131 and 132 as well as the authors’ calculations using NHANES microdata. Although a larger share of our sample (24%) had a high blood pressure reading, these readings are sensitive to recent consumption of caffeine, smoking, and physical activity, and the hospital put no restrictions on employees’ activities or consumption prior to their blood pressure readings.

on average, 434 calories, 6.12 grams of saturated fat and 108 milligrams of dietary cholesterol within the subset of items with recorded nutritional facts. Again, the averages are slightly higher for non-participants: 513 calories, 7.32 grams of saturated fat and 125 milligrams of dietary cholesterol.

The table also reports the share of spending devoted to items classified as “healthy” by the nutritionist in column 6. Forty-six percent of spending was allocated to items classified by a nutritionist as “healthy” among both HRA participants and non-participants. The most frequently purchased healthy item is the salad bar (\$6.24 per pound, \$3.13 on average). The most frequently purchased unhealthy items are French fries (\$1.22), breakfast potatoes (\$1.19), chicken tenders (\$3.50), 3 sausage links (\$1.35), and cheeseburger (\$2.39), and the top ambiguous items are bottled beverages (\$1.38),¹³ soup (\$1.63), and chips (\$1.07).

Table 2 also shows that total spending at the cafeteria and, to a greater degree, consumption of calories, saturated fat, and dietary cholesterol, correlate with HRA-measured indicators of worse health. Before their cholesterol tests, employees with high-risk cholesterol levels (N=354) were spending 28% more and consuming 32% more calories, 39% more saturated fat, and 57% more dietary cholesterol than those with low-risk values of cholesterol (N=869). High-risk employees also had a significantly lower healthy shares (41% vs. 48%, $p < .01$). The undiagnosed high-risk subsample, however, had similar consumption patterns as the high-risk group as a whole. A similar relationship holds when comparing employees in different BMI categories: employees indicating as overweight or obese spent more, consumed more calories and more saturated fat, and had significantly lower healthy shares than employees in the “healthy BMI” range. Lastly, the table summarizes spending characteristics by demographic groups. Males spend more than female employees and have lower healthy shares. We categorize workers into four occupation groups:

¹³ Because it includes a variety of carbonated soft drinks (both diet and regular) as well as bottled water, the item “Bottled beverage” was coded as “ambiguous.”

physicians, nurses, other (non-clinical) professional occupations and other non-professional occupations. Across these groups, employees in non-professional occupations have the highest spending levels and significantly lower healthy shares than the others.

3.2 Change in Eating Habits after Cholesterol Screening

The results of the event study analysis are shown graphically in Figure 1.¹⁴ A pattern of decreased spending following the cholesterol test is evident among the high-risk and undiagnosed high-risk samples, suggesting that these employees are responding to the notification of their health condition by consuming less food at the workplace cafeteria in the 1-2 months after the cholesterol test. Spending appears to gradually drop over the first month following the cholesterol test, which could reflect variation in the delay between being tested and receiving the cholesterol notification in the mail.¹⁵ The effect however, appears muted beyond the second month. In the full sample and the low-risk sample, none of the post-period time dummies (event weeks 1-23) is significantly different from zero.

For all four samples (the full sample, the low-risk, the high-risk, and the undiagnosed high-risk), no pre-trends are evident, and none of the pre-test event week coefficients are significantly different from zero with the exception of one week for the undiagnosed high-risk group. This is consistent with our assumption that the timing of the cholesterol test is exogenous to other factors influencing workplace eating habits.

The results of our main specifications (Equations 2 and 3) are shown in Table 3. We find that high-risk individuals and undiagnosed high-risk individuals reduced their weekly cafeteria spending by \$0.49 and \$0.69, respectively, in the first month after their cholesterol tests. These reductions correspond to a 6% drop in spending for the high-risk sample and an 8% drop for the

¹⁴ Coefficient estimates are also reported in Appendix Table A3.

¹⁵ Approximately 20% of participants completed their cholesterol test through a finger-prick test with instant results, but the remaining 80% had a blood draw at the lab. Notification letters sent after the lab tests would usually take 1-2 weeks, and typically no more than 3 weeks, to reach employees.

undiagnosed high-risk sample, but do not persist beyond the second month. Thus, the overall decrease in total spending, averaged over all post-test observation weeks, is not statistically significant in any of the subsamples.

