NBER WORKING PAPER SERIES

DRUG ADVERTISING AND HEALTH HABIT

Toshiaki Iizuka
Ginger Zhe Jin

Working Paper 11770
http://www.nber.org/papers/w11770

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
November 2005

Contact Author: Ginger Z. Jin, phone: 301-405-3484, fax: 301-405-3542, address: 3115H Tydings, Department of Economics, University of Maryland, College Park, MD 20742. We benefit from Bill Evans, John Cawley, and the attendants at the 2004 Southern Economic Association meeting and the 2005 American Economic Association meeting. Special thanks to Vanderbilt University, University of Maryland, and Aoyama Gakuin University for financial support. Excellent research assistance of Yan Chen is gratefully acknowledged. All errors are ours. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

Drug Advertising and Health Habit
Toshiaki Iizuka and Ginger Zhe Jin
NBER Working Paper No. 11770
November 2005, Revised January 2007
JEL No. I12,I18,D83

ABSTRACT

We examine the effect of direct-to-consumer advertising (DTCA) of drug treatment on an important health habit, physical exercise. By learning the existence of a new drug treatment via DTCA, rational consumers may become careless about maintaining healthy lifestyles. Using the National Health Insurance Survey (NHIS) and MSA-level DTCA data, we find that the DTCA related to four chronic conditions -- diabetes, high cholesterol, over weight, and hypertension -- reduce the likelihood of engaging in moderate exercise. This suggests the possibility that DTCA does not only affect pharmaceutical demand in the short-run, but also have long-run impacts on people's health by affecting their daily routines.

Toshiaki Iizuka
Aoyama Gakuin University
Shibuya 4-4-25
Tokyo, 150-8366
Japan
toshi.iizuka@gmail.com

Ginger Zhe Jin
University of Maryland
Department of Economics
3105 Tydings Hall
College Park, MD 20742-7211
and NBER
jin@econ.umd.edu

1 Introduction

Prior to 1997, direct-to-consumer advertising (DTCA) of prescription drugs were largely limited to print media. A DTCA that contains both brand names and medical claims had to include a "brief summary" of comprehensive risk information, which made TV advertising prohibitively expensive. In August 1997, the Food and Drug Administration (FDA) issued a clarification that a brief summary is no longer required for electric media.[1] Subsequently, DTCA experienced a three-hold growth from $800 million in 1996 to $2.5 billion in 2000.

The large increase in the DTCA expenditures created a controversy over the role of prescription drug advertising. Proponents claim that DTCA is informative and educational, while the opponents argue DTCA conveys inaccurate information, promotes the inappropriate uses of drugs, and encourages the demand for more expensive drugs.[2] In this paper, we contribute to the debate by examining the effects of DTCA on individual health habit. Ex-ante, it is difficult to predict the net impact of DTCA on people's routines. On the one hand, DTCA informs consumers of the existence of new drug treatments. As a result, rational consumers may care less about maintaining healthy lifestyles because they know drug treatments are available should they become sick. On the other hand, DTCA may alert people to adopt or keep healthy habits by reminding them that there are various diseases they might suffer and that there are potential treatments out there. The objective of the paper is to understand which of the two roles of advertising is more prevalent.

To distinguish these possibilities, we analyze the effect of DTCA of drug treatment on an important health habit, physical exercise. We obtain information on individual health habits from a national representative survey, the National Health Insurance Survey (NHIS 1997-2001). The survey data are combined with monthly, MSA-level DTCA data by time and location. We focus on the DTCA of prescription drugs related to four chronic conditions — diabetes, hypertension, high cholesterol, and overweight. According to medical experts, exercise is not only beneficial to people who currently suffer any one of the four conditions, but also help healthy

[1]DTCA still needs to include a "major statement" of the most important risks and refer consumers to other sources for more comprehensive information.

[2]See, Holmer (1999) and Holmer (2002) for the proponents' views of DTCA. Hollon (1999) and Wolfe (2002) summarize opponents' views. See, also, the debate on the role of DTCA by several authors published in the February 26, 2003, issue of *Health Affairs*.

people to keep away from the four conditions. Our aim is to examine whether the change in DTCA across time and region explains people's exercise habit.

Estimation results indicate that the DTCA related to the four conditions decreases the likelihood of moderate exercise (but has an insignificant impact on vigorous exercise). One explanation for this is that, by learning the existence of a drug treatment, people substitute away from moderate exercise. For both types of exercise, the effect does not vary significantly across the patients that have or do not have the four chronic conditions. Nor do they vary significantly by gender, age, education, insurance status, or other demographics. When we examine the impact of DTCA separately for the two most advertised classes (diabetes and cholesterol reducing), we find that the reduction in moderate exercise is mostly driven by the DTCA of cholesterol reducing drugs. One explanation is that individuals believe the substitution between drug treatment and exercise is stronger in cholesterol reducing than in diabetes.

We believe this paper contributes to two strands of literatures. First, our paper joins the growing literature that examines the economics of prescription drug advertising. So far, most of the existing studies have focused on DTCA's impact on the immediate demand of pharmaceuticals. That is, the focus has been i) whether DTCA motivated consumers to visit physician office (e.g., Rosenthal et al. 2003 and Iizuka and Jin 2005) or ii) whether DTCA affected doctor's prescription behavior once patients arrived at physician office (e.g., Rosenthal et al. 2003, Iizuka and Jin 2006, and Wosinska 2002).[3] In this paper, instead of examining the immediate demand effects of DTCA, we examine whether DTCA affects people's daily health habits. Our findings suggest that DTCA could worsen individual health habits and generate even greater drug demand in the long run, adding burden to the parties that eventually bear the cost of medical treatments.

