Direct-To-Consumer Television Advertising Exposure, Diagnosis with High Cholesterol, and Statin Use

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BACKGROUND: While statin drugs are recommended for secondary prevention of coronary heart disease (CHD), there is no medical consensus on whether or not a statin should be added to lifestyle change efforts for primary prevention of CHD. Previous research suggests that exposure to direct-to-consumer advertising (DTCA) increases drug demand among those at comparatively low risk. Research has yet to examine whether individual-level DTCA exposure may influence statin use among men and women at high, moderate, or low risk for future cardiac events.

OBJECTIVE: To determine the relationship between estimated exposure to DTCA for statin drugs and two clinical variables: diagnosis with high cholesterol and statin use.

DESIGN: We used logistic regression to analyze repeated cross-sectional surveys of the United States population, merged with data on the frequency of DTCA appearances on national, cable, and local television, between 2001 and 2007.

PARTICIPANTS: American adults ($n=106,685$) aged 18 and older.

MAIN MEASURES: Levels of exposure to statin DTCA, based on ad appearances and TV viewing patterns; self-reports of whether or not a respondent has been diagnosed with high cholesterol, and whether or not a respondent took a statin in the past year.

KEY RESULTS: Adjusting for potential confounders, we estimate that exposure to statin ads increased the odds of being diagnosed with high cholesterol by 16 to 20 %, and increased statin use by 16 to 22 %, among both men and women ($p<0.05$). These associations were driven almost exclusively by men and women at low risk for future cardiac events. There was also evidence of a negative association between DTCA exposure and statin use among high-risk women ($p<0.05$).

CONCLUSIONS: This study provides new evidence that DTCA may promote over-diagnosis of high cholesterol and over-treatment for populations where risks of statin use may outweigh potential benefits.

KEY WORDS: DTCA; direct-to-consumer advertising; statins; cholesterol; screening; treatment.

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INTRODUCTION

Coronary heart disease (CHD) is the leading cause of death in the United States,¹ and high levels of low-density lipoprotein (LDL cholesterol) are a major contributor.² The United States Preventive Services Task Force (USPSTF) strongly recommends screening for all men 35 years or older and women 45 years and older who are at increased risk for CHD. USPSTF also recommends (but not strongly) screening for men under 35, and for women between 20 and 45, if they are at increased risk for CHD.³ USPSTF does not recommend routine cholesterol screening for women or men under 35 years without elevated risk.³

There is general agreement from the medical community that patients should always initiate and maintain lifestyle change when LDL cholesterol levels are high.^{4,5} HMG-CoA reductase inhibitors (commonly referred to as “statins”), which block the formation of cholesterol in the liver, can reduce LDL cholesterol and the risk of mortality from CHD among patients with a history of CHD or diabetes.⁶ There is considerable debate, however, about whether or not a statin should be added to lifestyle change efforts for primary prevention of CHD.^{4,5} While statins can prevent serious cardiac and stroke events among those without a history of CHD,⁴ there is limited evidence for reductions in mortality among this group, and patients who use statins as a method of primary prevention may develop other serious adverse health effects.⁵

Pharmaceutical companies spend billions of dollars (US) annually on direct-to-consumer advertising (DTCA).^{7,8} Statins represent the largest class of DTCA expenditures, mainly directed toward television (TV) ads.^{7,8} Proponents of DTCA argue that the ads educate the population about health risks and encourage healthcare provider visits, relevant diagnostic tests, and appropriate treatment.^{9,10} Opponents argue that DTCA undermines healthcare by encouraging over-diagnosis, promoting questionable prescribing practices, and emphasizing drug benefits over risks.^{11–13}

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Studies have surveyed physician and patient views about the influence of DTCA on the quality of care,^{14,15} have linked market or monthly level DTCA expenditures to increased doctor visits, screening tests, and drug scripts written (including statins),^{10,15–20} and have tested whether individual-level DTCA exposure is associated with pharmaceutical use.^{21–24} Overall, this work suggests that DTCA exposure increases prescription drug demand, but several studies suggest demand is primarily among those at low risk for disease.^{24–27} This study tests whether DTCA exposure is related to high cholesterol diagnosis and statin use among men and women at high, moderate, or low risk for future cardiac events.