Panels B and C in Table 3 focus on spending on items classified by the nutritionist as “unhealthy” or “healthy,” respectively. Results show that the temporary decrease in spending for high-risk and high-risk undiagnosed employees occurs mostly within the set of items classified by a nutritionist as unhealthy.

Table 4 shows the effect of the HRA notification on calories, grams of fat, grams of saturated fat, and milligrams of dietary cholesterol among the subset of items with recorded nutritional facts, as well as the total spending for this subset of items purchased.¹⁶ The effects in aggregate and for each of the subgroups are negative, but small (under 4%) and not statistically significant. Results broken down by month after the cholesterol test show that the largest reductions were made in the first month for calories, fat, saturated fat, and dietary cholesterol, but they are statistically insignificant (Appendix Table A2). Overall, these results suggest employees were making modest reductions in their general consumption at the cafeteria rather than targeting specific nutrients to avoid.

3.3 Robustness

A limitation of our dataset is that not all employees took the cholesterol test. As Table 2 shows, employees who participated in the HRA had different eating habits at baseline than those who did not participate. We include non-participants in the sample to help identify week fixed effects, but the validity of this approach depends on the assumption that secular trends in cafeteria spending are similar between participants and non-participants.¹⁷ Weighting by inverse propensity

¹⁶ Consistent with the fact that items with recorded nutritional facts account for about 50% of the average employee’s spending, the effect of the HRA on spending for these items is smaller than its effect on total spending.

¹⁷ Note that level differences in spending are absorbed by individual fixed effects.

scores, to make the treated sample more comparable to the untreated sample on observables, does not change any of our results. Specifically, we use data on employee demographics and cafeteria spending in the first three months of 2013 (prior to the launch of the HRA) to estimate each individual's probability of taking the cholesterol test, and of receiving a low-risk or high-risk test result conditional on taking the cholesterol test.¹⁸ Then, we weight treated observations by the inverse of the probability of being treated and untreated observations by the inverse of the probability of not being treated. Our results, in the top panel of Table 5, are largely similar to the overall results in Table 3.

Another possible concern is that following the cholesterol test, employees might feel guilty about food purchases and choose to pay in cash, instead of with their ID card. If this were frequently occurring, however, we would expect to see a decrease in the share of cafeteria sales linked to employee ID cards as the year progressed, and in particular after the months of May, October, and November, in which completion of the health assessment was concentrated. In fact, as shown in Appendix Figure 3, the share of revenue linked to ID cards hovers between 70 and 75% over our sample period, showing no support for this hypothesis.

The remaining panels of Table 5 correspond to other robustness checks. First, we limit the sample to employees who had non-zero spending at the cafeteria in more weeks than the median value within our sample, i.e. "frequent cafeteria visitors." The results for total weekly spending are larger in magnitude, but similar in percentage terms, as in the full sample. We find a statistically significant increase in cafeteria spending for the employees with low-risk cholesterol, but no statistically significant effects for the high-risk sample. We also limit our sample to a balanced

¹⁸ The results of these logit regressions are shown as odds ratios (OR) in Appendix Table A4. Characteristics that are strongly associated with completion of the cholesterol test include being female, being white, and working in a non-clinical professional occupation. Conditional on taking the test, nurses, females, and younger employees are more likely to have low-risk cholesterol. Cafeteria spending at baseline is negatively associated with taking the test but positively associated with a high-risk test result. Having a higher "healthy share" of cafeteria spending is negatively associated with taking the test and strongly negatively correlated with a high-risk test result.

panel in event-time, with each individual appearing only from 13 weeks prior to their test to 23 weeks after their test, the longest span of time before and after the test that we observe for all of the individuals in our sample. The results indicate larger and marginally significant reductions in spending for the high-risk and high-risk undiagnosed samples, compared to our main specification, and a borderline significant increase in spending for the low-risk sample. The larger effect size for the high-risk sample is driven primarily by the shortened pre-period among late participants in the cholesterol test, as opposed to the shortened post-period among early participants.

We also vary the length of the period surrounding the cholesterol test that is excluded from the difference-in-differences analysis and show results in which the week of the cholesterol test is not excluded. Then, we exclude the large share of HRA participants who had their cholesterol tested during the first employee health fair (197 employees, i.e. 14.5% of participants) or in the last possible week (292 employees, i.e. 21.5% of participants) to address concerns of differential selection into these two groups. We also show the estimates excluding three holiday weeks in which total spending is lowest, to ensure that behavior during those periods is not driving our results. Overall, none of these additional checks produces results that differ substantially from our main specification in terms of the point estimate magnitudes.