Our paper is also related to a broader literature in moral hazard. Economists have argued that regulations that intend to enhance product safety may motivate consumers to engage in riskier behavior or to become less cautious about safety. As a result, the benefit of a safer product design may be offset by the consumers' riskier behavior. This argument has found empirical support in several contexts: Peltzman (1975), for example, studied the highway fatality rate before and after the National Traffic and Motor Vehicle Safety Act of 1966. He found that the

[3] Also, very few research had examined how pharmaceutical firms have responded to the 1997 FDA clarification. Iizuka (2004) and Avery et al. (2004) are the exceptions.

regulation did not decrease highway fatality at all. In fact, some auto occupants' lives were saved at the cost of more pedestrian deaths and more nonfatal accidents, suggesting that drivers had increased driving intensity after the regulation.[4] Viscusi(1985) examined the number of home accidents before and after the establishment of the Consumer Product Safety Commission. Like Peltzman, he found no change in the number of accidents. His case study on protective bottle caps suggested that the regulation may have a lulling effect on consumer behavior: parents had less incentive to reduce children access to drugs and many safety cap bottles were left open.

The rest of the paper is organized as follows. Section 2 lays out the theoretical arguments as to how DTCA would affect individual health habits and how such impact may differ by demographics. After data description in Section 3, we set up an empirical model and discuss identification issues in Section 4. Estimation results are reported in Section 5, and conclusion is offered in Section 6.

2 Potential Impacts of DTCA on Exercise

Consider an individual choosing to exercise or not in order to maximize his total utility of life:

$$U = \sum_{t=0}^{T-age} \delta^t u_t(r_t, q_t, e_t)$$

where t denotes time ($t = 0$ for present), T denotes expected life expectancy, δ is the annual discount rate, r is the perceived risk of contracting diseases, q is the quality of life, and e is exercise intensity (a dummy variable in our case). In the short run, exercise may generate disutility as it costs time and money. In the long run, exercise may reduce the probability of contracting certain diseases (r) thus increasing life expectancy (T) and the quality of life (q). A rational consumer would choose a sequence of e_t so that it will maximize U.

A DTCA of drug treatment may affect the total utility of the consumer thus the choice of exercise in many ways. First, consider a healthy individual who currently does *not* suffer any "lifestyle diseases" such as diabetes, high cholesterol, high blood pressure, and over weight. On

[4]Driving intensity consists of driving speed, passing frequency, willingness to drive under adverse conditions, etc. Using the same methodology, Stuart (1980) found little evidence for driving intensity offsetting the intended impacts of the Swedish traffic safety regulation. One explanation is that the Swedish regulation of physical vehicle safety was 50% stronger than the American and the Swedish regulation was accompanied with lower speed limits.

the one hand, a DTCA of drug treatment may tell her that there is a new treatment should she gets sick, so life expectancy (T) and the quality of future life (q) would remain high even if she does not exercise today. In this case, the expected drug treatment communicated by DTCA serves as a substitute for physical exercise, and a higher DTCA may result in lower exercise intensity.[5] On the other hand, by communicating various medical problems that one might suffer, a DTCA may increase the perceived risk of contracting the targeted disease (r). If so, DTCA may encourage the person to do more exercise.

For those who currently suffer a DTCA-targeted disease, the effects of DTCA can be more complex. In the simplest case, if an individual suffers the targeted disease and knows the existence of the advertised drug, the DTCA may deliver no new information and therefore has little impact on exercise habit. However, if the patient didn't know the existence of the drug treatment, DTCA may have the same effects as in the case of the healthy individual. Furthermore, if the patient seeks the treatment after observing an ad,[6] DTCA can have additional effects. If the doctor prescribes the requested drug, which generates immediate benefits and reduces the incentives to exercise, we may observe a negative relationship between DTCA and exercise intensity. If, on the other hand, the doctor refuses prescribing the drug and urges the patient to exercise first[7], the propensity to exercise may increase with DTCA. Unfortunately, we cannot isolate these explanations since we only observe DTCA data at the MSA level and the NHIS does not report whether an individual has visited doctors for a specific condition or obtained a specific drug in a specific time window.

The effects of DTCA may further vary by demographics and other individual attributes. For example, if the advertised treatment is paid by a third party other than the patient himself, one may expect greater benefits from the treatment. This suggests that, if DTCA has an effect to reduce exercise for some people, it is more likely to show up for the insured population than for the uninsured. Also, the decision to exercise depends on the individual's perception of risk, the individual's ability to compare today's cost and tomorrow's benefits, and the individual's discount factor. To the extent that these factors differ by age and education, the effects of

[5]Of course, if drug treatment and exercise are viewed as complements rather than substitutes, the effect could be reversed.

[6]Iizuka and Jin, 2005, shows that DTCA has an effect of increasing physician office visits.

[7]According to the FDA 1999 and 2002 surveys, 22% of the doctors that do not prescribe a drug as the result of DTCA ask patients to change behavior or lifestyles (Aikin 2003).

DTCA may vary by age and education as well.

3 Data

We combine two data sets, NHIS (1997-2001) and DTCA data (1996-2001), to analyze the impact of DTCA on health habits. NHIS aims at monitoring the health of the United States population through the collection and analysis of data on a broad range of health topics. NHIS is conducted by the National Center for Health Statistics (NCHS) through household interviews. The sampling plan follows a multistage area probability design to achieve a representative sample of households.

Our DTCA data contain DTCA expenditures of prescription drugs. Collected by the TNS Media Intelligence/Competitive Media Reporting (CMR), this data set includes DTCA expenditures by drug, month and MSA. Specifically, CMR monitors advertising outlays via DTC channels in units and dollars, including network TV, cable TV, newspapers, and magazines. These outlays can further be decomposed into two levels: national and local advertising, where local means DTCA through spot TV, spot radio, newspapers, and outdoor billboards at the MSA level.

