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COUCH-LOCKED WITH THE MUNCHIES: EFFECTS OF RECREATIONAL MARIJUANA LAWS ON EXERCISE AND NUTRITION

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ABSTRACT

As recreational marijuana laws (RML) expanded marijuana access over the last decade, still very little is known about the impact of RML on two costly social behaviors that may arise as a consequence of marijuana consumption: unhealthy eating (i.e. munchies), and sedentary lifestyle (i.e. couch-lock). Using Nielsen IQ Consumer Panel data, we find that the passage of RML led to an increase in the number of grocery store trips that involved "junk food", as well as the amount of respective "junk food" spending. This effect is particularly driven by an increase in snacks, cookies, and candy. Using the Behavioral Risk Factor Surveillance System (BRFSS) and the American Time Use Survey (ATUS), we find that the passage of RML led to a decrease in exercise, particularly driven by a reduction in cardio, and suggestive evidence of more time spent at home. The findings are robust to alternative methods that take into account the staggered implementation of RML. These results suggest that RMLs have an adverse effect on health through "munchies" and "couch-lock," which pose a significant public health challenge to diet and lifestyle-related chronic conditions.

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1 Introduction

While still classified as a Schedule I controlled substance at the federal level, state-level policies have increasingly enabled the use of marijuana for medical purposes through medical marijuana laws (MML), starting with California in 1996. Colorado and Washington in 2012 were the first states to adopt recreational marijuana laws (RML). Since then, several states and the District of Columbia have adopted RMLs, which fully legalize all components of the marijuana market (production, sale, possession, and consumption) for individuals of age 21 and older, without requiring proof of medical need.[1] Recent RML expansion is accompanied by growing support for marijuana legalization, which has doubled from 34 percent in support in 2001 to 68 percent by 2021 (Gallup 2022), and an increase in marijuana consumption over time (Herrington 2023; Substance Abuse and Mental Health Services Administration 2022). As the legal landscape of recreational marijuana consumption has drastically changed since 2012 and access is rapidly expanding, it has become crucial for policy makers to gain a better understanding of potential consequences on health.

While increased appetite (i.e. "the munchies" − a popular, colloquial term describing a common side effect from marijuana consumption) is a desired outcome among cancer patients undergoing chemotherapy, among HIV patients facing wasting syndrome, and anorexia patients, "the munchies" may lead towards unhealthy and frequent eating among recreational users, which has negative public health consequences.[2] Similarly, sleepiness (i.e. "couch-lock" − another popular colloquialism describing a side effect of marijuana consumption) may be a desired outcome among individuals who are diagnosed with insomnia, but it may lead to reduced movement, exercise, and increased social isolation among otherwise healthy individuals. Given these discrepancies, it is unsurprising that there are mixed views on the health effects of access to marijuana. Though MMLs already grant access to marijuana to

[1] Refer to Table 1 for a detailed breakdown of each state's MML and RML dates.

[2] In addition to stimulating appetite, marijuana is used to manage several other diseases and symptoms such as glaucoma, nausea, chronic pain, inflammation, multiple sclerosis, and epilepsy (Anderson and Rees 2014; Molina et al. 2011; Musty and Rossi 2001; Penner et al. 2013; Sabia et al. 2017; Ungerleider et al. 1982; Volkow et al. 2014)

patients with medical need, there are debates about whether the benefits of extending access to marijuana outside its medical purposes outweighs the associated costs. On the one hand, marijuana legalization mechanically reduces the number of prosecutions for possession, which is a crime often criticized for its economic and racial disparities (ACLU 2013; ACLU of Washington 2014). On the other hand, opponents express concerns about marijuana being a potentially addictive drug that is a gateway to other harmful substances (DeSimone 1998; van Ours 2003; Kelly and Rasul 2014; Volkow et al. 2014). Even though RML only increases access among those of age 21 and older, opponents of RML express concern about RML inadvertently becoming more available to underage youth, which can be consequential given the well-established correlation between early marijuana use and behavioral and cognitive impairments, poor academic performance, attention and memory deficits, as well as heightened risks of depression and anxiety (Wilson et al. 2000; Pacula and Ringel 2003; Van Ours and Williams 2009; George and Vaccarino 2015; Blanco et al. 2016; Ames et al. 2020).

This study exploits temporal variation in RML implementation across states to evaluate the popular stereotype of marijuana consumption leading to munchies and couch-lock. We begin by examining purchases of "junk food" in grocery stores using the NielsenIQ Consumer Panel data; we find a 3.1 percentage point (pp) increase in likelihood of a weekly grocery trip including "junk food", along with an 8.8% increase in spending on "junk food". The increase in spending is particularly notable as we find a parallel 1.4% decrease in the total number of grocery store trips. While our definition of "junk food" is broad, the effects we estimate are driven by spending increases on snack foods (13%), cookies (17.5%), and candy (8.5%).

We examine exercise and activities outside of the home next, using the Behavioral Risk Factor Surveillance System (BRFSS) and the American Time Use Survey (ATUS). We estimate a 1.2pp decrease in likelihood of reporting exercise in the previous 30 days in the BRFSS. This decrease can be attributed primarily to cardio intensive exercise declining by

2.0pp. Time use confirms these patterns; using ATUS, we find that respondents report 0.63 fewer daily minutes at the gym (18.2% effect). More broadly, however, the ATUS shows that respondents spend more time at home after the passage of RML: 8.37 daily additional minutes at home, 5.9 fewer daily minutes at work, 2.72 fewer daily minutes outdoors, and 1.99 fewer daily minutes in restaurants and bars.

In an additional analysis, we use Advan mobile device tracking data to examine whether the reduction in time spent outside of home also affects other "junk food" points of sale. We find a 7.7% decline in visits to fast-food restaurants and a 9.5% decrease in visits to convenience stores. We also estimate a 4.2% decrease in visits to grocery stores confirming our NielsenIQ findings. Though the Advan results are more limited, they provide additional suggestive evidence supporting couch-lock.

Evaluations of MML implementation have shown decreases in obesity, driven by increased physical mobility among older adults (Sabia et al. 2017). These findings appear to contradict the popular stereotype of marijuana munchies, and the more recent correlations between marijuana and "junk food" consumption (Baggio and Chong 2020). The aim and implementation of MML differ substantively from RML: MML was aimed at reducing the impact of chronic conditions associated with severe health conditions such as cancer, anorexia, and depression; MML was targeted at older and sicker individuals who would gain mobility from improved pain control and stimulation of appetite. Therefore, the findings around MML cannot be extended to the healthy and younger population of consumers at large. Accordingly, this paper contributes to this emerging literature in three ways. First, we focus on the more recent time period when recreational marijuana legislation was expanded, well after the implementation of MML. This allows us to focus on the effects of RML, while taking into account whether MML laws are also present. Our second contribution is the use of a number of novel datasets to evaluate the combined effect of "junk food" consumption and mobility changes resulting from RML. Such analysis allows us to not only see increased consumption of high caloric foods, but it also indicates reduced opportunities to spend those

calories. To our knowledge, this is the first paper that combines these two aspects of RMLs impact on health. Third, we improve on previous research by using methodological advances in staggered implementation literature to account for the gradual expansion of RML across states.

The remainder of the paper proceeds as follows. The next section summarizes the literature relating physical activity and food consumption with marijuana use. Sections 3 and 4 describe our data sources and empirical approaches, respectively. Section 5 discusses our main results and the consistency of our findings in a series of robustness checks. Finally, we provide a brief discussion of our findings and some concluding remarks in sections 6 and 7.

2 Background

We contribute to the literature that focuses on the effect of RML on two health outcomes: unhealthy eating and physical activity. Given the stereotype of marijuana consumption being associated with "munchies" and "couch-lock", and the costly social consequences of unhealthy eating and a sedentary lifestyle, this question is important for developing policy.

2.1 Food Consumption ("The Munchies")

Research examining the link between food consumption and marijuana use ranges from physiological reactions after consuming cannabinoids to dietary behaviors and overall public health implications. Our review synthesizes the findings from several papers exploring these issues, focusing on how marijuana relates to "the munchies."

Early research focused on randomized control trials examining the food preferences of users after ingesting marijuana, noting an increase in appetite and calorie consumption (Hollister 1971; Mendelson 1976; Greenberg et al. 1976; Mattes et al. 1994; Berry and Mechoulam 2002; Gorter 1999). Delving deeper into these appetite increases revealed a penchant for less nutritious foods, characterized by a surge in snacking on unhealthy foods (e.g., sugary, high-calorie treats) along with larger amounts of food when under the influence of cannabis (Foltin et al. 1988; Kruger et al. 2019). Even when satiated, marijuana users experienced

an increased preference for sweet foods (Iversen 2003). Beyond the laboratory, Gelfand and Tangney (2021) utilized the National Health and Nutrition Examination Survey (NHANES) between 2005 to 2016 to compare the dietary intake of current marijuana users, past users, and non-users in the United States, and found that current cannabis users consumed fewer fruits and vegetables in comparison to previous and never users, resulting in a lower quality diet. Combined, these findings raise health concerns. The high-calorie nature of many sweet foods favored by users, along with fewer fruits and vegetables in their diet, could lead to weight gain and an elevated risk of obesity among recreational marijuana consumers. However, these observations are not universal. Roberts et al. (2019) report an increased appetite for all foods, contradicting the common assumption and general findings that marijuana users prefer sweet, calorie dense foods.

While the link between marijuana use and food experience has been examined through controlled trials and survey data, representing small groups of individuals and their stated food preference, there has been relatively limited exploration of larger scale impacts or longer-term effects on health behavior changes. Roberts et al. (2019) suggested that sustained marijuana use over time may result in a less significant effect on appetite, implying that these effects may only be observed at a micro scale or in specific time-frames associated with marijuana ingestion. While research has overlooked the effect of marijuana legalization on unhealthy eating, a notable exception is Baggio and Chong (2020), which provides the first study utilizing non-survey data to estimate the relationship between a state's RML status and food consumption. Their analysis, based on county-level data spanning 52 designated markets from 2006 to 2016 and employing a difference-in-difference border analysis between RML and non-RML western states, indicated a 3.2 percent increase in overall "junk" food sales.

Expanding the work of Baggio and Chong (2020), Lu (2021), utilized the Consumer Expenditure Interview Survey from 2005 to 2019 to study how RML legislation affected food expenditures. Classifying food into two categories – at home and away from home

expenditure – they found that households in states with RMLs increased their spending on food consumed away from home with no change in food consumed at home. However, Lu does not indicate how this relates to health or changes in healthy behavior. Similarly, Hodge and Hazel (2022) examined an increase in taxable food sales in Washington after recreational marijuana was introduced, without associated decreases in other food categories (e.g., non-taxable and restaurant food). Taxable food was identified as prepared food, often considered more calorie dense than unprepared food. Finally, Romano et al. (2023) examined the link between fast-food consumption and cannabis. Using the Global School-Based Student Health Survey of adolescents from 28 countries (2010-2016), they observed statistically significant associations between the prevalence of cannabis use (within the last 30 days) and fast food consumption (within 7 days).

These studies collectively contribute to our understanding of how marijuana use in the United States may influence nutritional intake, dietary behaviors, and health outcomes associated with food. Overall, the literature suggests an unhealthy link between marijuana use and food consumption, with increases in high-calorie and snack foods observed after the ingestion of marijuana or legalization of recreational marijuana.[3]

2.2 Physical Activity ("Couch-Lock")

There is a growing body of research examining the relationship between marijuana use and physical activity or "couch-lock". Overall, the research has been mixed concerning potential health effects and outcomes. Marijuana use has been associated with enhancing exercise experience via reduced anxiety, increased enjoyment, and reduced pain, potentially leading to health improvements (Pillard et al. 2001; Huestis et al. 2011; Kozela et al. 2013; De Vita

[3]Although not an examination of the association between marijuana and food, medical research related to this topic has provided insight into the complex physiological relationship between marijuana use and food consumption. In particular, researchers are beginning to understand how cannabis affects appetite regulation, dietary choices, and nutritional outcomes (De Luca et al. 2012; Soria-Gomez et al. 2014; Koch et al. 2015). The findings suggest the properties of tetrahydrocannabinol (THC), the active compound in marijuana long associated with its psychoactive effects of making users feel "high", mimic the natural mechanism for controlling satiation from food, signaling satiety or hunger to the brain and influencing the palatability of food (Soria-Gomez et al. 2014; De Fonseca et al. 1992).

et al. 2018; Nicholas and Maclean 2019). There have also been links to decreasing motivation and impairing exercise performance (Bloomfield et al. 2014; Lutchmansingh et al. 2014). Rather than focus on sentiments and exercise experiences at an individual level, our review of this literature focuses on physical activity associated with marijuana use and accessibility of general populations.[4]

The bulk of the exercise-related marijuana research has focused on adolescents and young adults. While the majority of these studies reveal a negative relationship with exercise or a positive relationship with sedentary behavior (Ashdown-Franks et al. 2019; Delisle et al. 2010; Pate et al. 1996; Vancampfort et al. 2019; Winnail et al. 1995), these findings are not universal. Dunn and Wang (2003) and Gillman et al. (2015) failed to find any statistically significant relationship, while French et al. (2021) suggested a positive relationship, even among heavy marijuana users.