Finally, Appendix Table A5 reports the effects on cafeteria purchases of being screened as high risk in either blood glucose or blood pressure, instead of cholesterol. Similar to our cholesterol results, we do not find any statistically significant overall impact, but we do see a short-term reduction in total spending among those with high-risk and undiagnosed high-risk glucose.

4. Conclusion

Many public health interventions involve the provision of health information with the aim of inducing changes in behavior. In several cases ranging from calorie posting to weight report

cards, however, information provision appears to have little to no effect on behavior.¹⁹ One important challenge in interpreting null findings is the difficulty of identifying for whom the information is news.

This paper investigated how cholesterol test results influence employees' eating behavior while addressing this challenge. Data on employees' prior awareness of their high cholesterol allowed us to study the effect of new and negative information about one's health, which could be larger than the average effect of the test on all employees who took it.

Our main results show that employees with high cholesterol reduce their total spending at the workplace cafeteria after the cholesterol test and reduce their spending on unhealthy items in particular, but only for about two months. We see roughly similar changes among the high-risk individuals who were previously undiagnosed and those who were already aware of their risky condition. This suggests that the information received in a health risk assessment may briefly heighten the attention and effort devoted to healthy eating by high risk individuals, through salience as well as new information. Indeed, looking only at the average effect among all HRA participants obscures this effect, because the behavior of the low-risk population moves slightly in the opposite direction.

However, the reduction in spending is short-lived: changes seen in the high-risk and high-risk undiagnosed samples, relative to the untested population, dissipate by the third month. Our results are in line with those of Oster (2018), who finds small calorie reductions at the household level, concentrated in unhealthy foods, in response to a diabetes diagnosis. More broadly, our finding adds to a growing literature showing that health-related habits can be stubbornly persistent,

¹⁹ For example, evidence on the effects of mandatory posting of calories on restaurant menus is mixed, with several studies finding little to no impact (Downs, Wisdom and Loewenstein (2015) review this literature). Also, the provision of weight report cards to parents of schoolchildren has proven effective at improving parental knowledge and shifting parental attitudes about child's weight, but not at changing behaviors or children's body mass index (Chomitz et al. 2003; Prina and Royer 2014).

often gradually reverting to pre-intervention levels even after incentives change them temporarily (e.g., Carrera et al., forthcoming).

Overall, given the newfound popularity of health risk assessments at the workplace, more work is needed to better understand their potential for improving health. Employees might need additional support or incentives to maintain their behavior change efforts over the long term.