Because national advertising applies to all areas, it is difficult to disentangle the impact of national advertising from the overall trend of exercise intensity. To circumvent this difficulty, we exploit the geographic variations in DTCA. Available since 1996, the local DTCA data cover 75 MSAs, of which 58 are identifiable in the NHIS. The matching is imperfect because NHIS only discloses the identity of large MSAs.

Given the fact that advertising may not depreciate completely within a month, we define the independent variable– $SUMDTCA$–as the accumulative sum of monthly local DTCA within the last 12 months for all drugs in the relevant drug category (see Section 4 for more details as to why we choose this specific definition). To create this accumulative DTCA variable, we obtain DTCA data from 1996 to 2001 and match them with the 1997-2001 data from the NHIS by time and MSA. All the DTCA data are deflated to 1996 US dollars. We don't consider direct-to-doctor advertising (DTDA) of prescription drugs, because individuals are not directly exposed to DTDA and the existing data on DTDA don't distinguish advertising intensity by location.

In the analysis sample, we focus on the NHIS interviewed individuals that live in the 58-DTCA-matched MSAs and have valid data on height, weight, and whether they have any of the four conditions. Because emotional feeling has important power explaining exercise propensity, we further restrict the sample to the individuals that answer to the question of whether they feel sad, helpless, or worthless in all or most of the time in the past 30 days.[8] This results in the final sample of 76,792 indivdiuals throughout 1997-2001.

4 Empirical Model

4.1 The Effect of DTCA on Exercise Behavior

In this section we discuss our empirical approach to examine the impact of DTCA on exercise habits. As noted before, DTCA may reduce exercise by informing people that there is a possible alternative, drug treatments, to deal with their health problems. It is also possible that DTCA reminds people of the diseases that they may suffer more from if they do not exercise. Ex-ante, it is difficult to predict the net impact of DTCA on exercise habits.

We pay special attention to four categories of conditions – overweight, high cholesterol, high blood pressure, and diabetes. These are important risk factors, and experts say that frequent physical activity help reduce these risk factors. Surgeon General, for example, recommends at least 30 minutes of physical activity everyday, because physical activity helps lose or maintain weight, prevents heart diseases, helps control cholesterol levels and diabetes, slows bone loss associated with advancing age, lowers the risk of certain cancers, and helps reduce anxiety and depression.[9] Similarly, American Diabetes Association (ADA) recommends getting physical activity every day to lower the risk for heart attack, stroke, and other diabetes problems.[10] The benefits of physical activities appear to be also recognized by the general public.

[8] Including or excluding this last sampling criterion does not change our conclusion.

[9] http://www.surgeongeneral.gov/topics/obesity/calltoaction/fact_whatcanyoudo.htm (accessed on Oct. 30, 2004).

[10] Taken from the brochure printed by ADA. http://www.ndep.nih.gov/diabetes/pubs/ControlABC_broch_Eng.pdf (accessed on Oct. 30, 2004).

For example, according to an obesity poll conducted by Harvard School of Public Health in June 2005, 52% (and 42%) of respondents agreed that increasing one's physical activity level is "extremely important" (and "very important") in maintaining a healthy weight.[11] Thus, the benefits of physical exercise on chronic diseases, including the above four conditions, appear to be well understood.[12]

Our empirical approach is to sum up the DTCA of all the prescription drugs that fall into the four categories and examine their aggregate impact on the extent of physical activity. We adopt the following linear probability specification in our base model:

$$\begin{aligned} MODEXE_{ikt} &= \alpha_k + \beta_t + Demog_{ikt} \cdot \Pi \\ &\quad + SUMDTCA4_{kt} \cdot \{\gamma_0 + \gamma_1 \cdot 4Condition_{ikt}\} + \epsilon_{ikt} \end{aligned}$$

$$\begin{aligned} VIGEXE_{ikt} &= \alpha_k + \beta_t + Demog_{ikt} \cdot \Pi \\ &\quad + SUMDTCA4_{kt} \cdot \{\gamma_0 + \gamma_1 \cdot 4Condition_{ikt}\} + \epsilon_{ikt} \end{aligned}$$

where $MODEXE_{ikt}$ ($VIGEXE_{ikt}$) equal to 1 if individual i in MSA k at quarter t engages in moderate (vigorous) physical activities for at least 10 minutes per week and 0 otherwise. Moderate activities are defined as the activities that cause only light sweating or a slight to moderate increase in breathing or heart rate. Examples of moderate activities include brisk walking, bicycling, vacuuming, and gardening. In contrast, vigorous activities cause heavy sweating or large increases in breathing or heart rate. Typical examples are running, aerobics, and heavy yard work.[13] We estimate the above two regressions separately.

[11] Please see OB-4a of the poll. http://www.hsph.harvard.edu/press/releases/blendon/ObesityTopline.doc (accessed on Jan. 8, 2006)

[12] Exercise may also alleviate or prevent depression. However, NHIS does not specify who have depression and who don't. In a robustness check, we code depression as being sad, hopeless and/or worthless in all or most of the time in the past 30 days. By this definition, including depression as one of the exercise-sensitive conditions do not affect our main results. Results including depression are available upon request.

[13] Besides $MODEXE$ and $VIGEXE$, the NHIS also asks questions regarding exercise frequency and the length of exercise per time. From these questions we can calculate the number of minutes an individual engage in moderate or vigorous activities per week. This is no systematic difference in exercise intensity among low- and high-risk population once we condition on exercising. We have run the same regression specifications and find no relationship between DTCA and exercise intensity. Also, the regressions have little power explaining any variations in exercise intensity (R-squared is no bigger than 2%). For these reasons, we focus on the tendency to exercise rather than exercise intensity. Results about exercise intensity are available upon request.