Henchoz et al. (2014) were the first to examine the association between marijuana use and physical activity among adults. Focusing on the relationship between established health behaviors and marijuana use among young men in Switzerland, their analysis suggested differences based on the intensity of physical activity. Those engaged in regular sport and exercise were less likely to frequently use marijuana (greater than or equal to 2 times per week), but moderate levels of physical activity were associated with greater odds of frequent marijuana use than were low levels of physical activity. Interested in this relationship among US adults, Vidot et al. (2017) utilized the NHANES data from 2007-2014. Marijuana users were less likely to engage in moderate and vigorous physical activity compared to never users, and time spent engaging in physical activity decreased as the frequency of marijuana use increased. The researchers also uncovered a seemingly contradictory result within their analyses: current marijuana users had higher odds of meeting the World Health Organization's

[4]There is a related set of research examining the training, performance, and motivation enhancements of athletes (Ewing 1998; Kennedy 2017; Huestis et al. 2011; Renaud and Cormier 1986; Saugy et al. 2006; Ware et al. 2018), suggesting there may be increased activity or potential athletic performance enhancement associated with marijuana use. However, it is important to recognize these conclusions may not be translate to those who are not professional athletes.

(WHO) physical activity guidelines than never users.

Following the work of Vidot et al. (2017), Smith et al. (2021) utilized the same data source (NHANES) and documented higher odds of being active among survey respondents who reported having "ever used" cannabis, and attributed differences between their findings and Vidot et al. (2017) to having two additional years in their dataset (2007-2016), as well as additional covariates. However, their results were also mixed. Sedentary behavior increased among marijuana users, males who "ever used" cannabis had a significant increase in their television viewing times, and females who "ever used" cannabis experienced increases in total sitting time. Finally, YorkWilliams et al. (2019) observed cannabis users who used marijuana concurrently with exercise engaged in more minutes of aerobic and anaerobic exercise per week. Overall, research examining the relationship between marijuana and physical activity is inconclusive.

3 Data

We use a number of nationally representative public and private datasets to examine health outcomes and behavioral changes in response to RML. We discuss these below and address their interaction at the end of the section.

3.1 NielsenIQ Consumer Panel Survey

We use the NielsenIQ Consumer Panel Survey data, in which it covers millions of grocery trips made by 40,000 to 60,000 households each year between 2011 to 2020 across the contiguous 48 states and the District of Columbia.[5] The NielsenIQ Consumer Panel is a nationally representative panel of consumer purchases where individuals over the age of 18 are recruited into the ongoing panel, as well as added to the panel with the goal to remain nationally representative. Once enrolled, a household is required to scan each purchased

[5]Researcher(s)' own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the NielsenIQ data are those of the researcher(s) and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

product. Participating households remain in the survey for as long as they are deemed eligible, allowing for an extended longitudinal overview of how, where, and when purchases were made.

Each observation in the NielsenIQ Consumer Panel Survey is a purchase by a household. Therefore, we aggregate our data to household-week level, creating an indicator for category of purchase. Once collapsed, we have 20.5 million household-week observations. Data include information about the price, brand, and quantity of the products. Since the analysis focuses on purchasing patterns around snacks and unhealthy foods, we use product subcategories to identify purchases of snacks, chips, cookies, candy, and ice cream.

3.2 Behavioral Risk Factor Surveillance System (BRFSS)

The BRFSS is a publicly available individual-level cross-sectional national annual survey of approximately 400,000 respondents conducted annually by the Centers for Disease Control and Prevention (CDC). The focus of the survey is to provide a nationally representative dataset that monitors health behaviors. Given the cross-sectional nature of the interview, we observe variation across months and year of interview. We focus on annual waves between 2011 and 2021, consisting of approximately 4.3 million respondents.

Each year, as part of the survey, respondents are asked whether they have participated in any physical activity or exercise such as running, calisthenics, golf, gardening, or walking in the previous 30 days. Though the question is very broad and asks to identify any type of exercise, approximately 75% of respondents report exercise. Every other year, in addition to the question about any exercise, the survey delves deeper to evaluate the type of physical exercise. We divide the types of physical activity into four types: sports [6], cardio and strength

[6]The following exercise categories are considered sports: badmington, basketball, soccer, softball/basketball, squash, lacrosse, mountain climbing, surfing, swimming, volleyball, swimming in laps, tennis, wrestling, canoeing/rowing in competition, rugby, racquetball, snow skiing, table tennis, tai chi, touch football, karate, martial arts, hiking-cross country, hockey, rock climbing, horseback riding, boxing, frisbee, golf with motorized cart, golf without motorized card, handball, inline skating, paddleball

training[7], home activities[8], other[9], and an indicator for whether the respondent engaged in walking, running, jogging or swimming in the past month at least once a week.

Thus, while the outcome of interest in the main analysis is any exercise in the last month, in some analyses the outcome variables are the various types of exercise from the biennial survey.

In addition to the exercise questions, we use respondent demographic variables, interview date, and respondents location to control for implicit characteristics and identify RML access. Specifically, all analyses control for age and sex, and we limit the sample to respondents 21 years and older, which corresponds to the legal usage age of RMLs. In some analyses, we also report results for 18-21 age category to evaluate spillovers and illegal use.

3.3 American Time Use Survey (ATUS)

The ATUS is an annual nationally representative survey conducted by the Bureau of Labor Statistics (BLS) identifying how, where, and with whom Americans spend their time. ATUS participants are randomly selected from households which completed the Current Population Survey (CPS). While the CPS over samples households in small states, ATUS adjusts its household composition to construct a sample representative of the US. The sample is further stratified by race and household composition. One person from the household who is 15 years or older is then asked to complete the one-day time diary, detailing activities in 15-minute fragments over a designated 24 hour period of time. The respondent lists primary activities, describing them in their own words, including where each activity took place. The designated diary date is distributed across the week, with 10% allocated to each weekday,

[7]The following exercise categories are considered cardio and strength-training: jogging, elliptical or EFX machine exercise, running, walking, rope skipping, rowing machine, pilates, weight lifting, stair climbing or stair master, bycicling machine, biclycling, aerobics video or class, calisthenics, yoga, upper body cycling or wheelchair sports or ergometer, dancing (ballet ballroom, Latin, hip hop, etc)

[8]The following exercise categories are considered home activities: household activities, yardwork, childcare, mowing lawn, snow blowing, snow shoveling by hand, painting or papering house, raking lawn, carpentry, gardening, farm or ranch work (caring for livestock)

[9]The folloewing exercise categories are considered other: hunting big game or small game, fishing from river bank or boar, active gaming devices (wii fit, dance, dance revolution), backpacking, boating (canoing, rowing, kayaking, sailing for pleasure or camping), bowling, scuba diving, skateboarding, ice or roller skating,sledding or tobogganing, snorkeling, snowshoeing, stream fishing in waders, waterskiing

and 25% allocated each to Saturday and Sunday. In each survey year, ATUS includes about 14,000 respondents, or about 1,150 diaries per month.

We use the IPUMS ATUS Extract Builder to construct our sample, focusing on surveys between 2011 to 2021 and including 104,497 respondents. For our analysis, we use reported places of activity such as home, gym, outdoors, school, workplace, grocery store, bar/restaurant, and other people's homes. The outcome of interest is time spent in these locations throughout the day and the intent is to identify whether RML increases time spent at home and reduces time spent in out-of-home engagement. As with BRFSS, we use the recorded interview date and respondents state of residence to situate the response relative to passage of RML. As before, analyses are restricted to individuals 21 years and older, though we also report results for 18-21 year olds in some analyses.

4 Methods

We estimate the following two-way fixed effects model, where we compare RML states before and after the passage of the law (treatment) to states that either did not yet implemented or would never implement such laws (control):

$$Y_{ist} = \alpha + \beta_1 MML_{st} + \beta_2 RML_{st} + \gamma X_{ist} + \delta_s + \mu_t + \epsilon_{ist} \quad (1)$$

Y_{ist} represents the outcomes of interest for household or individual i in state s and time period t, and the time-frame differs by dataset as discussed below. As most states' approval of RML was preceded by MML, we control for the presence of medical marijuana laws standalone with an indicator that has the value of 1 if medical marijuana laws have been implemented in state s and year-month (or year-week) t, as long as RML had not been implemented yet (MML_{st}). The variable RML_{st} has a value of 1 if RML have been implemented in state s by time t. The coefficient of interest is β_2. We also control for individual or locality demographic characteristics, X_{ist}, such as gender, age, and race. The location fixed effects (δ_s) account for factors that are state-specific and do not vary over time. The time fixed effects (μ_t) represent

secular trends in these outcomes that are occurring nationally over this time period.

The outcomes of interest and unit of observation differ by dataset. The NielsenIQ Consumer Panel Survey tracks households across time. We aggregate observations to the household-week level, and aggregate the amount of trips and total amount purchased for all and "junk" groceries. We also aggregate the amount purchased in the following categories of "junk food" groceries: snacks, chips, cookies, candy, and ice cream. For these outcomes, location and time fixed effects are at the county and week levels.

The BRFSS, which is cross-sectional data, provides self-reported behavioral indicators for each interviewee. We use self-reported exercise in the 30 days prior to interview, as well as types of exercise from the biennial survey. The ATUS, also cross-sectional data, provides self-reported time spent in a specified location. The analysis focuses on time in minutes spent in specified places: home, gym, outdoors, school, workplace, grocery store, bar/restaurant, and other people's homes. For these outcomes, location and time fixed effects are at the state and year or month of the interview.

In order to address the staggered timing of RML implementation across states, we also implement the Borusyak et al. (2024) (henceforth BJS) imputation based estimator as our preferred specification. Specifically, BJS fits a simple TWFE regression using observations only for units and time periods which are not-yet-treated. Based on these estimates, BJS imputes the never-treated potential outcome into future periods for these units. BJS derives the treatment effect from the difference between the observed post-period and the imputed never-treated values. These estimates are then aggregated into average treatment effects for groups and overall. BJS use the average of all pre-treatment periods to make the imputation of the never-treated outcome. The estimates are valid in the presence of parallel trends in all pre-treatment periods. To check the robustness of our estimates, we also implement a Gardner (2022) stacked regression method (see Appendix A1 for exposition of these methods and estimates).

Though NielsenIQ covers a long period of time, the COVID-19 period changed grocery

shopping and consumption patterns. As many of the RML laws were passed after the start of the pandemic, we need to effectively remove these pre-period trends prior to implementing the TWFE and BJS imputation method. To do so, we use detrending for staggered implementation recommended by Goodman-Bacon (2019). This method involves estimation of group specific linear trends restricting the data only to the pre-period using a specification of type:

$$Y_{ist} = \alpha_1 + \sum_{g=1}^{G} \alpha_2^g RML_s^g * Time_t + \gamma X_{ist} + \delta_s + \mu_t + \epsilon_{ist} \tag{2}$$

where RML_s^g is a group indicator interacted with $Time_t$, providing a linear time trend for each of the G groups. X_{ist}, δ_s, and μ_t are defined as before. From this specification, we calculate the residuals for the entire period − both pre- and post-period, generating $\tilde{Y}_{ist}$. We then implement TWFE and BJS using $\tilde{Y}_{ist}$ as the outcome variable. This method of detrending is utilized for the NielsenIQ dataset, but not the ATUS and BRFSS which rely on point in time survey reporting and, therefore, do not reflect the same time trends.

5 Results

Prior to discussing presented adjusted results, we discuss the characteristics of the outcome variables in Table 2. We report the mean and standard deviation for each outcome of interest, separated by the behavioral pathway of munchies versus couch-lock. These means are further separated by whether the state has ever passed an RML within analysis time period. For "junk food" consumption, we note that a household in our data spends approximately $8.27 on "junk food" weekly; 67% of households have a grocery trip which includes the purchase of "junk food", an average of 1.1 trips per week. In terms of composition of spending, snacks and candy have higher average spending, but spending on chips, cookies, or ice cream is not much less. These consumption patterns are similar across RML and non-RML states.