METHODS

This study combines data on the appearance of DTCAs for statins on national, cable, and local TV with a nationally representative US population survey between 2001 and 2007. The survey includes questions about TV viewing behaviors, cholesterol diagnosis, statin use, and risk factors for CHD. Combined, these data allow for logistic regression analyses to examine the relationship between DTCA exposure, diagnosis of high cholesterol, and statin use among a variety of risk groups.

Individual-Level Survey Data

This study uses the Simmons National Consumer Survey (NCS),²⁸ a nationally representative repeated cross-sectional survey, administered twice per year. The NCS uses a multi-stage stratified probability sample of individuals, oversampling high-income and Hispanic households. The data include weights to account for oversampling and non-response, and to match the demographic profile of the American public.²¹ The NCS measures a large number of sociodemographic characteristics and health-related behaviors, including health insurance status and use of prescription drugs. The survey also gathers detailed reports of participants' media exposure, providing them with a list of 1,039 network and cable programs and asking them to indicate which they watch and how frequently. Our data set included 13 NCS waves from 2001 to 2007. The average survey response rate was 35 % (range, 19–43). The study was deemed exempt from human subjects review by the Institutional Review Board of the authors' institution.

Ad Appearance Data

The DTCA appearances data come from Kantar/TNS Media Intelligence (TNS).²⁹ We purchased data on the appearance of statin TV DTCA (including the time and program) and

antidepressant ads, for purposes of comparison. The ads aired between 2000 and 2007 on national networks, cable, and local markets identified by Designated Marketing Areas (DMAs). In 2001, TNS covered the largest 75 US DMAs; from 2002 to 2007, TNS covered the largest 100 DMAs.

Measures

We measured potential individual-level DTCA exposure by matching TNS ad appearance data for the year preceding a respondents' survey date, to NCS data on programs or time slots respondents reported watching regularly. To match ads that appeared in local markets, we used respondent's DMA of residence. The NCS identifies 56 DMAs, many (but not all) of which were also included in the TNS data. We thus made use of data from 106,865 respondents who lived in DMAs identified in both data sources (73 % of the full NCS sample, $N=146,775$). To identify the TV shows (and thus the ads embedded within those shows) likely viewed by an individual, we created a variable indicating that an individual was potentially exposed to a specific DTCA if the ad aired in the past year during a specific program they reported watching, or aired on a network during a time slot reported being watched. We further refined our measure of potential exposure by incorporating information about the frequency with which they reported watching these programs (0, 1, 2, 3 or 4 times in an average month) and the frequency of viewing a particular network and time-period (hours per week on this network during this time). This method accounts for 85 % of aired DTCAs in the TNS data, as 15 % of DTCAs appeared during programs that were not included or during times not asked about (1 am to 5 am) in the NCS.

We examined the relationship between DTCA exposure and two clinical variables: whether or not a respondent reported 1) having been diagnosed with high cholesterol, and 2) having taken a statin in the past year. Respondents were asked to indicate whether or not they "have been told by a doctor or other healthcare professional that you currently have or had [High Cholesterol] in the past 12 months." Respondents who answered "yes" were coded as having been diagnosed with high cholesterol. Respondents with high cholesterol were asked if they had taken any prescription drugs to treat the disease in the past 12 months. Those who did were coded as having taken a statin in the past year.

Identifying Respondents at High, Moderate, and Low Risk for Future Cardiac Events

National clinical practice guidelines were used to create a variable identifying respondents at high, moderate, or low risk for future cardiac events.⁶ Respondents who had CHD,

diabetes, and/or had previously experienced a heart attack were considered high risk. Respondents were deemed moderate risk if they were not in the high-risk category but had two or more other risk factors: age ≥ 45 years (men) or age ≥ 55 years (women), current smoker, or hypertension. While family history of premature CHD and low-HDL cholesterol are also risks, the NCS did not measure them; therefore, these risk factors were not included in this variable.