The key independent variable in the above models is $SUMDTCA4_{kt}$, which denotes the 12-month sum of DTCA expenditures in MSA k at time t, targeting any one of the above four conditions. We include only local-level advertising in $SUMDTCA4_{kt}$ since national DTCA are common across MSAs and its impact is non-distinguishable from an arbitrary time trend of exercise behaviors. Besides $SUMDTCA$, we include α_k and β_t as MSA and time fixed effects, respectively. $DEMOG$ controls for an extensive set of individual characteristics, including age, gender, race, education, income categories, health insurance coverage, and self-reported health conditions. $DEMOG$ also includes a full set of dummies describing whether an individual feels sad, has diabetes, has high cholesterol, has hypertension, or is over-weight.

As elaborated in Section 2, the individuals subject to any one of the four health risks may react to DTCA differently from the other individuals. In accordance, we define a dummy variable $4Condition$ that equals to 1 for the "high-risk" people who suffer at least one of the four conditions, and 0 for the remaining "low risk" people. In the regression, we include the interaction between $4Condition$ and $SUMDTCA4$ (recall that each of the four conditions has been controlled separately in $DEMOG$) to capture the differential effects of DTCA on high- and low-risk people.

We estimate the base models using linear specifications that allow us to take into account the complex sampling scheme of the NHIS data *and* to use instrumental variables (to be discussed later). However, we also estimated logit models (without instrumental variables) in our preliminary analysis. Since the logit results are similar to the results from the base models, we only report the results from the base models in the results section below.[14]

Following the discussions in Section 2, we can extend the base models by further allowing the heterogeneous effects of DTCA across the population. For example, the first equation above can be modified as follows by adding a number of interactions between DTCA and individual attributes:

$$\begin{aligned} MODEXE_{ikt} &= \alpha_k + \beta_t + DEMOG_{ikt} \cdot \Pi \\ &+ SUMDTCA4_{kt} \cdot \{\gamma_0 + \gamma_1 \cdot 4Condition_{ikt} + \gamma_2 \cdot FEMALE_{ikt} \\ &+ \gamma_3 \cdot WHITE_{ikt} + \gamma_4 \cdot COLLEGE_{ikt} + \gamma_5 \cdot INC20K_{ikt} \\ &+ \gamma_6 \cdot AGE_{ikt} + \gamma_7 \cdot INSURED_{ikt}\} + \epsilon_{ikt} \end{aligned}$$

[14]The logit results are available from the authors upon request.

where $COLLEGE_{ikt}$ equal to 1 if individual i in MSA k at month t has college education or higher and 0 otherwise. $INC20K$ equal to 1 if one's annual income is higher than \$20,000 and 0 otherwise. We define AGE as the deviation from the sample mean (45), so that γ_1 represents the effect of SUMDTCA on a person of average age who is male, non-white, uninsured, free of the four chronic conditions, with education less than college and income less than \$20,000 per year. By definition, BMI (body mass index) is highly correlated with whether an individual is over-weight or not. Since we have included over-weight in $4Condition$, we do not control for BMI or include an interaction between BMI and $SUMDTCA4$ in the main specification.

An obvious alternative specification to the above base models is to distinguish the four drug categories one by one. Unfortunately, we were unable to estimate such models for two reasons. First, there are limited variations in hypertension and weight-loss DTCA (more details to be discussed in Table 2), which hinders our ability to estimate a separate coefficient of $SUMDTCA$ for each of the four drug classes. In a robustness check shown below, we examine the two most advertised classes (diabetes and cholesterol reducing) separately. Moreover, to the extent that the four disease conditions are closely correlated, it is conceivable that DTCA on one condition may have an effect for patients with another condition. This concern leads us to believe that grouping them together is a reasonable approach.

4.2 Identification issues

This subsection discusses three issues: the potential endogeneity of DTCA variables, the potential noise in self-reported body size measures (height and weight), and the alternative ways to account for DTCA depreciation over time.

4.2.1 Endogeneity of DTCA variables

We realize that our DTCA variables may be endogeneous. For example, pharmaceutical firms may target their advertising efforts to the markets where advertising are likely to be effective. For example, drug companies may advertise more on weight-loss medicines in the MSAs where people engage in little physical activities. While the MSA fixed effects in the regressions mitigate this problem, they do not eliminate the potential correlation in the time-varying components of advertising intensity and individual health habits.

To solve the endogeneity problem, we consider two instruments. The first is the same drug companies' DTCA expenditures in all other classes in all other MSAs. We label the instruments as $SUMDTCA4_{-kt}$ (for $SUMDTCA4_{kt}$). We argue that DTCA across classes and MSAs are correlated within the same company, either because the company pursues a particular marketing strategy for all products and regions or because different drugs and regions are subject to a common advertising budget. To the extent that the local DTCA of different products in different regions are unlikely to affect peoples' exercise decisions in the studied market, they are valid instruments. Similar instruments have been used in the previous literature, including Berndt et al. (1995) and Iizuka and Jin (2005).

The second instrument utilizes the wage data of advertising related jobs reported in Occupational Employment Statistics (OES) between 1997 and 2001. Each year OES reports detailed wage estimates of over 700 occupations for all MSAs.[15] Among these occupations, we look at four categories that would capture the cost of media production, which in turn would affect the cost of DTCA in each area. They are i) broadcast technicians, ii) announcers: radio and television, iii) news analysts, reporters and correspondents, and iv) camera operators: television, video, and motion picture. In each MSA, we use the weighted sum of wage estimates for these four groups of occupations as an instrument for DTCA expenditure, where the weight is equal to the total employment by occupation by year. The use of OES average wage as instrument for DTCA entails the assumption that drug advertising constitutes a small fraction of all the advertising implemented in the related medias and pharmaceutical companies take the cost of advertising as given. By adding in the two instruments improves the first stage R-squared from 0.8337 to 0.8398. Both instruments make significant contribution to explaining the variations in $SUMDTCA4_{kt}$, but $SUMDTCA4_{-kt}$ is relatively more powerful, probably because DTCA advertising related to the four conditions involve a lot of pharmaceutical companies whose advertising in other categories vary greatly across time and MSA. For the sake of robustness, we have run the instrumental regressions in two ways: one uses both instruments, and the other uses the OES average wage only. Results are qualitatively similar, though the regressions with

[15]OES used a 5-digit classification system between 1997 and 1998 but changed it to a 6-digit system in 1999. However, the occupation categories we use for this analysis didn't change except for minor changes in wording before and after 1999.

both instruments deliver more precision. In all cases, Hausman test cannot reject the exogeneity of $SUMDTCA4_{kt}$. So in section 5 we report the IV results using both instruments, but focus most of the discussion on the OLS.