Panel B of Table 2 includes behavioral outcomes related to exercise and movement. In our sample 74.2% of respondents report any exercise in the previous month, with strength cardio

as the most frequent reported type. Panels B2 reports average time spent in locations, while panel B3 reports average time spent conditional on non-zero report. The averages show a preponderance of home (519 min) and work (490 min) time, but also substantial time spent at other's home (178 min), outdoors (85 min), in gym (83 min), and at school (82 min). Though differences exist across RML and non-RML states, they are within order of magnitude of each other.

5.1 Main Results

5.1.1 Is it the munchies?

We first turn to grocery purchase patterns from the NielsenIQ Consumer Panel Survey data, and evaluate whether the following household-level outcomes in a week-period changed in response to RML implementation: (i) total amount spent in "junk food," (ii) number of total trips to grocery stores that involved the purchase of any "junk food" items (extensive margin), (iii) number of total trips to grocery stores that involves the purchase of any "junk food" item using only households that with non-zero such trips (intensive margin), (iv) number of trips to grocery stores, and (v) total amount spent in grocery stores,.

We estimate equation (1) using both two-way fixed effects and then transitioning to our preferred specification that addresses staggered implementation of RML (Borusyak et al. 2024).[10] We find that RML increases several measures of "junk food" purchases: amount spent on "junk food" increases by 8.8% , the probability of any given grocery store trip involving "junk food" increased by 3.2 percentage points, and the number of grocery store trips that involved "junk food" increased by 4.0% (Panels A, B and C of Table 3).

We further examine the possibility that this increase in "junk food" consumption may be part of a trend in increasing grocery store spending post-RML, which could arise as a result of an income effect or preference shift towards at home food consumption. Our findings

[10]Each observation is a household-week. We control for county-level demographic characteristics and time detrend the observations using the Goodman-Bacon (2019) method and weighted by projection factors provided by NielsenIQ. Though the data is available for a wider period, we restrict the analysis to within 18 months of the passage of an RML to allow for both detrending as well as appropriate comparison of not yet treated to treated groups.

indicate that the total number of grocery store trips and total spending (Panels D and E in Table 3) decreased by 1.4% and 9.8%, respectively. The decrease in total trips makes the increase in "junk food" trips even more prominent.

We follow up these findings by delving further into particular categories of "junk food" spending. We use the log of weekly dollars spent on each specified category of "junk food". Table 4 indicates that RML implementation increased spending in snacks (13.0%), cookies (17.5%), and candy (8.5%). We find a 11.3% decrease in spending on chips. The mean of the dependent variable is comparable across all food categories, thus we may be able to interpret the decline in sales of chips as substitution away from savory towards sweet "junk foods". We find no effects on purchases of ice cream.

The event study for the NielsenIQ purchase data (Panel A of Figure 1), which is presented in terms of quarters relative to the passage of RML, shows that the number of grocery store trips that involve "junk food" purchases increased after the implementation of RML, and particularly after 4 quarters. Panel B of Figure 1 shows a consistent pattern for the amount paid in "junk food" purchases. Both of these measures also show a flat parallel pre-trend. The event studies for separate categories of "junk food" shows a flat pre-trend (Appendix Figure A1), and the results are consistent with the main results.

Ideally, we would be able to delve deeper and understand the extent to which the decrease in the number of trips to the grocery store (1.6% decrease) after RML implementation (Panel D of Table 3 and Panel C of Figure 1) arise as a result of these grocery store purchases being substitutes or complements to other "junk food" outlets such convenience stores or fast-food restaurants. In the absence of purchasing data in outlets other than grocery stores, we turn to weekly aggregation of visits to businesses across the United States provided by Advan between January 2019 and December 2022.[11] It is important to recognize the limitations of

[11] Advan is a private company providing data derived from movement of cellular devices across time and space. We use the Weekly Patterns dataset which counts the number of cellular devices frequenting over 4.4 million points of interest (POIs) across the US. As an individual navigates through their daily routine of work, leisure, shopping, and activities, the Weekly Patterns data records each of those stops aggregating to count the number of visits to individual businesses, public and private venues, and health care facilities. A visit is recorded if the individual stays a minimum of four minutes at the POI. The data also allows us to

this data. Due to its shorter time period, the analysis is restricted to only the most recent RML implementations, and coinciding with the COVID-19 pandemic. The short time period also precludes a balanced panel for analysis; Goodman-Bacon (2019) warns of the instability of estimates when detrending an unbalanced panel. Therefore, these additional findings are suggestive and we do not rely on them in our main conclusions.

We estimate equation (1), where the outcome of interest is the natural logarithm of the number of visits at each of the following types of venue at a weekly frequency: fast food, convenience food, dollar stores, and grocery stores. Our final sample includes over 654,000 county-week observations . We winsorize the top 1% and transform the number of weekly visits using a natural logarithm. Since these data do not include any information about visitor characteristics, we supplement our analysis with the following American Community Survey county characteristics as controls: population counts, percent population between 18-24 years, percent population male, percent population with high school education or less, and percent population married. Interestingly, Table 5 indicates that RML leads to a decrease in the number of visits to fast-food restaurants (7.7%), convenience food stores (9.5%), and grocery store visits (4.2%).

Combined, our results suggests an increase in "junk food" spending and "junk food" purchases in any given grocery store visit, accompanied by a decrease in the number of visits to grocery stores. This decrease in visits is not unique to grocery stores but it is consistent across other other food outlets and is also consistent with the estimated decrease in grocery store visits when using the NielsenIQ (Table 3). In the next subsection, we will present evidence that this decrease in visits to food establishments in also supported by the ATUS, which indicates less time spent outdoors, particularly fewer minutes spent in grocery stores

identify the census tract of POI visits, providing an opportunity to convert the data to the number of visitors from a census tract who have visited specific types of retail outlets. Retail outlets are identified using the North American Industry Classification System (NAICS) code system, which is a five to six digit number issued by the Office of Management and Budget (OMB) designating the nature of the business. The retail outlets of interest are those where, we believe, individuals may purchase low-nutrition foods such as fast food restaurants, convenience stores, and dollar stores, which correspond to the following NAICS codes: 722513 and 722511 (fast food restaurants), 44712 (convenience stores), 452319 (dollar stores).

and restaurants, even though the estimates are imprecise.

5.1.2 Is it couch-lock?

We first evaluate self-reported exercise behavior from the BRFSS for the entire sample, and separate for male and female respondents (Table 6). Each panel reports a different outcome and its respective number of observations as some outcomes are surveyed every other year, reducing the sample size used. We report estimates of TWFE specification in columns (1), (3), and (5) and the adjustment for staggered implementation using BJS in columns (2), (4), and (6).

Table 6 can be summarized as follows. First, Panel A indicates a 1.2 percentage point decrease in the likelihood of exercising last month, which corresponds to a modest 1.6% decline relative to the mean. Second, this effect is driven by approximately 1 percentage point decrease in the probability of cardio strength exercise in the previous month (weakly statistically significant), and 2.0 percentage point decline in the probability of engaging in cardio exercise at least once a week in the month to the interview, corresponding to a 8.7% effect on the mean (Panel D). Third, when separating the estimates by gender, these findings for exercise last month (Panel A) and for engaging in cardio at least weekly in the last month (Panel D) are consistent across genders and statistically significant at the conventional level using our preferred specification (BJS approach), and similar but noisier using TWFE.

These results are supported by the event study presented in Figure 2 for any exercise in the last month (Panel A), cardio strength training in the last month (Panel B), and the likelihood to engage in cardio at least once weekly in the past month (Panel C). Relative to the last period prior to the enactment of RML, Panel A and B show a notable, though noisy, decrease in exercise and cardio strength training in the previous month. Panel C also shows a decrease in the probability to engage in cardio at least weekly in the month prior to the interview. Figure 2 also shows flat trends prior to RML implementation.

As an additional exercise, Table A7 shows stratification by age for the following age groups: 18-21, 21-24, 25-39, and 40 and older. While most RMLs affect only those older than

21 (and therefore we restrict the main analysis to respondents 21 or older), young adults of age 18-21 exhibited a decrease in overall exercise in the past month (3.7 pp) driven by cardio strength training (3.0 pp), and also exhibited a lower likelihood of engaging in cardio at least once weekly in the past month (3.7 pp). The results for age groups affected by RML (21 and over) with our preferred specification (BJS) can be summarized as follows. First, exercise declines in every age category, though only older respondents (40 plus) have precisely estimated results with 1.2 pp decline. Second, the effects of engaging in cardio exercise at least once a week in the past month also prevails across all categories, with significant declines for 25-39 (1.7 to 2.2 pp) and 40 plus (2.1 pp to 2.7 pp) groups.

Taken together, the BRFSS estimates suggest a shift towards a more sedentary lifestyle. We further investigate the extent to which this decline in exercise may be substituted with other forms of physical activity. We explore possible substitutions using the ATUS by focusing on the time spent at home, as well as various indoor and outdoor locations. The results for all respondents and stratified by gender are presented in Table 7.

We find significant changes to time use after RML, using our preferred specification (BJS). In particular, we find that respondent report 8.36 more minutes spent at home (1.7% effect), primarily due to men who spend 13.78 (3.0%) more minutes at home each day. This increase in time spent at home is complemented with 5.98 fewer minutes spent at work (3.3% effect) – again, due to 12.53 minute reduction of time spent by men. We also find that RML leads to 0.63 fewer minutes spent at the gym, comparable estimates for men (-0.53) and women (-0.62) in this category. Previously, we showed that RML leads to an overall decrease in visits to commercial establishments overall in addition to grocery stores. Our findings from ATUS are consistent, as we find that RML leads to 1.99 fewer minutes spent in restaurants, with similar estimates for men (-2.34) and women (-1.77); and, more broadly, 2.72 fewer minutes spent outdoors – this effect comes primarily from declining outdoor time for women (-3.74). Finally, use of marijuana may affect respondent reporting accuracy – either intentionally or unintentionally. Thus, in Panel (I) we report the coefficient on missing or unaccounted time.

We find suggestive evidence that, overall, 1.7 to 3.5 additional minutes are unaccounted for during the day; an effect which may be due to under-reporting by women.

Figure 3 shows a gradual declines in time at work, outdoors, and restaurant or bar, and it shows a flat pre-trend allowing us to interpret our difference-in-difference estimates in a causal manner.

As previously, we show estimates by age groups in Table A8. The age group stratification shows that these effects are heterogeneous across age groups. In particular, young adults (21-24 yo) experience declines in gym (-7.5), grocery store (-4.2), and restaurant (-14.87), but may be spending more time at school (7.5). Adults (25-39 yo) experience the most significant loss in outdoor time (-7.96) which is most likely to be spent at home (19.04). Older adults (40 yo plus) spend less time at the gym (-0.75) and in restaurants (-2.12), but may spend more time at school (0.56). More importantly, however, is that the youngest adult group who are not affected by RML directly and who are not part of our main study (18-21 yo) experiences a somewhat different pattern of behavior. While this group is not included in our main results, they experience sharp declines in time spent at home (-42.87 or 12%) and school (-22.61 or 32%) substituted by time at gym (11.37) and at other's homes (13.35). We also note that this group experiences a 19.48 minute increase in missing/under-reporting of time suggesting avoidance of reporting of activity, including illegal activities.

Overall, our findings indicate that RML decreases the amount of exercise and reduces the number of visits to food outlets and overall commercial establishments, which is in line with an increase in the time spent at home.

5.2 Robustness of Estimates

5.2.1 Alternative Estimator

Our main analysis shows estimates of TWFE model, and BJS imputation method to account for the staggered implementation of the RML across states. We discuss the choice of staggered estimation methodology in Appendix A. In particular, we choose to test the sensitivity of our findings with a Gardner (2022) estimator in Table A1 for NielsenIQ, Table

A2 for BRFSS, and Table A3 for ATUS. Though in some cases the estimates lose statistical significance, the sign and magnitude of effects is very similar to TWFE and BJS, reinforcing our confidence in our main estimates.

5.2.2 Panel Length

When estimating the effect of consumer purchasing in the NielsenIQ Consumer Panel Survey, we restricted the sample to 18 months around the RML passage. This was motivated by data trend and quality constraints: the data has been aggregated to weekly totals which, inherently, include secular as well as cyclical trends with changing product availability and preferences; furthermore, this period includes the COVID-19 onset which affected consumption patterns in an unprecedented manner. Though restricting the sample to 18 months around RML allows us to overcome these confounding trends, our estimates may be sensitive to this choice. We explore the sensitivity of our estimates to the length of the time panel in Appendix Table A4, estimating our main results for a panel of 24 month and 30 month window. Increasing the panel window boosts the magnitude and statistical significance for most estimates.