Analyses

We use logistic regression in STATA v12 (College Station, TX) to test associations between DTCA exposure and cholesterol diagnosis and statin use. Our analytic approach is robust to several sources of bias. For instance, a successful marketing strategy would ensure that statin ads are seen more often in TV programs and watched by population groups more likely to suffer from high cholesterol. This targeting would produce a spurious, positive association between DTCA exposure and statin use. The NCS data allow us to address these concerns. First, the NCS is a commercially available data source used by marketers to plan media buys to target relevant population groups. We are therefore able to control for the same demographic information available to marketers when formulating their ad targeting strategies (listed in Table 1). Second, we are able to control for whether or not a respondent reported watching specific TV programs with TV program fixed effects, which means including a dummy variable for each of 1,039 programs measured in the study. Third, we control for the average number of hours a respondent watched TV per week. We also account for the possibility that statin ad exposure may reflect broader exposure to DTCAs, by controlling for exposure to the second-largest class of DTCA expenditures, antidepressant ads.²²

We used categorical exposure variables in our models, in roughly defined quintiles (0–14 ads, 15–39, 40–74, 75–149, and 150+ ads), to account for the possibility of non-linear relationships with outcomes. We ran logistic regression models with and without population weights, although in all models, we controlled for (or stratified by, in the case of biological sex) all of the demographic variables that were used to create the weights. The substantive interpretation of the findings was equivalent in both sets of models. For simplicity, we report results from unweighted models in all tables. Since more than one NCS adult from a single household could be included in the sample, we used the “cluster” command in STATA to adjust standard errors for non-independence of observations by household.

To test the relationship between DTCA exposure and clinical variables, we created eight different population groups: biological sex (men, women) by risk level (any level/overall, low, moderate, high). In preliminary analyses,

we further stratified the male sample by age (< 35 years or ≥ 35 years) to reflect differences in USPSTF clinical guidelines for cholesterol screening. Results were statistically equivalent for low-risk males regardless of age, and there was an insufficient number of young men at moderate or high risk in the sample to permit analyses specific to this group. We thus report findings for men overall. Within each group, we estimated separate logistic regression models on each clinical variable (diagnosis and statin use). To formally test whether the association between DTCA exposure and clinical variables differed by risk level, we estimated separate models that included interaction terms between each category of exposure and risk level for each clinical variable (not shown in tables). A significant interaction term indicates that a coefficient is different between confirmed low-risk and higher-risk individuals.

RESULTS

Sample Description

Table 1 presents sample statistics of NCS respondents used in the analysis, both overall and stratified by respondent sex. The sample over-represents women, older adults, Hispanics, married people, and those with lower household incomes, relative to US population estimates.²¹ The average respondent was potentially exposed to over 80 statin ads in the last year. Fifteen percent of the population reported that they had been told by a doctor that they have high cholesterol in the past year, and nearly 10 % reported taking a statin in the past year. Both rates are comparable to national prevalence estimates.^{30,31} Figure 1 shows average statin TV ad exposure levels for each survey wave during the study observation period, as well as rates of statin use over the same period.

DTCA Exposure, High Cholesterol Diagnosis, and Statin Use

Table 2 shows rates of cholesterol diagnosis and statin use by categories of DTCA exposure among men and women, both overall and at various levels of CHD risk, without controls for confounders. Table 3 presents odds ratios for specific categories of statin DTCA exposure in predicting high cholesterol diagnosis and statin use among men, controlling for potential confounders. Risk level was a strong predictor of both high cholesterol diagnosis and statin use. Overall, the odds of high cholesterol diagnosis were 20 % higher for men exposed to 75–149 statin ads ($p < 0.05$) and 16 % higher for men exposed to 150 or more ads ($p = 0.053$) than those with low ad exposure. These associations were driven by