4.3 Measurement errors in height and weight

Previous researchers have expressed concerns regarding measurement errors in self-reported height and weight (Rowland 1989). Since we use body mass index (BMI) to define one of the four "high-risk" conditions and BMI is calculated from self-reported height and weight in the NHIS, measurement errors may generate systematic bias. We follow Cawley (2004) to correct the bias.[16]

Specifically, we assess the degree of measurement errors by using the third National Health and Nutrition Examination Survey (NHANES III) which reports height and weight from both self report and physical examination. In the first step, we regress actual weight as a polynomial function of the reported weight (up to power of five) in NHANES III. Then we use the estimated relationship to predict the actual weight in the NHIS. To account for the possibility that different demographic groups may have different reporting errors, this process is carried out for 12 groups separately, where group is defined by race (white vs. non-white), gender, and age (18-39, 40-64 and 65+). Same procedure is repeated for height. After obtaining predicted height and weight, we recalculate the body mass index and use it to define an individual overweight if the corrected BMI is greater than 25.

For both height and weight, we achieve high R-squares in the first step (0.8-0.9 on average) and results are very similar no matter whether we use the original or the corrected BMI. We have also tried the alternative definition of overweight ($BMI > 30$) and results do not change in any significant way. In light of the robustness, Section 5 only reports the results with the corrected BMI under the standard definition of overweight ($BMI > 25$).

[16] The general strategy is outlined in Lee and Sepanski (1995) and Bound et al. (2002)

4.4 DTCA depreciation

Any study on the effect of advertising would involve some discussion on the depreciation rate of advertising. Ideally, if we have long enough data on advertising intensity, we can introduce a parameter to represent monthly depreciation rate, use it to construct the discounted sum of advertising intensity up to the interview time, and estimate the depreciation rate with the other parameters in the nonlinear model (see Iizuka and Jin, 2006, for such an attempt). We are unable to follow this strategy in this paper, mainly because we have no pre-1996 data on the total advertising intensity by category and MSA. Instead, our main results use a simple 12-month sum of DTCA to proxy the accumulated DTCA exposure up to the interview time. For robustness check, we also use the monthly depreciation rate estimated in our previous paper (0.9672, Iizuka and Jin, 2005) to compute the discounted sum of DTCA. This alternative approach entails an assumption of zero DTCA before 1996. Both specifications generate similar results, suggesting that our results are robust to different depreciation assumptions.

5 Results

5.1 Data summary

Table 1 summarizes exercise variables in the NHIS. Panel A Shows the percentage of population that has ever been told by doctor of having diabetes, hypertension, high cholesterol, or is overweighed at the time of interview. Over 60% of the population are at the risk of at least one of the four conditions, and this percentage has increased steadily over time (from 64.81% in 1997 to 66.84% in 2001). The trend is particularly driven by people getting overweight and facing higher risk of diabetes over time. In comparison, changes in hypertension and high cholesterol are non-monotone: for both conditions, the percentage at risk dropped slightly from 1998 to 2000, and picked up again in 2001.

Panel B summarizes the exercise variables for high-risk and low-risk groups separately. Perhaps not surprisingly, people at risk of at least one of the four conditions engage in much less physical activities. Only 35-38% of these high-risk people participates in vigorous exercise ($VIGEXE$) for at least 10 minutes per week. The corresponding number for the low-risk people is 44-47%. Similarly, only 47-51% of high-risk individuals exercise moderately ($MODEXE$) for at least 10 minutes a week, lower than that among the low-risk people (52-55%).

Table 2 presents summary statistics for local DTCA expenditures targeting diabetes, hypertension, cholesterol reducing, and weight control. Panel A reports the mean and standard deviation of local DTCA spent in each category in each quarter across all the 58 MSAs included in our NHIS and DTCA data. Note that these numbers only include the DTCA via local medias, hence much smaller than the overall DTCA spent nationwide. Among the four conditions, DTCA is more intensive for diabetes and cholesterol reducing, probably because the potential drug markets for these two conditions are much larger than the other two. The over-time variation is also striking: the local DTCA of hypertension drugs was positive only in 1996, while the annual DTCA sum of diabetes and cholesterol reducing drugs tripled from 2000 to 2001.

Panel B reports the percentage of zero advertising by MSA, quarter, and category. This is to further examine how much variations we have in our MSA DTCA data. Panel B indicates that local DTCA has been used in many MSAs especially for diabetes and cholesterol reducing drugs in recent years. This will help us identifying the impact of DTCA on health habit. In contrast, local DTCA expenditures for hypertension and weight control drugs do not exist in many MSAs overtime. This suggests that these DTCA may not have much explanatory power. Based on this observation, we will also estimate a model that focuses only on local DTCA of diabetes and cholesterol reducing drugs.

In Panel C, conditional on non-zero advertising, we further report the mean and standard deviation of local DTCA by quarter, MSA, and category. This shows that the standard deviation of local DTCA is often close to or larger than the mean itself. Since this table bounds DTCA above zero, this suggests that DTCA varies greatly across MSAs and quarters. Overall, there is a substantial variation in local DTCA across time and location, and it will help us to identify the effect of DTCA on exercise habits.