5.2.3 Alternative Definition of Time Spent in ATUS

In Table 7 Panel I, we show a slight increase in the number of minutes reported as missing from the ATUS. This increase in the gap of accounted minutes may mechanically affect the number of minutes reported in any given activity, including exercise. To test for this, we estimate the share of time spent on activity relative to total non-missing daily minutes in Table A5. Consistent with minute estimates, we show a 1.1 percentage point increase in minutes at home, and decreases in minutes spent at gym, work, outdoors, and restaurants. These results are consistent with our main reported effects.

5.2.4 Excluding COVID years

Grocery purchase and consumption behavior changed significantly during the pandemic period as stay-at-home orders and work-from-home policies changed how and where these were done. While the NielsenIQ data incorporates online and third party (such as Shipt)

purchases, the COVID-19 period may be driving some of our main findings. To test for this possibility, in Appendix Table A6 we restrict the analysis of pre-2020 data, and find effects that are broadly consistent with our main findings: 4.1% increase in spending on "junk food", and higher incidence of grocery visits which include "junk food" purchase. Thus, while RML passage during the COVID-19 period may have a somewhat different effect on grocery shopping − particularly in the fast development of online shopping technologies, the consumption of "junk food" appears to change in a manner similar to the previous decade.

6 Does Munchies + Couch-Lock = More Calories?

The dual impact of reduced exercise and mobility and increased consumption of "junk food" imply a significant increase in net caloric intake per day after RML. While analyzing the precise amount of additional net caloric intake requires a precise estimate of amounts of time and types and quantities of "junk food" consumed, we are able to comment on the magnitudes and the factors involved.

A more sedentary lifestyle results in fewer calories expended. Each hour of exercise, expends between 200 to 800 calories, depending on intensity. Cardio intensive exercises, such as running, cycling, or swimming can expend up to 700 calories in an hour. Furthermore, mobility at work and outdoors, expends between 200 and 400 calories per hour, depending on the type of work and the intensity of walking.[12]

Increased consumption of "junk food" results in more calories consumed. While we track grocery store trips, snacks and chips can be consumed over an long period of time. We show, however, that the frequency of grocery store trips with "junk food" purchases increases, suggesting that the higher spending on "junk food" is not spread over a longer period of consumption. Collectively, this allows us to believe that RML results in more daily "junk food" consumption. According to the USDA, 100 grams of potato chips includes 530 calories, one ounce of cookies includes 150 calories, and half a cup of ice cream includes 140 calories.[13]

[12] "Fast Break! Challenge Resource Guide: Calories Burned Conversion chart" https://hr.uky.edu/wellness/exercise-calories-burned-hour Accessed May 2024.

[13] FoodData Central Search Results https://fdc.nal.usda.gov/fdc-app.html#/food-details/170649/

Thus, our estimates allow us to assume that the increased "junk food" purchases in the grocery store translate into significant daily increases in calories consumed from this source.

Our analysis, as well as the extrapolation to net caloric intake, are subject to a number of limitations. First, though we have suggestive evidence on visits to fast food restaurants and other points of sale of "junk food", the data used in these analyses is not complete and does not allow for conclusions to be drawn reliably. The suggestive evidence on visits shows a decrease to fast-food restaurants, which may offset some of the caloric gain.

Second, we have not examined the relationship between RML and alcohol consumption. If it is a substitute for marijuana, then there may be a parallel reduction in alcohol consumption, with a reduction in calories. It may, however, act as a complement, increasing the total calories consumed. The evidence in literature on this relationship is mixed.[14]

Finally, while we know the relative caloric value of each unit of exercise and "junk food", we have not aggregated the monthly reduction in exercise and weekly increase in "junk food" consumption in a cohesive caloric tally. This detailed analysis would require analysis of detailed nutritional information on grocery purchases, and improved understanding of the types of exercises. These would be a direction for future analyses.

In net, therefore, we believe that the couch-lock and munchies effect of RML result in more calories per day. Wishnofsky (1958) estimates that 336 additional calories per week will add five pounds per year in weight gain. A continued surplus of calories generated by the two RML effects shown here are likely to contribute towards long term weight gain.

The health risks associated with weight gain are well established. Weight gain has been linked to a wide range of cardio-metabolic conditions (diabetes, hypertension, heart disease, stroke), musculoskeletal conditions (breathing problems, joint problems), pregnancy and fertility problems, as well as mental health conditions (Ferraro et al. 2012; Pratt and Brody 2014). These conditions impose a significant lifestyle and medical cost burden on the indi-

nutrients

[14]We direct interested readers to Guttmannova et al. (2016) and Subbaraman (2016) for an early review of the alcohol-marijuana literature, andAnderson and Rees (2023) for an updated review concerning all substance use related to marijuana.

vidual and society; Cawley and Meyerhoefer (2012) estimate an additional $2,741 annual additional cost of health care care for obese individuals in the US. Furthermore, obesity has been shown to impose a labor market cost on the individual, in terms of lower wages (Morris 2007).

7 Conclusion

As of 2024, 24 states have legalized recreational marijuana, while 38 states have medical marijuana laws in place. The US has been experiencing what has been termed as an epidemic of obesity and sedentary lifestyle, along with associated chronic conditions of diabetes and cardiovascular disease (Ferraro et al. 2012; Pratt and Brody 2014). While these laws have been viewed as a step forward in law enforcement and judicial equity, our results suggest that RML may have unintended consequences in two health outcomes: unhealthy eating (i.e. "the munchies") and sedentary behavior (i.e. "couch-lock"). While appetite increase may be a desirable outcome for medical purposes, unhealthy eating is a socially costly outcome in otherwise healthy adults. Similarly, while the use of marijuana may provide pain management increasing mobility among patients with such constraints, it results in a sedentary lifestyle among adults without such conditions. Our findings are intended to highlight these lifestyle changes and alert for the need for parallel policy efforts to reduce their long-term impact. Combining multiple datasets, we are able to establish the effect of RML on "the munchies" and "couch-lock."

Using high-frequency data to examine weekly grocery store purchasing habits of households from NielsenIQ, we find that RML increased "junk food" spending by 7.2% , increased the likelihood that a grocery trips includes a "junk food" purchase by 5.6%, and increase the number of trips to the grocery store that involved "junk food" by 4.2%. These "junk food" purchases are broadly distributed among snacks, cookies, and candy. In other words, we substantiate evidence of munchies resulting from RML. We also observe an 8.5% reduction in visits to the grocery store. We confirm these results with mobility data, which confirms that RML decreased visits to fast-food restaurants by 7.7%, convenience food stores by 9.5%, and

grocery stores by 4.2%. This overall decrease in visiting a variety of commercial establishments is suggestive of couch-lock. In order to estimate the effect of RML on physical activity directly, we use the BRFSS and find that RML led to a 1.1 pp reduction in exercise in the previous month and, specifically, 2.7 pp decline in cardio exercise. These results are sensitive to gender and age, as women and individuals under 40 years of age experience the largest effect. At the same time, however, we estimate that this decline in exercise is more broad-based, as the ATUS results show that people may be spending more time at home after the passage of RML. We find significant reductions in time spent at work and outdoors, and some marginal evidence of increased time spent at home. Together, these estimates suggest that after RML, people are more likely to adopt sedentary habits, or couch-lock.

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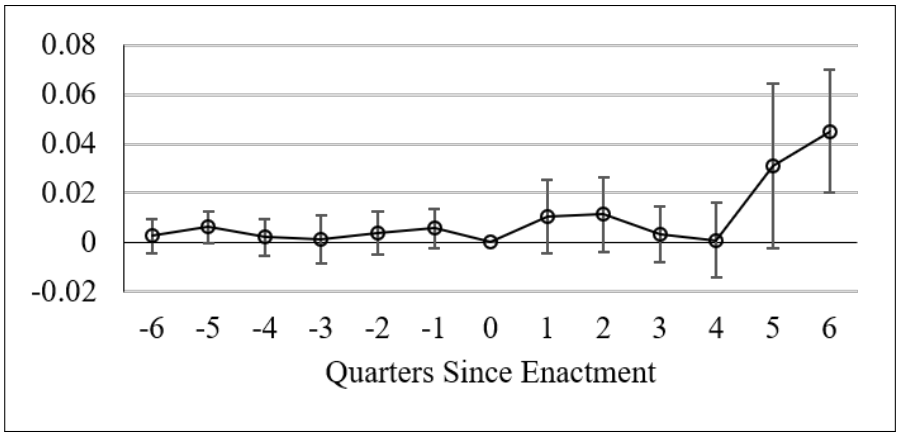
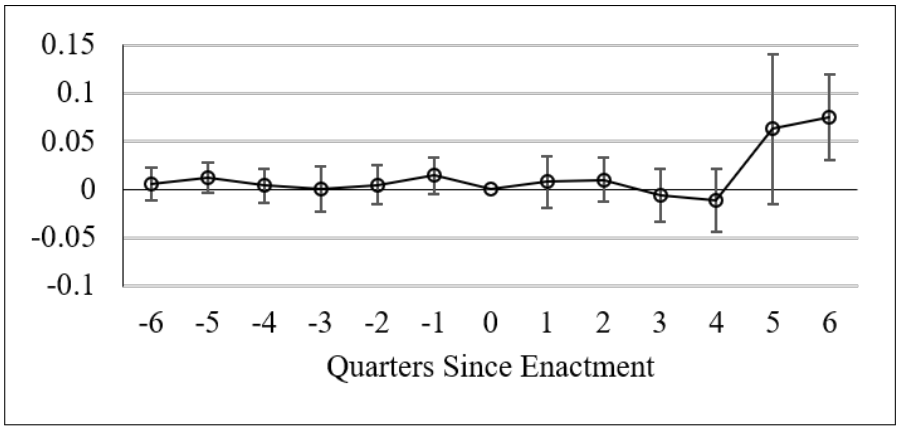
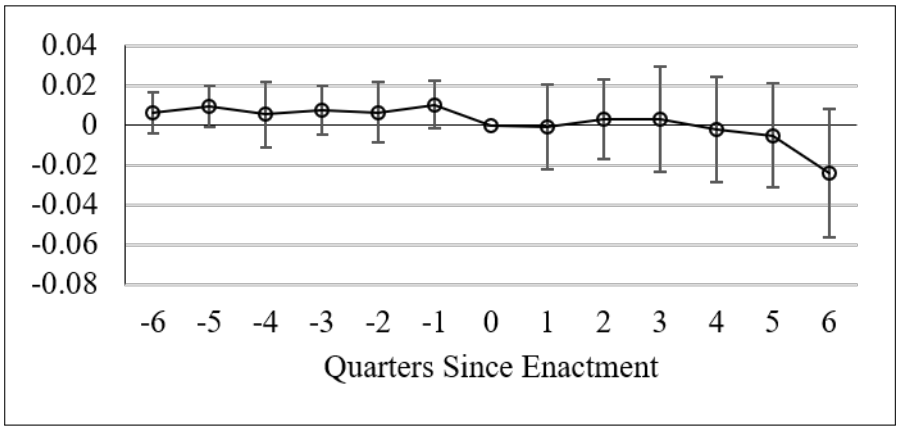


(a) NielsenIQ: All trips with "junk food" purchases



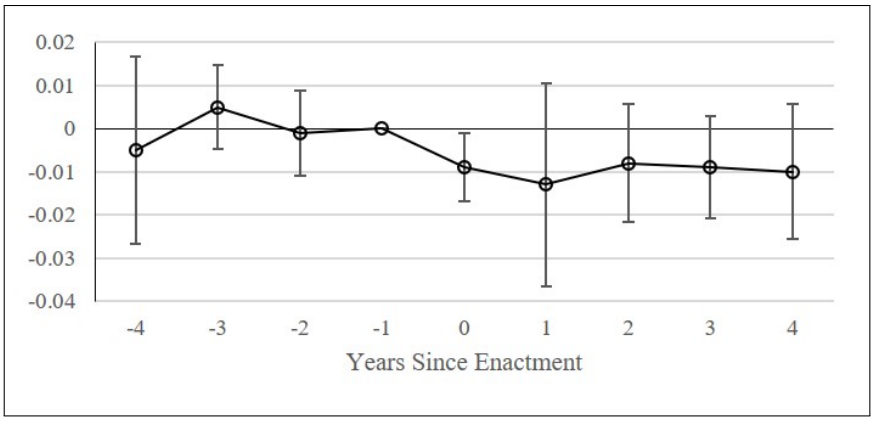
(b) NielsenIQ: Total paid for "junk food" purchases



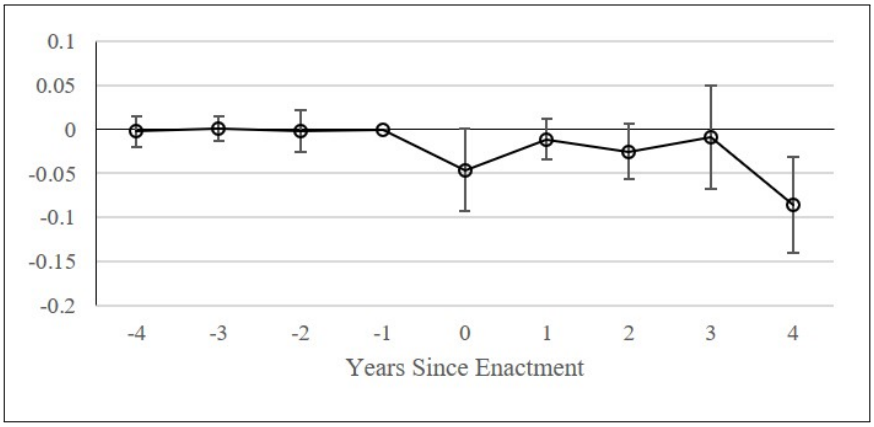
(c) NielsenIQ: All trips to grocery stores

Figure 1: Event study for grocery and "junk food" purchases.