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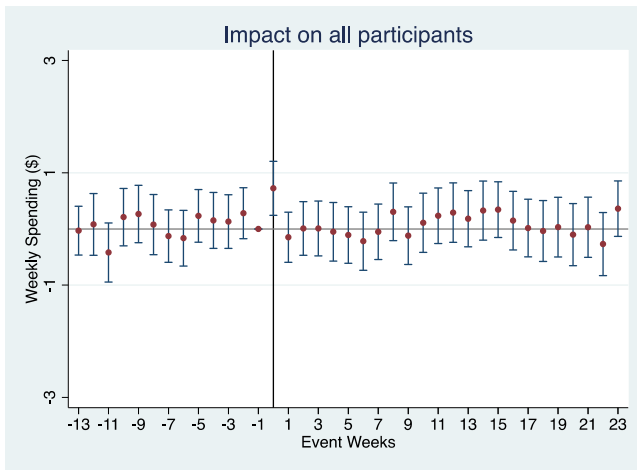
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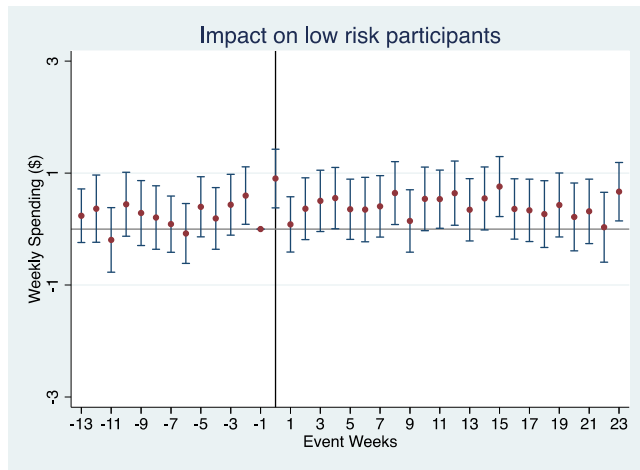
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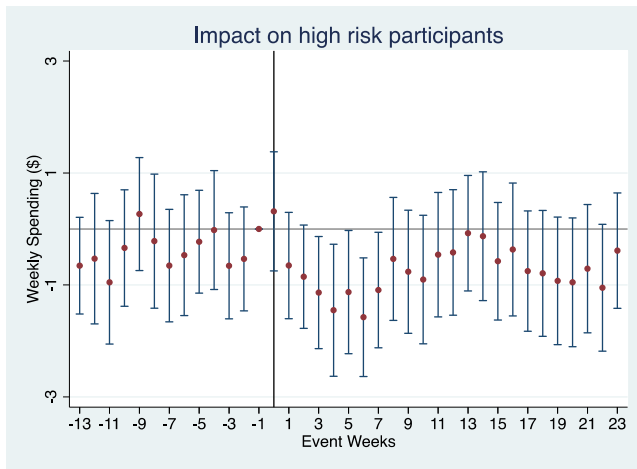
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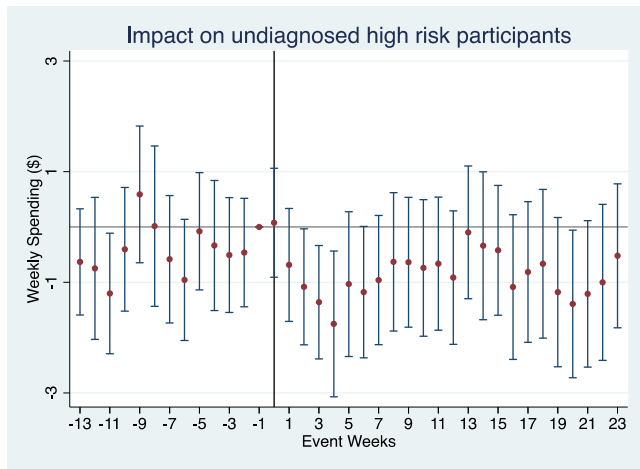
a. N = 2,336 (1,459 participants)



b. N = 1,982 (869 low-risk participants)



c. N = 1,467 (354 high-risk participants)



d. N = 1,349 (236 undiagnosed participants)

Figure 1: Event study estimates for total weekly spending at the cafeteria for the full sample, the high-risk and undiagnosed high-risk subsamples.

Note: The excluded time dummy is the week preceding the test (-1). The coefficients labeled “-13” (and “23”) represent all weeks that precede (follow) the cholesterol test by that number of weeks or more. The panel is balanced within the (-13, +23) interval. Bars represent 95% confidence intervals.

Table 1: Biometric statistics from health risk assessment

	Obs. (Employees tested)	High-risk¹	Undiagnosed high-risk²
	(1)	(2)	(3)
Cholesterol	1,223	28.9%	19.3%
Blood Pressure	1,125	22.2%	13.2%
Glucose	1,313	1.9%	0.5%
Overweight	1,062	32.9%	
Obese	1,062	36.7%	

Sample includes only employees who ate at the cafeteria at least once in Jan-March 2013 and at least once in Jan-April 2014 and had these measures recorded between April 1 and November 15 of 2013 as required for the health risk assessment. ¹High risk for cholesterol was defined as total cholesterol at or above 240, LDL at or above 160, or HDL below 40 (Men) or 45 (Women). High risk for blood pressure was defined as a systolic value above or at 140 or diastolic blood pressure above or at 90. High risk for glucose was defined as glucose above 126 (if fasting) or 200 (if not fasting). Being overweight was defined as a BMI between 25 and 30. Being obese was defined as a BMI value at or above 30. ²Undiagnosed was defined as answering "No" to the question: "Do you have, or have you been told that you have any of the following health conditions?" for the health conditions high cholesterol, high blood pressure, and diabetes, respectively. Since not all individuals were tested for all conditions, the number of employees in each row differs.