Table 1. Basic Descriptive Data for the Analytic Sample, 2001–2007

	Overall	Men	Women
	N=106,685	n=47,383; 44.3 %	n=59,482; 55.7 %
Clinical Variables			
Has High Cholesterol	15.1	15.3	14.9
Has High Cholesterol and Taking a Statin	9.5	10.2	8.9
Number of Overall Statin TV DTCA Potentially Seen	M=81.4, SD=97.0	M=76.7, SD=93.9	M=85.3, SD=99.2
0–14 Ads	23.1	25.0	21.5
15–39 Ads	20.0	20.3	19.8
40–74 Ads	19.0	18.8	19.2
75–149 Ads	21.4	20.8	21.8
150 or More Ads	16.5	15.0	17.7
Number of Antidepressant TV DTCA Potentially Seen	M=80.0, SD=107.9	M=63.4, SD=91.7	M=90.9, SD=118.1
0–14 Ads	27.9	31.2	25.2
15–39 Ads	20.4	21.6	19.5
40–74 Ads	17.2	17.5	16.9
75–149 Ads	18.1	17.6	18.5
150 or More Ads	16.5	12.1	20.0
Risk for Future Cardiac Events			
Low Risk—1 or fewer confirmed risk factors	76.1	72.5	79.0
Moderate Risk—2 or more confirmed risk factors	18.9	22.2	16.4
High Risk—Has CHD, diabetes, or had a heart attack	5.0	5.4	4.7
Age	M=47.3, SD=16.5	M=47.1, SD=16.5	M=47.3, SD=16.6
18 to 34 Years	25.4	25.4	25.3
35 to 44 Years	20.4	20.4	20.4
45 to 54 Years	20.5	20.5	20.4
55 to 69 Years	21.7	21.9	21.5
70 Years or More	12.2	11.8	12.4
Race			
White, Non-Hispanic	63.8	63.7	63.9
Black, Non-Hispanic	5.9	5.3	6.4
Other Race, Non-Hispanic	4.4	4.6	4.2
Hispanic or Latino	25.9	26.4	25.6
Highest Level of Formal Education			
Less than High School Diploma	15.5	16.5	14.6
High School Diploma or Equivalent	26.9	25.4	28.1
Some College	26.1	24.7	27.1
College Degree or Higher	31.6	33.4	30.2
Overall Household Income			
Less Than \$25,000 Per Year	13.6	11.2	15.5
Between \$25,000 and \$49,999 Per Year	22.4	21.4	23.1
Between \$50,000 and \$74,999 Per Year	19.3	19.8	19.0
Between \$75,000 and \$99,999 Per Year	14.0	14.9	13.4
\$100,000 Or More Per Year	30.7	32.6	29.0
Currently Enrolled in College Full or Part Time	6.0	5.4	6.5
Married or Living as Married	64.5	69.2	60.7
Employed Full Time, ≥30 h/week	50.6	63.2	40.7
Has Health Insurance	59.0	58.0	59.7
Overall number of hours watching TV per day	M=4.9, SD=4.3	M=4.7, SD=4.3	M=5.1, SD=4.2
Number of Children in the Household	M=1.0, SD=1.3	M=1.0, SD=1.3	M=1.0, SD=1.3
Number of Overall People in the Household	M=3.2, SD=1.6	M=3.2, SD=1.6	M=3.1, SD=1.6

Cells contain percentages for categorical variables, means (M) and standard deviations (SD) for continuous variables
 CHD coronary heart disease; DTCA direct-to-consumer advertising

men at comparatively low risk for future cardiac events. There were no associations between any level of DTCA exposure and high cholesterol diagnosis for men at moderate or high risk, and a subsequent model with interaction terms between each level of DTCA exposure and risk revealed that three of the four DTCA ad exposure coefficients were significantly higher among low risk men than among moderate risk men (all $p < 0.05$; not in tables).

The pattern of results was nearly identical for statin use. The odds of using a statin were higher for men exposed to 75–149 statin ads (21 %; $p < 0.01$) and 150 or more ads

(22 %; $p < 0.05$) than those with low ad exposure. These associations were also driven by men at low risk; three of the four DTCA ad exposure coefficients were greater among low than moderate risk men (each $p < 0.05$; not shown).

Table 4 presents odds ratios for statin DTCA exposure in predicting clinical variables among women, again controlling for potential confounders. Risk level was again a strong predictor of high cholesterol diagnosis and statin use. The odds of high cholesterol diagnosis were 17 % higher for women exposed to 40–74 statin ads ($p < 0.01$) and 20 % higher for women

Figure 1. Estimated prevalence of statin use and statin TV DTCA exposure by wave, 2001–2007.

exposed to either 75–149 or 150+ statin ads (both $p < 0.01$) than those with low ad exposure. Echoing patterns for men, these associations were driven by women at low risk; three of the four DTCA ad exposure coefficients were greater among

low-risk women than among both moderate-risk and high-risk women (each $p < 0.05$; not shown).