5.2 Estimation Results

Tables 3 and 4 report the results on moderate and vigorous exercise, respectively. In each table, we report four columns for the determinants of whether to participate in exercise ($MODEXE$

and $VIGEXE$). The first two columns report the OLS and IV results for the basic model, the next two columns include the interaction of $SUMDTCA4$ and demographics, and the last two columns focus on the two heavily advertised classes (diabetes and cholesterol reducing) and allow the DTCA coefficients to differ by class. To allow high- and low-risk populations to respond to DTCA differently, we include the interaction between $SUMDTCA4$ and $4CONDITION$ in Columns 1-4. This interaction becomes class-specific in Columns 5-6. We only report DTCA related variables in the table, but all regressions include a full set of year-quarter dummies, a full set of MSA dummies, detailed demographics such as race, gender, age, income categories, insurance status, the existence of certain health conditions, and self-reported health status. All regressions take into account of stratification, primary sample unit, and sampling weight.

Four patterns are worth noting. First, focusing on the basic model, estimates suggest that DTCA tends to lower the propensity of moderate exercise but has no significant impact on vigorous exercise. This result is robust after we apply the instrumental variables, which suggests that the OLS effect is unlikely driven by targeted advertising. Moreover, the impact of DTCA does not vary much for high- and low-risk individuals. More specifically, the OLS coefficients (Column 1) suggest that one-million increase in $SUMDTCA4$ is associated with a 1.64 percentage point reduction in the likelihood of moderate exercise for healthy people, and a 1.43 percentage point reduction for people that have at least one of the four chronic conditions. The difference is small and insignificant. When we use instruments (Column 2), the reduction of moderate exercise becomes stronger and more significant for the high-risk population (9% versus 7.71% for the low risk), but the difference remains small. We note that, for all regressions in this paper, Hausman test does not reject the null hypothesis of DTCA being exogenous (conditional on we have valid instruments.) Thus, although we report instrumental variable results for all regressions, we take the OLS results as our primary results in this paper.

In columns 3 and 4, we report the results that add interaction terms between DTCA and demographics to the previous regressions. For both moderate and vigorous exercise, the effect of DTCA tends to be more negative for the educated people, more negative for the insured, and more positive for those with income over \$20k. These signs are consistent with the notion that the third-party payment, the ability to calculate the tradeoff between today and tomorrow, and the lack of high income intensify the tendency to substitute away from exercise. It should be noted, however, that most OLS coefficients for these interactions do not pass the conventional confidence level. Although using instruments makes them larger and statistically more significant, as before, Hausman test does not reject the null of DTCA being exogenous. For this reason, the differential effects of DTCA across the population are not conclusive.

Finally, when we examine diabetes and cholesterol reducing separately, it is clear that the reduction of moderate exercise is largely driven by the DTCA of cholesterol reducing drugs (see columns 5 and 6). One explanation for this is that individuals tend to view that drug treatment and physical exercise are substitutable for lowering cholesterol but less so for the control of diabetes. Like in the basic model reported in columns 1 and 2, the effect of DTCA does not depend on whether an individual has high cholesterol or diabetes. In an unreported table, we also allow the DTCA of cholesterol reducing and diabetes to interact with demographics. The signs of the key coefficients remain unchanged, and the interaction terms paint a similar picture as before: the effect of DTCA on (both moderate and vigorous) exercise tends to be more negative for the insured, the educated, and the ones with income less than $20k. However, none of them are statistically significant.

To summarize, we find that DTCA of prescription drugs tend to decrease the likelihood of engaging in moderate exercise. In some specifications, this negative impact is stronger for the insured, the educated, and the people that currently suffer from one of the four conditions, but the difference is often statistically insignificant. When we examine the effect of DTCA separately for the two most advertised classes (diabetes and cholesterol reducing), we find that the reduction of moderate exercise is largely driven by the cholesterol reducing advertising. This suggests that exercise and drug treatment is perceived more substitutable for cholesterol reducing than for diabetes.

6 Conclusion

This paper examined the effect of DTCA of an important health habit, physical exercise. According to the estimation results, the DTCA of four conditions — diabetes, hypertension, high cholesterol, and overweight — appears to decrease the likelihood of moderate exercise. This suggests the possibility that DTCA of drug treatments may have encouraged (at least some) people to substitute away from healthy lifestyles. While most of the existing research examines the immediate effect of DTCA on pharmaceutical demand, our results indicate that DTCA may affect consumers even more broadly by changing their daily routines. The fact that DTCA encourages unhealthy habits may have long run impacts on the nation's health status and overall health care expenditure. Future research should explore the mechanisms by which the DTCA affects health habits, which may provide further insights into how policy makers should regulate the DTCA of prescription drugs.

7 References

Aikin, Kathryn (2003) "The Impact of Direct-to-Consumer Prescription Advertising on Physician-Patient Relationship" accessed at http://www.fda.gov/cder/ddmac/aikin/index.htm on Jan. 10, 2007.

Berndt, E.R., L. Bui, D.R. Reiley, and G. L. Urban (1995) "Information, Marketing, and Pricing in the US Antiulcer Drug Market," American Economic Review 85(2), 100?105.

Bound, John; Charles Brown and Nacy Mathiowetz (2002) "Measurement Error in Survey Data" in *Handbook of Econometrics* volume 5, edited by James Heckman and Ed Leamer. New York: Springer-Verlag.

Cawley, John (2004) "The Impact of Obesity on Wages" *Journal of Human Resources* Spring 2004, 39(2): 451-474.

Hollon, Matthew F. (1999): "Direct-to-Consumer Marketing of Prescription Drugs" *Journal of American Medical Association*, January 27, 1999, Vol 281, No. 4.

Holmer, Alan (1999): "Direct-to-Consumer Prescription Drug Advertising Builds Bridges Between Patients and Physicians" *Journal of American Medical Association*, January 27, 1999, Vol 281, No. 4.