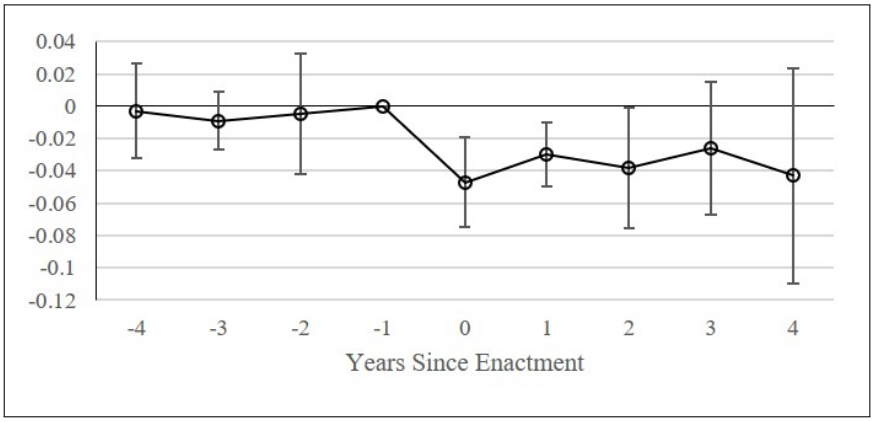
Note: Each point in the figure represents the difference between RML and non-RML states quarterly relative to the enactment year. Each model controls for state shelter-in-place orders during pandemic onset and the period between MML and RML sales start. In addition, each specification includes county indicators such as proportion of population that is between 20-24 years, has more than high school education, and is married. Fixed effects include those for year by month and state of residence. Standard errors are clustered at the state level and adjusted with population weights. 95% confidence intervals reported as band around point estimates. Source: NielsenIQ 2011-2020.



(a) Exercise last month



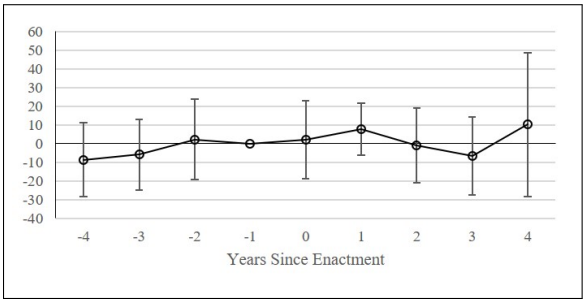
(b) Cardio last month



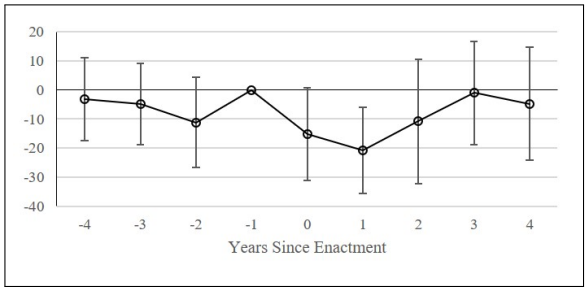
(c) Cardio at least once in prior week

Figure 2: BRFSS Event Study.

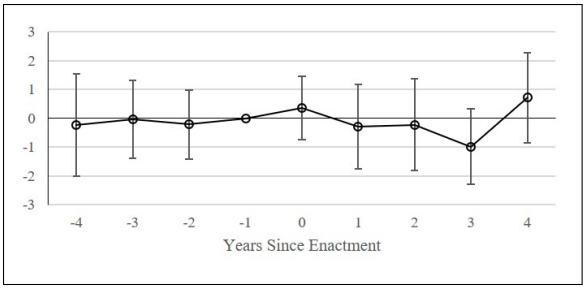
Note: Each point in the figure represents the difference between states with RML relative to those without relative to period prior to enactment. Each model controls for state shelter-in-place orders during pandemic onset and the period between MML and RML sales start. In addition, each specification includes demographic controls for age, sex, education, marital status, and fixed effects for month, year, and state of residence. Standard errors are clustered at the state level and adjusted with survey weights. 95% confidence intervals reported as band around point estimates. Source: BRFSS 2011-2021.



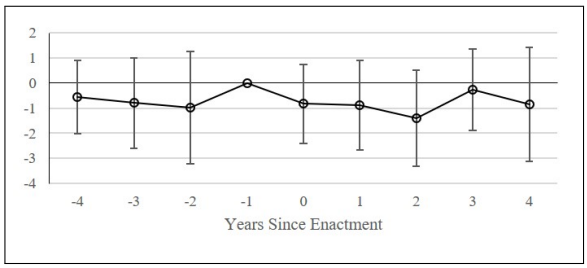
(a) Time at home



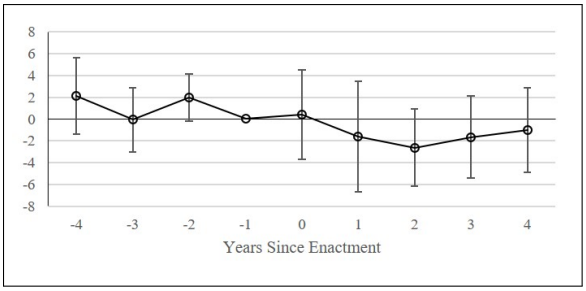
(b) Time at work



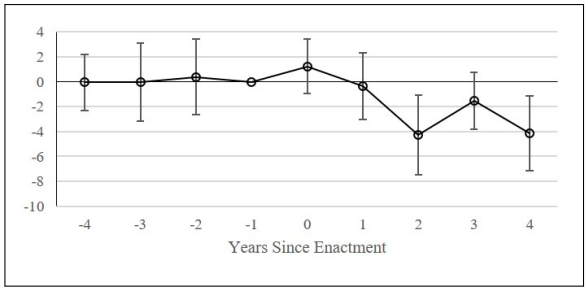
(c) Time at grocery store



(d) Time at gym



(e) Time spent outdoors



(f) Time at a restaurant or bar

Figure 3: ATUS Event Study.

Note: Each point in the figure represents the difference between states with RML relative to those without relative to period prior to enactment. Each model controls for state shelter-in-place orders during pandemic onset and the period between MML and RML sales start. In addition, each specification includes demographic controls for age, sex, education, marital status, and fixed effects for month, year, and state of residence. Standard errors are clustered at the state level. 95% confidence intervals reported as band around point estimates. Source: ATUS 2011-2021.

Table 1: MML and RML Effective and Sale Dates

State	MML Effective	MML Sales	RML Approved	RML Effective	RML Sales
Alabama	5/17/2021	-	-	-	-
Alaska	3/4/1999	-	11/4/2014	2/24/2015	10/29/2016
Arizona	4/14/2011	12/6/2012	11/3/2020	11/30/2020	1/22/2021
Arkansas	11/9/2016	5/11/2019	-	-	-
California	11/6/1996	1/1/2018	11/9/2016	11/9/2016	1/1/2018
Colorado	6/1/2001	10/26/2011	11/6/2012	12/10/2012	1/1/2014
Connecticut	10/1/2012	8/20/2014	6/22/2021	7/1/2021	1/10/2023
Delaware	7/1/2011	6/26/2015	3/28/2023	4/23/2023	Late 2024
District of Columbia	1/1/2011	7/30/2013	11/4/2014	2/26/2015	2/26/2015
Florida	3/25/2016	7/26/2016	-	-	-
Georgia	-	-	-	-	-
Hawaii	12/28/2000	8/8/2017	-	-	-
Idaho	-	-	-	-	-
Illinois	1/1/2014	11/9/2015	6/25/2019	1/1/2020	1/1/2020
Indiana	-	-	-	-	-
Iowa	-	-	-	-	-
Kansas	-	-	-	-	-
Kentucky	1/1/2025	-	-	-	-
Louisiana	5/19/2016	8/6/2019	-	-	-
Maine	12/22/1999	Mar-11	11/8/2016	1/30/2017	10/9/2020
Maryland	6/1/2014	12/1/2017	11/8/2022	7/1/2023	7/1/2023
Massachusetts	1/1/2013	6/24/2015	11/8/2016	12/15/2016	11/20/2018
Michigan	12/4/2008	Aug-18	11/6/2018	12/6/2018	12/1/2019
Minnesota	5/29/2014	7/1/2015	5/30/2023	8/1/2023	-
Mississippi	2/2/2022	1/25/2023	-	-	-
Missouri	12/6/2018	10/17/2020	11/8/2022	12/8/2022	2/3/2023
Montana	11/2/2004	Apr-18	11/3/2020	1/1/2021	1/1/2022
Nebraska	-	-	-	-	-
Nevada	10/1/2001	7/31/2015	11/8/2016	1/1/2017	7/1/2017
New Hampshire	5/23/2013	5/1/2016	-	-	-
New Jersey	1/18/10	12/6/2012	11/3/2020	2/22/2021	4/20/2022
New Mexico	7/1/2007	1/1/2010	4/12/2021	6/29/2021	4/1/2022
New York	7/5/2014	1/7/2016	3/31/2021	3/31/2021	12/29/2022
North Carolina	-	-	-	-	-
North Dakota	4/18/2017	3/1/2019	-	-	-
Ohio	9/8/2016	1/16/2019	-	-	-
Oklahoma	6/26/2018	10/26//2018	-	-	-
Oregon	12/3/1998	3/21/2014	11/4/2014	7/1/2015	10/1/2015
Pennsylvania	5/17/2016	2/15/2018	-	-	-
Rhode Island	1/3/2006	4/19/2013	5/25/2022	5/25/2022	12/1/2022
South Carolina	-	-	-	-	-
South Dakota	7/1/2021	7/27/2022	-	-	-
Tennessee	-	-	-	-	-
Texas	-	-	-	-	-
Utah	12/1/2018	3/2/2020	-	-	-
Vermont	7/1/2004	6/25/2013	1/22/2018	7/1/2018	10/1/2022
Virginia	7/1/2020	10/17/2020	4/7/2021	7/1/2021	-
Washington	11/3/1998	7/8/2014	11/6/2012	12/6/2012	7/8/2014
West Virginia	7/1/2019	11/12/2021	-	-	-
Wisconsin	-	-	-	-	-
Wyoming	-	-	-	-	-