DTCA exposure was also associated with greater statin use among women overall ($p < 0.05$ for the two highest levels of

Table 2. Rates of Cholesterol Diagnosis and Statin Use by Sex, Risk Group, and Statin TV Direct-to-Consumer Advertising (DTCA) Exposure, 2001–2007

DV: Told by a Doctor Respondent Has High Cholesterol	Men Overall (n=47,383)	Men Low Risk (n=34,327)	Men Mid Risk (n=10,502)	Men High Risk (n=2,554)
Overall	15.3	8.4	33.4	33.5
By the Number of Statin TV DTCA Potentially Seen				
0–14 Ads	10.0	5.8	28.5	27.2
15–39 Ads	11.6	6.9	29.7	32.0
40–74 Ads	14.7	8.6	30.5	36.0
75–149 Ads	19.7	11.3	35.9	34.1
150 or More Ads	23.9	12.6	38.3	37.2
DV: Statin Use in the Past 12 Months	Men Overall (n=47,383)	Men Low Risk (n=34,327)	Men Mid Risk (n=10,502)	Men High Risk (n=2,554)
Overall	10.2	4.9	24.5	22.5
By the Number of Statin TV DTCA Potentially Seen				
0–14 Ads	5.9	2.9	19.5	16.2
15–39 Ads	7.0	3.8	19.9	20.2
40–74 Ads	9.7	5.0	22.3	24.3
75–149 Ads	13.9	7.1	26.9	25.2
150 or More Ads	17.3	8.3	29.4	25.0
DV: Told by a Doctor Respondent Has High Cholesterol	Women Overall (n=59,482)	Women Low Risk (n=46,973)	Women Mid Risk (n=9,743)	Women High Risk (n=2,766)
Overall	14.9	8.6	39.7	34.5
By the Number of Statin TV DTCA Potentially Seen				
0–14 Ads	11.3	6.5	39.4	37.4
15–39 Ads	10.9	6.4	38.9	32.1
40–74 Ads	13.8	8.5	39.1	32.2
75–149 Ads	17.5	10.5	41.5	35.0
150 or More Ads	22.0	12.7	23.1	35.2
DV: Statin Use in the Past 12 Months	Women Overall (n=59,482)	Women Low Risk (n=46,973)	Women Mid Risk (n=9,743)	Women High Risk (n=2,766)
Overall	8.9	4.4	27.13	21.7
By the Number of Statin TV DTCA Potentially Seen				
0–14 Ads	6.0	2.8	24.3	23.9
15–39 Ads	6.1	3.0	26.7	19.2
40–74 Ads	8.0	4.3	25.8	20.3
75–149 Ads	10.7	5.7	26.7	21.1
150 or More Ads	14.3	7.1	29.8	23.6

DV dependent variable

Cells contain percentages of respondents reporting each clinical outcome within each sex and risk group

Table 3. Logistic Regression Models Predicting High Cholesterol Diagnosis and Statin Use in the Past 12 Months by Statin TV Direct-to-Consumer Advertising (DTCA) Exposure among Men, Controlling for Confounders, 2001–2007

DV: Told by a Doctor Respondent Has High Cholesterol	Men Overall (n=47,182)	Men Low Risk (n=33,120)	Men Mid Risk (n=10,328)	Men High Risk (n=2,088)
IV: Number of Statin TV DTCA Potentially Seen	Reference	Reference	Reference	Reference
0–14 Ads	1.09 [0.99–1.21]	1.08 [0.94–1.25]	0.99 [0.82–1.19]	1.51 [0.90–2.54]
15–39 Ads	1.11 [0.99–1.24]	1.16 [0.99–1.36]	0.88 [0.72–1.08]	1.75 [0.95–3.22]
40–74 Ads	1.20* [1.06–1.36]	1.28** [1.07–1.53]	1.04 [0.84–1.28]	1.03 [0.54–1.97]
75–149 Ads	1.16 [1.00–1.35]	1.23 [0.98–1.55]	1.03 [0.79–1.33]	1.45 [0.63–3.31]
150 or More Ads	3.81*** [3.57–4.07]	—	—	—
Moderate Risk (vs. Low Risk)	3.84*** [3.46–4.27]	—	—	—
High Risk (vs. Low Risk)	—	—	—	—
DV: Statin Use in the Past 12 Months	Men Overall (n=46,816)	Men Low Risk (n=31,580)	Men Mid Risk (n=10,151)	Men High Risk (n=1,913)
IV: Number of Statin TV DTCA Potentially Seen	Reference	Reference	Reference	Reference
0–14 Ads	1.06 [0.93–1.21]	1.07 [0.88–1.30]	0.96 [0.78–1.19]	1.44 [0.66–3.17]
15–39 Ads	1.10 [0.96–1.26]	1.13 [0.92–1.40]	0.92 [0.73–1.14]	1.57 [0.65–3.75]
40–74 Ads	1.21** [1.05–1.40]	1.32* [1.05–1.66]	1.05 [0.83–1.34]	0.79 [0.32–1.95]
75–149 Ads	1.22* [1.02–1.46]	1.35* [1.01–1.81]	1.12 [0.84–1.49]	0.86 [0.27–2.69]
150 or More Ads	4.17*** [3.85–4.51]	—	—	—
Moderate Risk (vs. Low Risk)	3.81*** [3.37–4.32]	—	—	—
High Risk (vs. Low Risk)	—	—	—	—