Holmer, Alan (2002): "Direct-to-Consumer Advertising – Strengthening Our Health Care System" *New England Journal of Medicine*, February 14, 2002, Vol. 346, No. 7.

Iizuka, Toshiaki (2004): "What Explains the Use of Direct-to-Consumer Advertising of Prescription Drugs?" *Journal of Industrial Economics*, Vol. 52, No.3, pp. 349-379.

Iizuka, Toshiaki and Ginger Jin (2005): "The Effect of Prescription Drug Advertising on Doctor Visits" *Journal of Economics and Management Strategy* 14(3): 701-727.

Iizuka, Toshiaki and Ginger Jin (2006): "Direct-to-Consumer Advertising and Prescription Choice" *Journal of Industrial Economics*, forthcoming.

Lee, Lung-fei and Jungsywan H. Sepanski (1995) "Estimation of Linear and Nonlinear Errors-in-Variables Models Using Validation Data" *Journal of the American Statistical Association* 90(29): 130-40.

Lindgren, Bjorn and Charles Stuart (1980) "The Effects of Traffic Safety Regulation in Sweden" *Journal of Political Economy* 88(2): 412-427.

Prevention Magazine (1998-2000): "National Survey of Consumer Reactions to Direct-to-Consumer Advertising" Emmaus PA, Rodale Press, 1998-2000.

Peltzman, Sam (1975) "The Effects of Automobile Safety Regulation" *Journal of Political Economy* 83(4): 677-726.

Rowland, Michael L. (1989) "Reporting Bias in Height and Weight Data." *Statistical Bulletin* 70(2): 2-11.

Rosenthal, Meredith B., Ernst R. Berndt, Julie M. Donohue, Arnold M. Epstein and Richard G. Frank (2003): "Demand Effects of Recent Changes in Prescription Drug Promotion," in *Frontiers in Health Policy Research*, Vol. 6, David M. Cutler and Alan M. Garber, editors, MIT Press, pp. 1-26.

Viscusi, W. Kip (1985) "Consumer Behavior and the Safety Effects of Product Safety Regulation" *Journal of Law and Economics* 28(3): 527-553.

Wolfe, Sidney M. (2002): "Direct-to-Consumer Advertising – Education or Emotion Promotion? " *New England Journal of Medicine*, February 14, 2002, Vol. 346, No. 7.

Wosinska, Marta (2002): "Just What the Patient Ordered? Direct-to- Consumer Advertising and The Demand for Pharmaceutical Products," unpublished manuscript.

Table 1: Summary of NHIS Exercise variables

Panel A: percentage of individuals with a specific condition

Year	Diabetes	Hypertension	High Cholesterol	Overweight	Diabetes or high cholesterol	Any one of the four
	%	%	%	%	%	%
1997	4.64	21.18	11.56	56.05	14.40	64.81
	(0.19)	(0.41)	(0.32)	(0.48)	(0.37)	(0.44)
1998	4.73	21.38	11.06	57.98	14.02	65.76
	(0.21)	(0.41)	(0.31)	(0.41)	(0.36)	(0.40)
1999	4.65	20.66	10.38	58.95	13.50	66.22
	(0.19)	(0.44)	(0.27)	(0.51)	(0.30)	(0.53)
2000	5.15	20.39	10.31	58.73	13.79	65.69
	(0.21)	(0.37)	(0.30)	(0.50)	(0.33)	(0.49)
2001	5.41	21.30	11.36	59.53	14.77	66.84
	(0.22)	(0.39)	(0.35)	(0.50)	(0.39)	(0.47)
Total OBS	76,792	76,792	76,792	76,792	76,792	76,792

Panel B: tendency to exercise by low- and high-risk (High risk refers to individuals with at least one of the four conditions)

	VIGEXE (%)		MODEXE %	
	low risk	high risk	low risk	high risk
1997	47.28	37.14	55.64	50.60
	(0.83)	(0.56)	(0.82)	(0.56)
1998	46.21	35.97	53.64	48.00
	(0.89)	(0.57)	(0.92)	(0.62)
1999	45.19	36.81	52.51	47.93
	(0.89)	(0.65)	(1.00)	(0.69)
2000	45.92	37.00	52.44	49.55
	(0.95)	(0.59)	(0.94)	(0.70)
2001	48.13	38.71	55.78	51391.00
	(0.83)	(0.60)	(0.87)	(0.66)
Total OBS	76,792		76,792	

Note: Standard error in parentheses, taking into account of stratification, PSU and sampling weight. All summaries are conditional on the same samples as used in regressions.

Table 2: Summary of DTCA variables

Panel A: Mean of Local DTCA by MSA, quarter and category, thousand dollars as of 1996 January (std dev in parentheses)

Year	Diabetes	Hypertension	Cholesterol Reducing	Weight Control	Diabetes + Cholesterol reducing	All 4 Total
1996	0.00	56.14	111.57	0.00	111.57	167.71
	(0.00)	(130.51)	(199.18)		(199.18)	(260.77)
1997	57.34	0.00	138.20	0.00	195.55	195.55
	(133.78)		(189.62)		(278.12)	(278.12)
1998	9.82	0.00	274.47	6.10	284.29	290.39
	(33.62)		(448.13)	(22.12)	(448.31)	(454.22)
1999	34.24	0.00	50.71	0.61	84.96	85.57
	(58.12)		(59.82)	(1.62)	(96.45)	(96.86)
2000	124.44	0.00	40.71	2.04	165.14	167.19
	(165.98)		(99.11)	(5.71)	(222.61)	(223.99)
2001	375.83	0.00	114.03	1.33	489.86	491.19
	(581.14)		(197.66)	(5.00)	(617.93)	(618.46)

Total OBS = 1392 = 58 MSA * 6 years * 4 quarters

Table 2 continued: Summary of DTCA variables

Panel B: How many of Panel A are driven by zero advertising in a specific quarter?
Report: % of zero advertising by MSA, quarter and category