Table 2: Weekly cafeteria purchases, prior to the cholesterol test

	Observations/ Individuals	Total spending ¹	Calories	Grams of Saturated Fat	Milligrams of Dietary Cholesterol	Healthy share ²
	(1)	(2)	(3)	(4)	(5)	(6)
Full sample						
Chol. test participants	42,333 / 1,223	7.26	434	6.14	106	0.46
Non-participants ³	67,137 / 973	8.47	513	7.32	125	0.45
Cholesterol screening⁴						
Low risk	29,652 / 869	6.69	397	5.51	91	0.48
High risk	12,681 / 354	8.59	518	7.56	141	0.41
Undiagnosed	8,974 / 236	8.50	526	7.67	135	0.41
BMI⁵						
BMI in healthy range	9,896 / 290	5.74	344	4.75	73	0.51
Overweight	10,523 / 306	7.25	413	5.70	101	0.48
Obese	12,350 / 347	8.57	530	7.67	135	0.39
Gender						
Male	80,992 / 529	11.18	688	9.95	168	0.42
Female	28,478 / 1667	6.88	406	5.71	100	0.47
Age						
Under 40	34,255 / 669	8.21	504	6.93	115	0.44
40-55	49,235 / 997	7.65	457	6.56	117	0.45
Over 55	25,980 / 530	8.39	486	7.10	123	0.48
Occupation category⁶						
Physicians	12,903 / 245	8.03	362	4.61	76	0.56
Nurses	25,516 / 551	5.44	298	4.07	67	0.48
Other professionals	19,100 / 436	8.33	432	6.18	102	0.51
Other nonprofessionals	51,951 / 1,004	9.13	612	8.89	159	0.39

Notes: The sample includes cholesterol test participants and non-participants. We exclude 140 employees who did not take the cholesterol test but participated in either the glucose or blood pressure screening during this time period.¹Total spending is the employee's total weekly spending at the cafeteria. ²Healthy share is the share of weekly spending devoted to healthy items.³For those who did not participate in the cholesterol test, spending characteristics are averaged over the full set of weeks in the sample: January 2013-April 2014. For all others, only data prior to the test week is included in this summary. ⁴High risk for cholesterol was defined as total cholesterol at or above 240, LDL at or above 160, or HDL below 40 (Men) or 45 (Women). ⁵Being overweight was defined as a value from 25 to 30 for BMI. Being obese was defined as a value above or at 30 for BMI. The sample size is smaller because not all employees whose cholesterol was tested had their height and weight measured. ⁶The physician category includes: physicians, interns/residents, and non-physician practitioners. The nurses category includes clinical nurses and licensed practical nurses. The other professional category includes professional directors, coordinators, managers, professional support, and administration. The other non-professional category includes technicians, supervisors, support services, maintenance skilled trade, administrative support, and non-professional support.

Table 3: Impact of the cholesterol test on spending at the employee cafeteria

	Full Sample		Employees with low-risk cholesterol ¹		Employees with high-risk cholesterol		Employees with undiagnosed high-risk cholesterol ²	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Total Spending								
Overall	0.06 (0.12)		0.20 (0.14)		-0.18 (0.22)		-0.29 (0.27)	
First month after the test		-0.09 (0.13)		0.12 (0.15)		-0.49** (0.25)		-0.69** (0.30)
Second month after the test		-0.06 (0.14)		0.17 (0.16)		-0.55** (0.27)		-0.41 (0.33)
Third month and beyond		0.13 (0.14)		0.24 (0.16)		-0.03 (0.25)		-0.18 (0.32)
Pre-HRA average	7.26	7.26	6.69	6.69	8.59	8.59	8.5	8.50
Change as a share of pre-HRA average ³	0.01	-0.01	0.03	0.02	-0.02	-0.06	-0.03	-0.08
B. Spending on unhealthy items								
Overall	0.03 (0.08)		0.13 (0.09)		-0.13 (0.14)		-0.20 (0.18)	
First month after the test		-0.14 (0.09)		-0.02 (0.10)		-0.35** (0.17)		-0.52*** (0.20)
Second month after the test		-0.02 (0.10)		0.12 (0.11)		-0.27 (0.18)		-0.19 (0.22)
Third month and beyond		0.09 (0.10)		0.17* (0.10)		-0.05 (0.16)		-0.12 (0.21)
Pre-HRA average	3.99	3.99	3.52	3.52	5.08	5.08	5.07	5.07
Change as a share of pre-HRA average ³	0.01	-0.03	0.04	-0.01	-0.03	-0.07	-0.04	-0.10
C. Spending on healthy items								
Overall	0.03 (0.07)		0.07 (0.08)		-0.05 (0.12)		-0.10 (0.15)	
First month after the test		0.05 (0.08)		0.14 (0.09)		-0.15 (0.15)		-0.16 (0.17)
Second month after the test		-0.04 (0.08)		0.05 (0.09)		-0.28* (0.15)		-0.22 (0.18)
Third month and beyond		0.04 (0.08)		0.06 (0.09)		0.02 (0.14)		-0.06 (0.17)
Pre-HRA average	3.27	3.27	3.17	3.17	3.51	3.51	3.43	3.43
Change as a share of pre-HRA average ³	0.01	0.01	0.02	0.04	-0.01	-0.04	-0.03	-0.05
Observations (employee-weeks)	151,524		127,098		91,563		83,421	
Observations (employees)	2,196		1,842		1,327		1,209	
Observations (non-HRA participants)	973		973		973		973	
Observations (low-risk employees)	869		869					
Observations (high-risk employees)	354				354			
Observations (high-risk undiagnosed employee)							236	