DV dependent variable; IV independent variable

All models controlled for: the number of antidepressant TV DTCA potentially seen (none were statistically significant), fixed effects for over 1,000 specific TV programs, demographic characteristics not included in the risk status measure, media use, insurance status, region of residence, and survey wave. Cells present odds ratios and 95 % confidence intervals

* denotes odds ratios that are significantly different from 1 at $p < 0.05$, adjusting for clustering by household; ** $p < 0.01$; *** $p < 0.001$

exposure), among those at low risk (although only for 75–149 ad exposure, $p < 0.05$), and among those at moderate risk (only at 150 or more exposures; $p < 0.05$). Contrary to expectations, however, the relationship between DTCA exposure and statin use among high-risk women was negative and significant for all but the highest exposures category (each $p < 0.05$). Three of four DTCA ad exposure coefficients were greater among low-

risk women than women at high risk for future cardiac events (each $p < 0.05$; not shown).

DISCUSSION

Linking data on DTCA appearances with nationally representative survey data, this study provides a test of whether

Table 4. Logistic Regression Models Predicting High Cholesterol Diagnosis and Statin Use in the Past 12 Months by Statin TV Direct-to-Consumer Advertising (DTCA) Exposure Among Women, Controlling for Confounders, 2001–2007

DV: Told by a Doctor Respondent Has High Cholesterol	Women Overall (n=59,367)	Women Low Risk (n=45,998)	Women Mid Risk (n=9,627)	Women High Risk (n=2,531)
IV: Number of Statin TV DTCA Potentially Seen	Reference	Reference	Reference	Reference
0–14 Ads	1.03 [0.94–1.14]	1.02 [0.90–1.16]	1.13 [0.93–1.38]	0.79 [0.57–1.11]
15–39 Ads	1.17** [1.05–1.30]	1.22** [1.07–1.41]	1.12 [0.91–1.38]	0.72 [0.50–1.05]
40–74 Ads	1.20** [1.07–1.35]	1.29*** [1.11–1.51]	1.11 [0.89–1.39]	0.75 [0.50–1.11]
75–149 Ads	1.20** [1.05–1.38]	1.24* [1.02–1.50]	1.27 [0.98–1.64]	0.68 [0.43–1.31]
150 or More Ads	4.03*** [3.78–4.31]	—	—	—
Moderate Risk (vs. Low Risk)	4.41*** [4.01–4.87]	—	—	—
High Risk (vs. Low Risk)	—	—	—	—
DV: Statin Use in the Past 12 Months	Women Overall (n=59,172)	Women Low Risk (n=44,526)	Women Mid Risk (n=9,563)	Women High Risk (n=2,531)
IV: Number of Statin TV DTCA Potentially Seen	Reference	Reference	Reference	Reference
0–14 Ads	1.04 [0.92–1.19]	1.02 [0.90–1.23]	1.21 [0.98–1.51]	0.65* [0.44–0.96]
15–39 Ads	1.12 [0.98–1.29]	1.22 [0.99–1.49]	1.09 [0.87–1.37]	0.62* [0.40–0.94]
40–74 Ads	1.16* [1.00–1.34]	1.30* [1.04–1.61]	1.17 [0.92–1.49]	0.57* [0.37–0.89]
75–149 Ads	1.21* [1.02–1.44]	1.23 [0.94–1.60]	1.35* [1.03–1.78]	0.64 [0.38–1.07]
150 or More Ads	4.44*** [4.10–4.82]	—	—	—
Moderate Risk (vs. Low Risk)	4.87*** [4.33–5.48]	—	—	—
High Risk (vs. Low Risk)	—	—	—	—