Year	Diabetes	Hypertension	Cholesterol Reducing	Weight Control	Diabetes + Cholesterol reducing	All 4 Total
1996	100.00	50.43	53.45	100.00	53.45	26.29
1997	70.26	100.00	28.45	100.00	24.57	24.57
1998	84.91	100.00	19.53	81.03	18.10	16.81
1999	53.88	100.00	0.86	62.93	0.43	0.43
2000	18.53	100.00	9.05	18.97	5.17	1.29
2001	9.05	100.00	6.47	42.24	0.43	0.43

Panel C: Conditional on non-zero advertising: Mean of Local DTCA (std dev in parentheses)

Year	Diabetes	Hypertension	Cholesterol Reducing	Weight Control	Diabetes + Cholesterol reducing	All 4 Total
1996		113.26	239.66		239.66	227.53
		(167.29)	(233.80)		(233.80)	(280.55)
1997	192.80		193.15		259.24	259.24
	(185.19)		(199.15)		(293.40)	(293.40)
1998	65.09		342.35	32.18	347.13	349.07
	(63.07)		(476.85)	(42.06)	(472.98)	(477.11)
1999	74.24		50.16	1.65	85.32	85.94
	(66.06)		(59.89)	(2.32)	(96.50)	(96.91)
2000	152.75		44.76	2.52	174.15	169.38
	(171.76)		(103.07)	(6.25)	(225.16)	(224.63)
2001	413.24		121.91	2.30	491.98	493.32
	(596.63)		(202.04)	(6.41)	(618.42)	(618.95)

Table 3: MODEXE regressions based on NHIS 1997-2001, focus on 4 health conditions

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV
SUMDTCAALL4($million)	-0.0164 ***	-0.0771 **	-0.0113 *	0.0060		
	(0.0045)	(0.0315)	(0.0062)	(0.0360)		
SUMDTCAALL4 * ALL4 conditions	0.0021	-0.0129 **	0.0007	-0.0134 **		
	(0.0033)	(0.0030)	(0.0035)	(0.0061)		
SUMDTCA for Diabetes ($million)					-000083	0.0215
					(0.0062)	(0.0250)
SUMDTCA for Cholesterol ($million)					-0.0138 ***	-0.0300
					(0.0047)	(0.0430)
Diabetes * SUMDTCA Diabetes					-0.0004	0.0192
					(0.0096)	(0.0360)
Cholesterol *SUMDTCA Cholesterol					-0.0054	-0.0368
					(0.0079)	(0.0326)
SUMDTCAALL4 * female			-0.0023	-0.0028		
			(0.0033)	(0.0093)		
SUMDTCAALL4 * age			0.0001	-0.0002		
			(0.0001)	(0.0003)		
SUMDTCAALL4 * white			-0.0047	-0.0179		
			(0.0041)	(0.0124)		
SUMDTCAALL4 * college plus			-0.0046	-0.0205 *		
			(0.0039)	(0.0120)		
SUMDTCAALL4 * income over 20k			0.0043	0.0202 **		
			(0.0035)	(0.0102)		
SUMDTCAALL4 * insured			-0.0054	-0.0275 **		
			(0.0043)	(0.0112)		
OBS	76,792	76,792	76,792	76,792	76,792	76,792
R2	0.1067	0.1014	0.1068	0.1050	0.1066	0.1051

Note: Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. All regressions take into account of stratification, PSU and sampling weight. All regressions include a full set of year-quarter dummies, a full set of MSA dummies, and detailed demographics such as race, gender, age, income categories, education categories, insurance status, the existence of certain health conditions, and self-reported health status. We use OES average wage of media workers and the same pharmaceutical companies' DTCA in other drug classes and other areas as instruments for SUMDTCA.

Table 4: VIGEXE regressions based on NHIS 1997-2001, focus on 4 health conditions

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV
SUMDTCAALL4($million)	0.0021	-0.0276	0.0074	0.0597 *		
	(0.0043)	(0.0252)	(0.0059)	(0.0304)		
SUMDTCAALL4 * ALL4 conditions	-0.0006	-0.0043	-0.0020	-0.0018		
	(0.0030)	(0.0059)	(0.0029)	(0.0062)		
SUMDTCA for Diabetes ($million)					0.0074	0.0409 *
					(0.0046)	(0.0242)
SUMDTCA for Cholesterol ($million)					-0.0008	0.0224
					(0.0041)	(0.0402)
Diabetes * SUMDTCA Diabetes					0.0074	-0.0102
					(0.0092)	(0.0278)
Cholesterol *SUMDTCA Cholesterol					-0.0006	-0.0264
					(0.0063)	(0.0229)
SUMDTCAALL4 * female			-0.0040	-0.0119		
			(0.0029)	(0.0093)		
SUMDTCAALL4 * age			0.0001	-0.0010 ***		
			(0.0001)	(0.0003)		
SUMDTCAALL4 * white			-0.0040	-0.0302 **		
			(0.0039)	(0.0122)		
SUMDTCAALL4 * college plus			-0.0052	-0.0112		
			(0.0037)	(0.0120)		
SUMDTCAALL4 * income over 20k			0.0054	0.0228 **		
			(0.0035)	(0.0107)		
SUMDTCAALL4 * insured			-0.0067 *	-0.0342 ***		
			(0.0039)	(0.0118)		
OBS	76,792	76,792	76,792	76,792	76,792	76,792
R2	0.1592	0.1581	0.1593	0.1532	0.1592	0.1582

Note: Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. All regressions take into account of stratification, PSU and sampling weight. All regressions include a full set of year-quarter dummies, a full set of MSA dummies, and detailed demographics such as race, gender, age, income categories, education categories, insurance status, the existence of certain health conditions, and self-reported health status. We use OES average wage of media workers and the same pharmaceutical companies' DTCA in other drug classes and other areas as instruments for SUMDTCA.