Table 2: Summary Statistics

	(1) Total		(2) Ever RML		(3) Never RML	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Panel A: Munchies						
Junk Food Spending	8.274	12.31	8.278	12.62	8.272	12.20
Junk Food Trips (extensive)	0.676	0.468	0.661	0.473	0.682	0.466
Junk Food Trips (intensive)	1.108	1.117	1.073	1.103	1.120	1.121
Junk Food Type Spent						
Snacks	7.381	8.344	7.845	8.935	7.229	8.136
Chips	4.838	4.083	4.959	4.101	4.798	4.077
Cookies	5.032	4.961	5.240	5.145	4.967	4.901
Candy	7.408	9.833	7.728	10.42	7.302	9.630
Ice Cream	5.963	4.583	5.979	4.581	5.957	4.583
Panel B: Couch-Lock						
Any exercise Last Month	0.742	0.437	0.767	0.423	0.725	0.447
1. Conditional on exercise last month						
Sports	0.097	0.296	0.107	0.310	0.090	0.286
Strength cardio	0.630	0.483	0.659	0.474	0.611	0.487
Home activity	0.161	0.368	0.150	0.357	0.169	0.375
Cardio At Least Once/Week	0.284	0.451	0.302	0.459	0.273	0.445
2. Time Spent at Location						
Home	504.7	276.5	505.7	275.2	503.9	277.5
Gym	3.001	18.50	3.439	20.00	2.663	17.25
Grocery Store	7.484	22.20	7.953	23.01	7.121	21.54
Restaurant-Bars	17.57	46.98	18.00	47.97	17.24	46.21
School	5.146	37.84	5.410	39.06	4.943	36.86
Work	134.9	237.8	132.4	235.0	136.9	239.8
Other's Home	40.75	115.8	40.46	115.6	40.97	115.9
Outdoors	12.95	52.30	14.79	54.42	11.53	50.56
3.Time Spent (Conditional on Activity)						
Home	519.0	266.8	519.7	265.6	518.4	267.7
Gym	83.52	52.91	84.78	54.42	82.31	51.39
Grocery Store	46.76	35.25	46.54	36.11	46.95	34.49
Restaurant-Bars	68.68	71.54	71.66	72.89	66.45	70.42
School	82.83	128.9	84.26	130.9	81.65	127.2
Work	490.9	175.9	488.9	172.2	492.3	178.7
Other's Home	178.1	184.7	182.1	185.4	175.3	184.1
Outdoors	85.37	108.8	84.95	105.1	85.78	112.5

Source: NielsenIQ (2011-2020), BRFSS (2011-2021), ATUS (2011-2021).
Notes: Column (1) includes observations from all states, column (2) includes states which have passed an RML in the period of analysis, and column (3) includes states which did not pass RML during the period of analysis. In Panel B1, types of exercise conditional on any exercise in the previous month; in Panel B3, time spent in location conditional on having spent any time on activity.

Table 3: NielsenIQ, Grocery Store Total Spent and Number of Trips (18 Months)

	(1) TWFE	(2) BJS
Panel A: Junk Food Spending		
Recreational Start	0.088***	0.088***
	(0.008)	(0.003)
Observations	20,511,303	
Dependent Mean	1.520	
Panel B: Junk Food Trips (Extensive)		
Recreational Start	0.032***	0.031***
	(0.007)	(0.001)
Observations	20,714,780	
Dependent Mean	0.676	
Panel C: Junk Food Trips (Intensive)		
Recreational Start	0.040***	0.040***
	(0.006)	(0.001)
Observations	20,608,891	
Dependent Mean	0.620	
Panel D: Trips		
Recreational Start	-0.016	-0.014***
	(0.017)	(0.001)
Observations	20,546,142	
Dependent Mean	1.379	
Panel E: Total Paid		
Recreational Start	0.097***	0.098***
	(0.017)	(0.004)
Observations	20,510,204	
Dependent Mean	4.476	

Source: NielsenIQ (2011-2020).
Notes: The outcome variables are the log of weekly total household purchase price spent (panel a), log of all weekly household trips (b), log of total weekly household spending on junk food (c), probability of taking a trip that includes junk food (d), and the log of weekly household trips involving junk food purchases (e). Each model controls for state shelter-in-place orders during pandemic onset, the period between MML and RML sales start, percent population aged 20-24, percent with at least high school education, percent of married households at the county level, and week-year and county fixed effects. All models are time detrended and weighted using an annual projection factor for the household before applying the specified differencing estimation. Pre-period trends are limited to 18 months of the state's RML sales date. All models are weighed by a projection factor of household representation annually. Standard errors are clustered at the state level. Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.

Table 4: NielsenIQ, Spending on Specific Categories of Food (18 Months)

	(1) TWFE	(2) BJS
Panel A: Snacks		
Recreational Start	0.126***	0.130***
	(0.038)	(0.005)
Observations	7,370,453	
Dependent Mean	1.852	
Panel B: Chips		
Recreational Start	-0.113***	-0.111***
	(0.021)	(0.004)
Observations	5,792,938	
Dependent Mean	1.602	
Panel C: Cookies		
Recreational Start	0.173***	0.175***
	(0.039)	(0.006)
Observations	4,468,706	
Dependent Mean	1.606	
Panel D: Ice Cream		
Recreational Start	-0.0001	0.001
	(0.007)	(0.003)
Observations	2,670,668	
Dependent Mean	1.805	
Panel E: Candy		
Recreational Start	0.089	0.085***
	(0.077)	(0.004)
Observations	6,741,784	
Dependent Mean	1.785	

Source: NielsenIQ 2011-2020.

Notes: The outcome variables are the log of weekly total household purchase price spent (panel a), log of all weekly household trips (b), log of total weekly household spending on junk food (c), probability of taking a trip that includes junk food (d), and the log of weekly household trips involving junk food purchases (e). Each model controls for state shelter-in-place orders during pandemic onset, the period between MML and RML sales start, percent population aged 20-24, percent with at least high school education, percent of married households at the county level, and week-year and county fixed effects. All models are time detrended and weighted using an annual projection factor for the household before applying the specified differencing estimation. Pre-period trends are limited to 18 months of the state's RML sales date. All models are weighed by a projection factor of household representation annually. Standard errors are clustered at the state level. Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.

Table 5: Advan Weekly Patterns, Visits to Specific Food Vendors (2019-2022)

	(1) TWFE	(2) BJS
Panel A: Fast Food		
Recreational Start	-0.122***	-0.077***
	(0.041)	(0.018)
Observations	595,469	
Dependent Mean	6.823	
Panel B: Convenience Food		
Recreational Start	-0.152**	-0.095***
	(0.054)	(0.021)
Observations	594,895	
Dependent Mean	5.446	
Panel C: Dollar Store		
Recreational Start	-0.001	-0.005
	(0.056)	(0.017)
Observations	595,047	
Dependent Mean	5.912	
Panel D: Grocery Store		
Recreational Start	-0.085+	-0.042*
	(0.048)	(0.019)
Observations	595,631	
Dependent Mean	5.947	

Source: Advan 2019-2022.

Notes: The outcome variables are the log of weekly visits to a specified business type. Each model controls for state shelter-in-place orders during pandemic onset, the period between MML and RML sales start dates, percent population aged 20-24, percent with at least high school education, percent of married households, and week-year and county fixed effects. All models are time detrended and weighted using the number of devices residing in the county week-year before applying the specified differencing estimation. Standard errors are clustered at the state level. Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.

Table 6: BRFSS, Overall and by Gender (21+, 2011-2021)

	All		Male		Female	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	TWFE	BJS	TWFE	BJS	TWFE	BJS
Panel A: Exercise						
Recreational Start	-0.010+	-0.012***	-0.011	-0.011***	-0.008	-0.012***
	(0.005)	(0.003)	(0.007)	(0.003)	(0.005)	(0.003)
Observations	4,256,949		1,812,955		2,443,994	
Dep. Mean	0.744		0.767		0.726	
Panel B: Sports						
Recreational Start	0.000	0.005*	-0.003	0.004	0.004	0.006**
	(0.005)	(0.002)	(0.008)	(0.003)	(0.003)	(0.002)
Observations	1,700,254		701,666		998,588	
Dep. Mean	0.097		0.139		0.067	
Panel C: Strength Cardio						
Recreational Start	-0.016	-0.009+	-0.016	-0.006	-0.017	-0.012+
	(0.017)	(0.006)	(0.021)	(0.005)	(0.014)	(0.006)
Observations	1,700,254		701,666		998,588	
Dep. Mean	0.631		0.623		0.636	
Panel D: Home Activity						
Recreational Start	0.010	0.008*	0.014*	0.015***	0.006	0.001
	(0.007)	(0.004)	(0.007)	(0.004)	(0.009)	(0.004)
Observations	1,700,254		701,666		998,588	
Dep. Mean	0.158		0.150		0.163	
Panel E: Cardio Week						
Recreational Start	-0.025*	-0.020**	-0.023+	-0.015**	-0.026**	-0.024**
	(0.011)	(0.006)	(0.014)	(0.005)	(0.009)	(0.008)
Observations	1,823,749		755,643		1,068,106	
Dep. Mean	0.286		0.277		0.293	

Source: BRFSS (2011-2021).
Notes: Each model controls for state shelter-in-place orders during pandemic onset and the period between MML and RML sales start. In addition, each specification includes demographic controls for age, sex, education, marital status, and fixed effects for month, year, and state of residence. Standard errors are clustered at the state level and adjusted with survey weights (when available). Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.

Table 7: ATUS, Overall and by Gender (21+, 2011-2021)

	All		Male		Female	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	TWFE	BJS	TWFE	BJS	TWFE	BJS
Panel A: Home						
Recreational Start	5.734	8.368*	5.537	13.779**	5.551	3.402
	(5.186)	(3.541)	(8.660)	(5.158)	(5.625)	(3.658)
Observations	109,896		48,722		61,174	
Dep. Mean	480.2		457.2		501.4	
Panel B: Gym						
Recreational Start	-0.082	-0.631**	0.313	-0.531*	-0.426	-0.629*
	(0.245)	(0.208)	(0.441)	(0.259)	(0.377)	(0.262)
Observations	109,896		48,722		61,174	
Dep. Mean	3.468		4.025		2.953	
Panel C: Grocery Store						
Recreational Start	-0.144	-0.111	-0.119	-0.043	-0.175	-0.127
	(0.363)	(0.276)	(0.456)	(0.280)	(0.526)	(0.403)
Observations	109,896		48,722		61,174	
Dep. Mean	6.701		5.066		8.212	
Panel D: Restaurant/Bar						
Recreational Start	-0.571	-1.996***	-0.103	-2.343***	-1.151	-1.772***
	(0.911)	(0.454)	(1.623)	(0.702)	(1.162)	(0.533)
Observations	109,896		48,722		61,174	
Dep. Mean	16.56		17.42		15.77	
Panel E: School						
Recreational Start	1.139	0.879	0.136	0.545	2.283	1.070
	(1.164)	(0.535)	(1.740)	(0.620)	(1.388)	(0.863)
Observations	109,896		48,722		61,174	
Dep. Mean	7.003		6.025		7.906	
Panel F: Work						
Recreational Start	-9.119+	-5.981*	-13.882+	-12.533***	-3.918	0.306
	(4.962)	(2.441)	(7.988)	(3.585)	(4.569)	(3.720)
Observations	109,896		48,722		61,174	
Dep. Mean	180.6		218.3		145.8	
Panel G: Other's Home						
Recreational Start	0.213	0.699	1.532	0.491	-0.947	1.038
	(1.859)	(1.280)	(3.467)	(1.615)	(2.490)	(1.923)
Observations	109,896		48,722		61,174	
Dep. Mean	34.16		32.40		35.78	
Panel H: Outdoors						
Recreational Start	-2.653**	-2.724***	-2.188	-1.839	-3.115***	-3.472***
	(0.883)	(0.598)	(1.423)	(1.162)	(0.888)	(0.574)
Observations	109,896		48,722		61,174	
Dep. Mean	12.16		13.98		10.47	
Panel I: Missing						
Recreational Start	3.535*	1.724	2.325	-0.012	4.817+	3.534+
	(1.391)	(1.262)	(2.929)	(2.231)	(2.599)	(2.083)
Observations	109,896		48,722		61,174	
Dep. Mean	569.2		555.0		582.2	

Source: ATUS (2011-2021).
Notes: Each model controls for state shelter-in-place orders during pandemic onset and the period between MML and RML sales start. In addition, each specification includes demographic controls for age, sex, education, marital status, and fixed effects for month, year, and state of residence. Standard errors are clustered at the state level. Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.

A Appendix

A.1 Staggered DID Implementation

Gardner (2022) employs a stacked regression structure, where each treated unit is compared to a not-yet-treated controls with fixed effects for each treated-control pair. Under the assumption of parallel trends and no anticipation, Gardner shows that this estimate is a convex weighted average of the group specific average treatment effects on treated.

We do not use the Callaway and Sant'Anna (2021) estimator, as we believe it does not reflect the structure of the data used in this analysis. Callaway and Sant'Anna uses only a single pre-period in estimation of treatment effect, and relies on parallel trends existing between the single pre-period and treatment period. Our analysis relies on multiple pre-periods which, in some datasets, are panel series with high time granularity. Therefore, the use of single period is detrimental to accurate measurement of ATE.