DV dependent variable; IV independent variable

All models controlled for: the number of antidepressant TV DTCA potentially seen (none were statistically significant), fixed effects for over 1,000 specific TV programs, demographic characteristics not included in the risk status measure, media use, insurance status, region of residence, and survey wave. Cells present odds ratios and 95 % confidence intervals

* denotes odds ratios that are significantly different from 1 at $p < 0.05$, adjusting for clustering by household; ** $p < 0.01$; *** $p < 0.001$.

exposure to statin DTCA is related to cholesterol diagnosis and treatment behaviors. The pattern of results was consistent—positive associations between DTCA exposure and both high cholesterol diagnosis and statin among both men and women were observed, but these results were driven by those at comparatively low risk of future cardiac events. There was very little evidence of positive associations between DTCA exposure and these clinical variables among those at moderate or high risk for future cardiac events, and strong evidence for a negative relationship among women with CHD, diabetes, or a previous heart attack.

Implications

Study findings enhance our understanding of the role DTCA plays in shaping health-related behaviors. The fact that statin DTCA exposure predicted a higher likelihood of receiving a diagnosis for high cholesterol and statin use among those at low risk for future cardiac events suggests potential over-diagnosis and over-treatment, a finding consistent with several previous studies and syntheses of the literature.^{24–27} While the USPSTF strongly recommends routine screening for men 35 years and older,³ a group that comprised a substantial proportion of those in the low risk category, the benefits of statin use among this group is under debate.^{4,5} Patterns of association with DTCA exposure were nearly identical among men for high cholesterol diagnosis and statin use, and previous work suggests that a trip to the doctor inquiring about pharmaceutical drugs from DTCAs often leads to a prescription for prominent health conditions.²⁵

Among women, a group for whom routine cholesterol screening is not recommended by the USPSTF at any age,³ results were more striking. DTCA exposure was linked to higher odds of both high cholesterol diagnosis and statin use among low-risk women, higher odds of statin use among moderate-risk women, but lower odds of statin use among high-risk women. The latter results are puzzling but preliminary, requiring further replication. Overall, however, results clearly indicate that DTCA exposure does not appear to be linked to a greater likelihood of cholesterol diagnosis or statin use among those at the greatest risk for future cardiac events, for whom there is an established benefit.⁶

Study Limitations and Strengths

While control variables were included in our design, and a replication of the analysis with DTCA for antidepressants serves as a comparison, this study cannot make any claims regarding the causal direction of relationships between exposure to DTCA, high cholesterol diagnosis, and statin use. Although the survey question referenced being told by a doctor that a respondent had high cholesterol in the past 12 months, we cannot be certain that DTCA exposure preceded either a diagnosis or statin use. Our DTCA exposure measure is also limited in that we cannot be certain a respondent saw the ads they were potentially exposed to.

Our approach nevertheless improves upon previous studies assuming that all individuals in a media market are potentially exposed to an ad, regardless of their demographic characteristics or media use patterns.^{15–20} Our approach measures individual variation in exposure, while also taking market-level variation into account. Another advantage of our method is that respondents did not have to remember seeing an ad to be classified as potentially exposed, only whether or not they regularly view a particular program, network, and time. This reduces the likelihood of confounding by interest in health issues, which we suspect would be correlated with recall of a health-related message, but less likely to be linked to recall of broader media use patterns.

The survey's 35 % response rate raises questions about the study's generalizability. Our risk status variable is also subject to limitations. While we are confident that all respondents in the confirmed high-risk category are at elevated risk of future cardiac events, a proportion of non-confirmed respondents may also be at high risk. Data on LDL cholesterol, specific blood pressure readings, or family history of CHD were not available to permit a more accurate risk assessment and classification. Results should be interpreted with these limitations in mind.

Conclusions

This study provides no evidence of favorable associations between DTCA exposure and statin use among those at high risk for future cardiac events. Results raise questions about the extent to which DTCA may promote over-diagnosis and over-treatment for populations where risks may outweigh potential benefits.

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