Notes: The sample includes non-HRA participants and cholesterol test participants. We exclude 140 employees who did not take the cholesterol test but participated in either the glucose or blood pressure screening during this time period. ¹Low risk is defined as not at high risk. High risk is defined as total cholesterol at or above 240, LDL at or above 160, or HDL below 40 (Men) or 45 (Women). ²Undiagnosed is defined as answering "No" to the question: "Do you have, or have you been told that you have any of the following health conditions?" for high cholesterol. ³In odd-numbered columns, shares are the overall effect divided by the pre-HRA average. In even-numbered columns, shares are the first month effect divided by the pre-HRA average. Statistically significant coefficients are indicated as follows: *10%; **5%; ***1%.

Table 4: Impact of the cholesterol test on cafeteria purchases with linked nutritional content

	Full Sample	Employees with low-risk cholesterol ¹	Employees with high-risk cholesterol	Employees with undiagnosed high-risk cholesterol ²
	(1)	(2)	(3)	(4)
Total spending on cafeteria items with nutritional information	-0.05 (0.07)	-0.00 (0.08)	-0.15 (0.13)	-0.14 (0.17)
Pre-HRA average	3.64	3.36	4.26	4.31
Change as a share of pre-HRA average	-0.01	-0.00	-0.03	-0.03
Calories	-11.11 (9.72)	-8.34 (10.65)	-14.16 (17.85)	-13.49 (21.30)
Pre-HRA average	433.81	396.51	518.43	526.03
Change as a share of pre-HRA average	-0.03	-0.02	-0.03	-0.03
Grams of fat	-0.69 (0.46)	-0.62 (0.51)	-0.74 (0.84)	-0.89 (0.98)
Pre-HRA average	18.15	16.25	22.49	22.83
Change as a share of pre-HRA average	-0.04	-0.04	-0.03	-0.04
Grams of saturated fat	-0.21 (0.16)	-0.21 (0.17)	-0.18 (0.28)	-0.23 (0.33)
Pre-HRA average	6.14	5.51	7.56	7.67
Change as a share of pre-HRA average	-0.03	-0.04	-0.02	-0.03
Milligrams of dietary cholesterol	-0.72 (3.60)	-0.33 (3.70)	-1.88 (7.48)	-1.88 (9.23)
Pre-HRA average	106.38	91.28	141.22	135.14
Change as a share of pre-HRA average	-0.01	-0.00	-0.01	-0.01
Observations (employee-weeks)	151,524	127,098	91,563	83,421
Observations (employees)	2,196	1,842	1,327	1,209

Notes: ¹Low risk is defined as not at high risk. High risk is defined as total cholesterol at or above 240, LDL at or above 160, or HDL below 40 (Men) or 45 (Women). ²Undiagnosed is defined as answering "No" to the question: "Do you have, or have you been told that you have any of the following health conditions?" for high cholesterol. Statistically significant coefficients are indicated as follows: *10%; **5%; ***1%.