Table A1: NielsenIQ, Gardner Results for Grocery Store Total Spent and Number of Trips

	(1) Gardner
Panel A: Trips	
Recreational Start	-0.015
	(0.019)
Observations	20,546,142
Dependent Mean	1.379
Panel B: Total Paid	
Recreational Start	0.098***
	(0.016)
Observations	20,510,204
Dependent Mean	4.476
Panel C: Junk Food Spending	
Recreational Start	0.088***
	(0.008)
Observations	20,511,303
Dependent Mean	1.520
Panel D: Junk Food Trips (Extensive)	
Recreational Start	0.031***
	(0.007)
Observations	20,714,780
Dependent Mean	0.676
Panel E: Junk Food Trips (Intensive)	
Recreational Start	0.040***
	(0.006)
Observations	20,608,891
Dependent Mean	0.620

Source: NielsenIQ (2011-2020).
Notes: The outcome variables are the log of weekly total household purchase price spent (panel a), log of all weekly household trips (b), log of total weekly household spending on junk food (c), probability of taking a trip that includes junk food (d), and the log of weekly household trips involving junk food purchases (e). Each model controls for state shelter-in-place orders during pandemic onset, the period between MML and RML sales start, percent population aged 20-24, percent with at least high school education, percent of married households at the county level, and week-year and county fixed effects. All models are time detrended and weighted using an annual projection factor for the household before applying the specified differencing estimation. Pre-period trends are limited to 18 months of the state's RML sales date. All models are weighed by a projection factor of household representation annually. Standard errors are clustered at the state level. Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.

Table A2: BRFSS, Gardner Results

	All	Male	Female	Age 18-21	Age 21-24	Age 25-39	Age 40+
Panel A: Exercise							
Recreational Start	-0.010+	-0.009	-0.011*	-0.033*	-0.009	-0.007	-0.011
	(0.005)	(0.007)	(0.005)	(0.017)	(0.009)	(0.007)	(0.007)
Observations	4,256,949	1,812,955	2,443,994	94,809	141,861	692,735	3,422,353
Dep. Mean	0.742	0.767	0.726	0.847	0.831	0.807	0.726
Panel B: Sports							
Recreational Start	0.001	-0.002	0.004	-0.038+	0.026*	-0.003	0.000
	(0.005)	(0.008)	(0.003)	(0.022)	(0.013)	(0.012)	(0.005)
Observations	1,700,254	701,666	998,588	35,503	53,707	269,089	1,377,458
Dep. Mean	0.097	0.139	0.067	0.204	0.173	0.138	0.086
Panel C: Strength Cardio							
Recreational Start	-0.013	-0.011	-0.014	-0.035	-0.020	-0.009	-0.013
	(0.018)	(0.021)	(0.015)	(0.029)	(0.016)	(0.020)	(0.018)
Observations	1,700,254	701,666	998,588	35,503	53,707	269,089	1,377,458
Dep. Mean	0.630	0.623	0.636	0.739	0.724	0.689	0.615
Panel D: Home Activity							
Recreational Start	0.009	0.013+	0.006	0.014*	0.008	0.006	0.011
	(0.007)	(0.007)	(0.008)	(0.007)	(0.006)	(0.009)	(0.009)
Observations	1,700,254	701,666	998,588	35,503	53,707	269,089	1,377,458
Dep. Mean	0.161	0.150	0.163	0.024	0.039	0.093	0.180
Panel E: Cardio Week							
Recreational Start	-0.022+	-0.019	-0.025*	-0.064***	-0.010	-0.020+	-0.024
	(0.013)	(0.016)	(0.012)	(0.019)	(0.022)	(0.012)	(0.015)
Observations	1,823,749	755,643	1,068,106	39,134	59,076	293,547	1,471,126
Dep. Mean	0.284	0.277	0.293	0.380	0.354	0.321	0.274

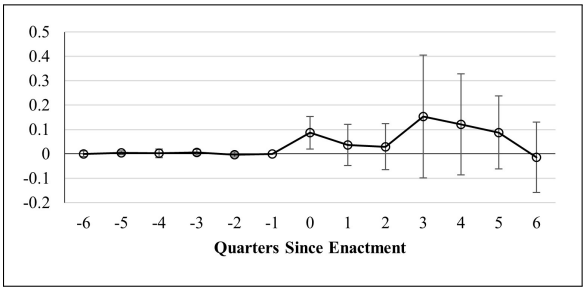
Source: BRFSS (2011-2021).
Notes: Each model controls for state shelter-in-place orders during pandemic onset and the period between MML and RML sales start. In addition, each specification includes demographic controls for age, sex, education, marital status, and fixed effects for month, year, and state of residence. Standard errors are clustered at the state level and adjusted with survey weights (when available). Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.

Table A3: ATUS, Gardner Results

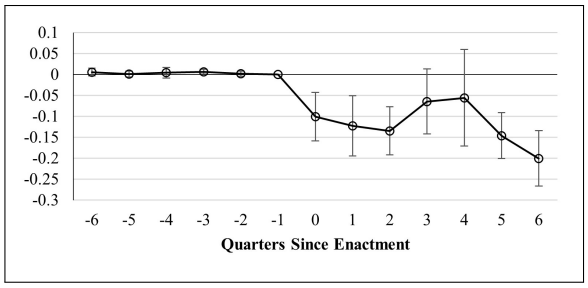
	All	Male	Female	Age 18-21	Age 21-24	Age 25-39	Age 40+
Panel A: Home							
Recreational Start	5.498	6.933	3.770	-64.681	3.944	-0.376	3.555
	(7.752)	(10.05)	(10.97)	(51.72)	(34.49)	(17.96)	(8.662)
Observations	109,896	48,722	61,174	2,681	3,794	28,595	77,507
Dep. Mean	480.2	457.2	501.4	358.7	378.2	415.5	519.1
Panel B: Gym							
Recreational Start	-0.007	0.590	-0.470	12.469+	-3.728	1.287	-0.388
	(0.302)	(0.585)	(0.475)	(6.624)	(4.541)	(1.053)	(0.380)
Observations	109,896	48,722	61,174	2,681	3,794	28,595	77,507
Dep. Mean	3.468	4.025	2.953	6.602	6.519	4.341	2.752
Panel C: Grocery Store							
Recreational Start	-0.345	-0.080	-0.524	-1.364	-5.899	0.078	0.158
	(0.672)	(0.688)	(1.019)	(2.145)	(3.729)	(0.746)	(0.642)
Observations	109,896	48,722	61,174	2,681	3,794	28,595	77,507
Dep. Mean	6.701	5.066	8.212	3.021	4.827	6.087	7.175
Panel D: Restaurant/Bar							
Recreational Start	-1.286	-1.215	-1.458	1.021	-10.826	2.401	-1.890*
	(0.983)	(1.695)	(1.300)	(4.710)	(7.596)	(1.747)	(0.787)
Observations	109,896	48,722	61,174	2,681	3,794	28,595	77,507
Dep. Mean	16.56	17.42	15.77	16.70	21.45	18.65	15.12
Panel E: School							
Recreational Start	1.449	0.585	2.264+	-4.349	15.363+	-0.680	0.758
	(1.145)	(1.907)	(1.355)	(21.15)	(9.197)	(2.860)	(0.645)
Observations	109,896	48,722	61,174	2,681	3,794	28,595	77,507
Dep. Mean	7.003	6.025	7.906	69.46	29.08	9.280	3.521
Panel F: Work							
Recreational Start	-6.737	-16.058*	2.442	13.124	-23.859	-0.173	-3.524
	(5.825)	(7.944)	(5.224)	(37.54)	(24.80)	(15.14)	(6.353)
Observations	109,896	48,722	61,174	2,681	3,794	28,595	77,507
Dep. Mean	180.6	218.3	145.8	133.5	200.5	235.0	155.4
Panel G: Other's Home							
Recreational Start	0.497	0.487	0.566	20.899	3.688	-1.021	0.982
	(2.238)	(3.203)	(3.594)	(15.95)	(13.90)	(5.156)	(2.028)
Observations	109,896	48,722	61,174	2,681	3,794	28,595	77,507
Dep. Mean	34.16	32.40	35.78	66.45	53.76	39.72	29.57
Panel H: Outdoors							
Recreational Start	-2.652*	-1.733	-3.538*	5.433	-6.390	-7.339**	-0.370
	(1.077)	(2.244)	(1.470)	(9.564)	(6.985)	(2.487)	(1.299)
Observations	109,896	48,722	61,174	2,681	3,794	28,595	77,507
Dep. Mean	12.16	13.98	10.47	15.68	11.82	13.42	11.66

Source: ATUS (2011-2021).
Notes: Each model controls for state shelter-in-place orders during pandemic onset and the period between MML and RML sales start. In addition, each specification includes demographic controls for age, sex, education, marital status, and fixed effects for month, year, and state of residence. Standard errors are clustered at the state level. Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.

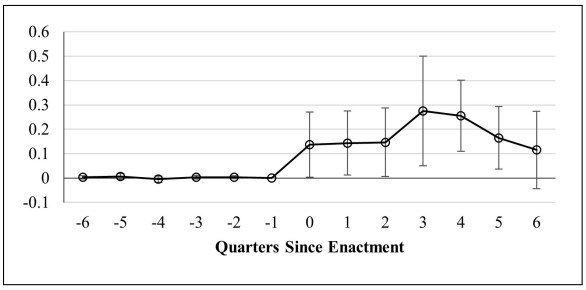
A.2 Additional Event Studies



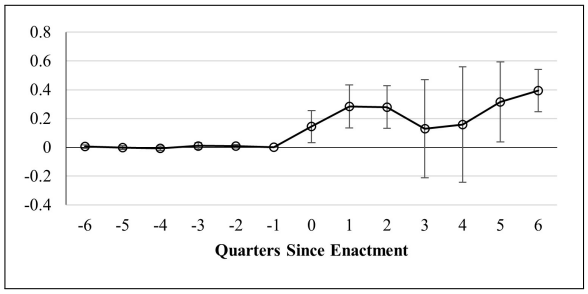
(a) NielsenIQ: Snacks



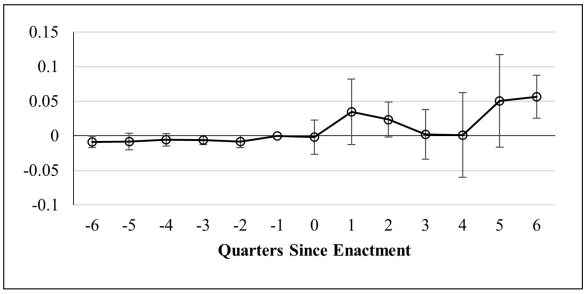
(b) NielsenIQ: Chips



(c) NielsenIQ: Cookies



(d) NielsenIQ: Candies



(e) NielsenIQ: Ice Cream

Figure A1: Event study for "junk food" purchases by category.

Note: Each point in the figure represents the difference between RML and non-RML states quarterly relative to the enactment year. Each model controls for state shelter-in-place orders during pandemic onset and the period between MML and RML sales start. In addition, each specification includes county indicators such as proportion of population that is between 20-24 years, has more than high school education, and is married. Fixed effects include those for year by month and state of residence. Standard errors are clustered at the state level and adjusted with population weights. 95% confidence intervals reported as band around point estimates. Source: NielsenIQ Consumer Panel Survey 2011-2020.