Table 5: Robustness checks

	Total spending ¹			
	Full Sample	Employees with low-risk cholesterol ²	Employees with high-risk cholesterol	Employees with undiagnosed high-risk cholesterol ³
	(1)	(2)	(3)	(4)
Inverse probability weighted	-0.14 (0.13)	0.05 (0.15)	-0.14 (0.20)	-0.25 (0.24)
Pre-HRA average	7.3	6.7	8.6	8.5
Change as a share of pre-HRA average	-0.02	0.01	-0.02	-0.03
Observations (employee-weeks)	151,524	127,098	91,563	83,421
Observations (employees)	2,196	1,842	1,327	1,209
Frequent cafeteria visitors⁴	0.14 (0.21)	0.46* (0.23)	-0.32 (0.35)	-0.49 (0.43)
Pre-HRA average	12.17	11.57	13.31	12.84
Change as a share of pre-HRA average	0.01	0.04	-0.02	-0.04
Observations (employee-weeks)	74,451	60,927	46,644	42,435
Observations (employees)	1,079	883	676	615
Balanced in event-time⁵	0.03 (0.12)	0.22* (0.13)	-0.40* (0.22)	-0.48* (0.26)
Pre-HRA average	7.15	6.57	8.58	8.36
Change as a share of pre-HRA average	0.00	0.03	-0.05	-0.06
Observations (employee-weeks)	112,388	99,290	80,235	75,869
Observations (employees)	2,196	1,842	1,327	1,209
Varying excluded weeks:⁶ Excluding weeks -1 to +1	0.07 (0.13)	0.21 (0.14)	-0.16 (0.22)	-0.28 (0.28)
Pre-HRA average	7.26	6.69	8.59	8.50
Change as a share of pre-HRA average	0.01	0.03	-0.02	-0.03
Observations (employee-weeks)	151,524	127,098	91,563	83,421
Observations (employees)	2,196	1,842	1,327	1,209
Varying excluded weeks:⁶ Week of HRA considered pre-test	0.02 (0.12)	0.20 (0.14)	-0.21 (0.21)	-0.31 (0.27)
Pre-HRA average	7.26	6.69	8.59	8.50
Change as a share of pre-HRA average	0.00	0.03	-0.02	-0.04
Observations (employee-weeks)	151,524	127,098	91,563	83,421
Observations (employees)	2,196	1,842	1,327	1,209
Varying excluded weeks:⁶ Week of HRA considered post-test	0.09 (0.12)	0.20 (0.14)	-0.14 (0.21)	-0.26 (0.27)
Pre-HRA average	7.26	6.69	8.59	8.50
Change as a share of pre-HRA average	0.01	0.03	-0.02	-0.03
Observations (employee-weeks)	151,524	127,098	91,563	83,421
Observations (employees)	2,196	1,842	1,327	1,209
Excluding first health fair and last week of HRA completion	0.05 (0.15)	0.20 (0.16)	-0.22 (0.26)	-0.36 (0.35)
Pre-HRA average	7.14	6.47	8.66	8.88
Change as a share of pre-HRA average	0.01	0.03	-0.03	-0.04
Observations (employee-weeks)	121,026	104,673	83,490	77,418
Observations (employees)	1,754	1,517	1,210	1,122
Excluding holiday weeks⁷	0.08 (0.13)	0.22 (0.14)	-0.12 (0.22)	-0.23 (0.28)
Pre-HRA average	7.32	6.75	8.65	8.54
Change as a share of pre-HRA average	0.01	0.03	-0.01	-0.03
Observations (employee-weeks)	144,936	121,572	87,582	79,794
Observations (employees)	2,196	1,842	1,327	1,209

Notes: ¹Total spending is the employee's total weekly spending at the cafeteria. ²Low risk is defined as not at high risk. High risk was defined as total cholesterol at or above 240, LDL at or above 160, or HDL below 40 (Men) or 45 (Women). ³Undiagnosed was defined as answering "No" to the question: "Do you have, or have you been told that you have any of the following health conditions?" for the health condition high cholesterol. ⁴Frequent cafeteria visitors are employees who had non-zero spending at the cafeteria in more weeks than the median value within our sample. ⁵This specification includes all individuals only from the period 13 weeks prior to their test to 23 weeks following their test. ⁶In our main specification, week 0, i.e. the week of the health risk assessment, is excluded. ⁷This specification drops the weeks of New Year's Day, Thanksgiving and Christmas because they are outliers in weekly spending. Statistically significant coefficients are indicated as follows: *10%; **5%; ***1%.