A.3 Additional Robustness Checks

Table A4: NielsenIQ, Different Time Windows

	18 Months	24 Months			30 Months		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Gardner	TWFE	BJS	Gardner	TWFE	BJS	Gardner
Panel A: Snacks							
Recreational Start	0.130***	0.105***	0.107***	0.107***	0.154***	0.149***	0.150***
	(0.039)	(0.029)	(0.004)	(0.031)	(0.040)	(0.008)	(0.043)
Observations	7,370,453		7,553,097			7,898,217	
Dependent Mean	1.852		1.852			1.852	
Panel B: Chips							
Recreational Start	-0.112***	-0.125***	-0.124***	-0.125***	-0.017	-0.017***	-0.017+
	(0.021)	(0.026)	(0.005)	(0.028)	(0.010)	(0.002)	(0.009)
Observations	5,792,938		5,933,576			6,206,275	
Dependent Mean	1.602		1.602			1.602	
Panel C: Cookies							
Recreational Start	0.176***	0.178***	0.181***	0.182***	0.167***	0.173***	0.174***
	(0.041)	(0.042)	(0.006)	(0.045)	(0.032)	(0.007)	(0.032)
Observations	4,468,706		4,571,268			4,767,337	
Dependent Mean	1.606		1.606			1.606	
Panel D: Ice Cream							
Recreational Start	0.0003	0.036	0.040***	0.039	0.156***	0.157***	0.157***
	(0.007)	(0.030)	(0.004)	(0.032)	(0.022)	(0.008)	(0.022)
Observations	2,670,668		2,740,489			2,877,075	
Dependent Mean	1.805		1.805			1.805	
Panel E: Candy							
Recreational Start	0.087	0.137***	0.137***	0.138***	0.026	0.014**	0.014
	(0.082)	(0.020)	(0.005)	(0.021)	(0.085)	(0.005)	(0.099)
Observations	6,741,784		6,905,469			7,220,272	
Dependent Mean	1.785		1.785			1.785	

Source: NielsenIQ (2011-2020).
Notes: The outcome variables are the log of weekly total household purchase price spent (panel a), log of all weekly household trips (b), log of total weekly household spending on junk food (c), probability of taking a trip that includes junk food (d), and the log of weekly household trips involving junk food purchases (e). Each model controls for state shelter-in-place orders during pandemic onset, the period between MML and RML sales start, percent population aged 20-24, percent with at least high school education, percent of married households at the county level, and week-year and county fixed effects. All models are time detrended and weighted using an annual projection factor for the household before applying the specified differencing estimation. Pre-period trends are limited to 18 months of the state's RML sales date. All models are weighed by a projection factor of household representation annually. Standard errors are clustered at the state level. Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.

Table A5: ATUS Percentage of Non-Missing Time (21+, 2011-2021)

	All		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)
	TWFE	BJS	TWFE	BJS	TWFE	BJS
Panel A: Home						
Recreational Start	0.901	1.079*	0.667	1.443**	1.115+	0.781
	(0.583)	(0.435)	(0.910)	(0.530)	(0.621)	(0.483)
Observations	109,896		48,722		61,174	
Dep. Mean	56.01		52.66		59.11	
Panel B: Gym						
Recreational Start	0.003	-0.052*	0.057	-0.027	-0.046	-0.065*
	(0.027)	(0.023)	(0.058)	(0.031)	(0.044)	(0.029)
Observations	109,896		48,722		61,174	
Dep. Mean	0.398		0.463		0.339	
Panel C: Grocery Store						
Recreational Start	-0.018	-0.021	-0.018	-0.001	-0.019	-0.033
	(0.043)	(0.035)	(0.051)	(0.033)	(0.062)	(0.053)
Observations	109,896		48,722		61,174	
Dep. Mean	0.793		0.593		0.978	
Panel D: Restaurant/Bar						
Recreational Start	-0.032	-0.214***	0.051	-0.221**	-0.124	-0.217***
	(0.098)	(0.051)	(0.160)	(0.078)	(0.144)	(0.062)
Observations	109,896		48,722		61,174	
Dep. Mean	1.916		1.979		1.858	
Panel E: School						
Recreational Start	0.110	0.079	-0.000	0.041	0.237	0.101
	(0.136)	(0.063)	(0.202)	(0.071)	(0.163)	(0.103)
Observations	109,896		48,722		61,174	
Dep. Mean	0.787		0.664		0.901	
Panel F: Work						
Recreational Start	-0.933	-0.589*	-1.362	-1.231**	-0.461	0.022
	(0.569)	(0.269)	(0.836)	(0.410)	(0.564)	(0.424)
Observations	109,896		48,722		61,174	
Dep. Mean	19.74		23.56		16.21	
Panel G: Other's Home						
Recreational Start	0.033	0.086	0.108	-0.035	-0.031	0.214
	(0.223)	(0.149)	(0.424)	(0.194)	(0.275)	(0.215)
Observations	109,896		48,722		61,174	
Dep. Mean	3.983		3.735		4.212	
Panel H: Outdoors						
Recreational Start	-0.296**	-0.311***	-0.242	-0.195	-0.351**	-0.409***
	(0.097)	(0.067)	(0.157)	(0.128)	(0.112)	(0.065)
Observations	109,896		48,722		61,174	
Dep. Mean	1.403		1.589		1.232	

Source: ATUS (2011-2021).

Notes: Each model controls for state shelter-in-place orders during pandemic onset and the period between MML and RML sales start. In addition, each specification includes demographic controls for age, sex, education, marital status, and fixed effects for month, year, and state of residence. Standard errors are clustered at the state level. Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.

Table A6: NielsenIQ, non-COVID Years

	(1) TWFE	(2) BJS
Panel A: Trips		
Recreational Start	0.010	0.010***
	(0.023)	(0.001)
Observations	18,287,373	
Dependent Mean	1.369	
Panel B: Total Paid		
Recreational Start	0.119***	0.119***
	(0.015)	(0.004)
Observations	18,258,757	
Dependent Mean	4.446	
Panel C: Junk Food Spending		
Recreational Start	0.041***	0.041***
	(0.012)	(0.002)
Observations	18,263,476	
Dependent Mean	1.489	
Panel D: Junk Food Trips (Extensive)		
Recreational Start	0.005	0.004***
	(0.006)	(0.001)
Observations	18,439,901	
Dependent Mean	0.678	
Panel E: Junk Food Trips (Intensive)		
Recreational Start	0.018+	0.018***
	(0.009)	(0.001)
Observations	18,341,954	
Dependent Mean	0.616	

Source: NielsenIQ (2011-2020).
Notes: The outcome variables are the log of weekly total household purchase price spent (panel a), log of all weekly household trips (b), log of total weekly household spending on junk food (c), probability of taking a trip that includes junk food (d), and the log of weekly household trips involving junk food purchases (e). Each model controls for state shelter-in-place orders during pandemic onset, the period between MML and RML sales start, percent population aged 20-24, percent with at least high school education, percent of married households at the county level, and week-year and county fixed effects. All models are time detrended and weighted using an annual projection factor for the household before applying the specified differencing estimation. Pre-period trends are limited to 18 months of the state's RML sales date. All models are weighed by a projection factor of household representation annually. Standard errors are clustered at the state level. Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.

A.4 Stratification by Age

Table A7: BRFSS, by Age (2011-2021)

	Age 18-21		**Age 21-24**		**Age 25-39**		**Age 40+**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	TWFE	BJS	TWFE	BJS	TWFE	BJS	TWFE	BJS
Panel A: Exercise								
Recreational Start	-0.036**	-0.037***	-0.008	-0.013+	-0.007	-0.009+	-0.011+	-0.012***
	(0.013)	(0.008)	(0.007)	(0.007)	(0.005)	(0.005)	(0.006)	(0.003)
Observations	94,809		141,861		692,735		3,422,353	
Dep. Mean	0.850		0.834		0.809		0.727	
Panel B: Sports								
Recreational Start	-0.032	-0.015	0.026*	0.031***	-0.005	0.007+	-0.000	0.002
	(0.020)	(0.013)	(0.012)	(0.008)	(0.011)	(0.004)	(0.005)	(0.002)
Observations	35,503		53,707		269,089		1,377,458	
Dep. Mean	0.207		0.175		0.138		0.085	
Panel C: Strength Cardio								
Recreational Start	-0.042	-0.030*	-0.019	-0.022*	-0.013	-0.005	-0.017	-0.009
	(0.031)	(0.012)	(0.014)	(0.009)	(0.021)	(0.006)	(0.017)	(0.006)
Observations	35,503		53,707		269,089		1,377,458	
Dep. Mean	0.742		0.725		0.690		0.616	
Panel D: Home Activity								
Recreational Start	0.015*	0.010**	0.009	0.005	0.010	0.003	0.010	0.010*
	(0.007)	(0.003)	(0.005)	(0.003)	(0.009)	(0.004)	(0.010)	(0.004)
Observations	35,503		53,707		269,089		1,377,458	
Dep. Mean	0.023		0.037		0.090		0.175	
Panel E: Cardio Week								
Recreational Start	-0.067***	-0.037**	-0.015	-0.019	-0.022*	-0.017*	-0.027*	-0.021***
	(0.019)	(0.013)	(0.017)	(0.012)	(0.010)	(0.007)	(0.012)	(0.006)
Observations	39,134		59,076		293,547		1,471,126	
Dep. Mean	0.388		0.359		0.326		0.275	

Source: BRFSS (2011-2021).
Notes: Each model controls for state shelter-in-place orders during pandemic onset and the period between MML and RML sales start. In addition, each specification includes demographic controls for age, sex, education, marital status, and fixed effects for month, year, and state of residence. Standard errors are clustered at the state level and adjusted with survey weights (when available). Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.

Table A8: ATUS, by Age (2011-2021)

	Age 18-21		Age 21-24		Age 25-39		Age 40+	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	TWFE	BJS	TWFE	BJS	TWFE	BJS	TWFE	BJS
Panel A: Home								
Recreational Start	-47.396	-42.981+	12.890	6.556	6.411	19.040*	1.791	0.715
	(40.78)	(23.05)	(24.93)	(16.18)	(12.58)	(8.895)	(5.971)	(4.003)
Observations	2,681		3,794		28,595		77,507	
Dep. Mean	358.7		378.2		415.5		519.1	
Panel B: Gym								
Recreational Start	7.990	11.372***	-2.390	-7.560***	1.039	0.944+	-0.436	-0.758***
	(5.828)	(1.915)	(3.115)	(1.711)	(0.930)	(0.515)	(0.264)	(0.213)
Observations	2,681		3,794		28,595		77,507	
Dep. Mean	6.602		6.519		4.341		2.752	
Panel C: Grocery Store								
Recreational Start	-1.647	-0.281	-1.879	-4.214*	-0.178	0.019	0.203	0.399
	(2.134)	(0.913)	(1.873)	(2.108)	(0.538)	(0.347)	(0.391)	(0.349)
Observations	2,681		3,794		28,595		77,507	
Dep. Mean	3.021		4.827		6.087		7.175	
Panel D: Restaurant/Bar								
Recreational Start	0.283	-0.805	-9.541	-14.875***	2.877+	1.111	-0.823	-2.124***
	(4.438)	(2.951)	(6.414)	(2.936)	(1.537)	(0.882)	(0.878)	(0.489)
Observations	2,681		3,794		28,595		77,507	
Dep. Mean	16.70		21.45		18.65		15.12	
Panel E: School								
Recreational Start	-13.692	-22.609*	16.054+	7.514+	-1.831	-0.762	0.513	0.558*
	(16.34)	(10.47)	(9.390)	(4.050)	(2.787)	(1.785)	(0.663)	(0.277)
Observations	2,681		3,794		28,595		77,507	
Dep. Mean	69.46		29.08		9.280		3.521	
Pacel F: Work								
Recreational Start	0.616	24.504	-45.634*	-15.72	-6.072	-5.107	-4.089	-2.463
	(25.00)	(21.62)	(22.16)	(14.40)	(12.48)	(7.787)	(4.486)	(2.182)
Observations	2,681		3,794		28,595		77,507	
Dep. Mean	133.5		200.5		235.0		155.4	
Panel G: Other's Home								
Recreational Start	18.494	13.351+	1.631	9.115	4.165	-1.370	-1.638	0.966
	(12.318)	(7.905)	(10.069)	(7.775)	(4.129)	(3.186)	(1.901)	(1.499)
Observations	2,681		3,794		28,595		77,507	
Dep. Mean	66.45		53.76		39.72		29.57	
Panel H: Outdoors								
Recreational Start	18.979*	6.774	-5.081	-1.66	-6.072***	-7.965***	-0.713	-0.590
	(8.951)	(8.117)	(4.914)	(2.936)	(1.564)	(1.387)	(0.840)	(0.648)
Observations	2,681		3,794		28,595		77,507	
Dep. Mean	15.68		11.82		13.42		11.66	
Panel I: Missing								
Recreational Start	-8.836	-19.48*	30.88*	13.57	-5.162+	-2.307	3.875+	2.236
	(19.65)	(7.950)	(14.95)	(13.16)	(2.835)	(2.663)	(1.963)	(1.737)
Observations	2,681		3,792		28,595		77,507	
Dep. Mean	628.1		601.0		568.3		565.9	

Source: ATUS (2011-2021).
Notes: Each model controls for state shelter-in-place orders during pandemic onset and the period between MML and RML sales start. In addition, each specification includes demographic controls for age, sex, education, marital status, and fixed effects for month, year, and state of residence. Standard errors are clustered at the state level. Symbols denote significance at the 0.5% (***), 1% (**), 5% (*), and 10% (+) levels.