Cigarette Smoking Status and the Association between Media Use and Overweight and Obesity

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For biologic and behavioral reasons, cigarette smokers weigh less than nonsmokers. Thus, cigarette smoking may modify the association between media use and obesity. The authors examined whether the association between media use and overweight and obesity was modified by cigarette smoking by analyzing 8,467 adults (>20 years) from the 1999–2002 National Health and Nutrition Examination Survey. Odds ratios and 95% confidence intervals of overweight and obesity were estimated by use of multinomial regression. To examine effect modification, the authors created separate regression models for smokers and nonsmokers ($p_{interaction} = 0.002$). Nonsmokers using media 4 or more hours daily were 3.9 times more likely to be obese (95% confidence interval (CI): 2.9, 5.2) and 1.6 times more likely to be overweight (95% CI: 1.3, 2.0) compared with those reporting less than 1 hour/day of media use. Among smokers, media use 4 or more hours daily was not significantly associated with increased odds of obesity (odds ratio = 1.3, 95% CI: 0.8, 2.2) or overweight (odds ratio = 1.4, 95% CI: 1.0, 1.9). Media use was associated with overweight and obesity and modified by cigarette smoking. Cigarette smoking should be evaluated as an effect modifier in studies of media use and obesity.

body mass index; body weight; obesity; smoking; television

Overweight and obesity affect almost two thirds (65.1 percent) of US adults (1). Although obesity has many component causes, a combination of sedentary behaviors and unhealthy diet contributes to the increase in obesity prevalence (2) occurring over the past 20 years (3). In addition to the 25.4 percent of US adults who do no leisure-time physical activity (4), the sedentary behaviors of television viewing and computer use (i.e., media use) are increasing. In 1998, adults viewed an average of 1,551 hours of television per year, 42.1 percent of US households had a computer, and 26.2 percent of US households had Internet access (5). By 2003, 61.8 percent of US households had a computer, 54.6 percent of US households had Internet access, and hours of television viewing in 2006 were projected to be 1,726 (6). Generally, as media use increases, so does the prevalence of overweight and obesity (7–12).

To examine the association between television viewing and body mass index, researchers reporting in many studies have analyzed smoking status as a potential confounding variable. For example, cross-sectional studies have found that adults watching the most hours of television daily have almost twice the odds of obesity as those watching the least amount of television, after adjustment for smoking, physical activity, and other covariates (7, 10, 11). A longitudinal study, adjusting for smoking, physical activity, and diet, found a 23 percent increase in obesity with each 2-hour/day increase of television viewing among women (12). Some studies using smoking as a confounding variable have found little difference in the results once smoking was included in the model (10–12). In an evaluation of studies on the association between media use and overweight or obesity, we did not find any studies that examined cigarette smoking as an effect modifier.

Abbreviations: CI, confidence interval; NHANES, National Health and Nutrition Examination Survey; OR, odds ratio.
The association between media use and overweight or obesity, however, may be different for those who smoke cigarettes as compared with those who do not. Cigarette smokers weigh less than nonsmokers, because smoking inversely affects weight through biologic and behavioral mechanisms (13–17). Nicotine’s physiologic effects result in appetite suppression, increased resting metabolic rates, and reduced calorie storage (18–20). Smoking is related to decreased meal size (18), and some smokers may use smoking as a marker for meal termination (e.g., smoking rather than consuming dessert) or simply substitute cigarettes for meals altogether (20). Studies of weight gain and coronary mortality (21) and of body mass index and mortality (22) examined smoking status as an effect modifier and found that these associations vary by smoking status.

We used the 1999–2002 National Health and Nutrition Examination Survey (NHANES) to examine the association between media use (television viewing and computer use outside of work) and overweight or obesity among a representative sample of US adults. The primary research question was whether the association between level of media use and overweight and obesity was modified by cigarette smoking status.

MATERIALS AND METHODS

Data

NHANES is an ongoing national household interview survey of a representative sample of the US population. Survey data are released for public use in 2-year cycles. The survey uses both household interview surveys and medical examinations to assess the health and nutritional status of the US population. NHANES is designed as a stratified, multistage, probability sample, targeting the civilian, noninstitutionalized US population and oversampling persons of low income, adolescents, those aged 60 or more years, African Americans, and Mexican Americans. Data from NHANES were combined for two cycles (1999–2000, 2001–2002) to increase sample size and analytical options. Response rates to NHANES were 81.9 percent for the survey interview and 76.3 percent for the medical examination in 1999–2000 and 83.9 percent and 79.6 percent, respectively, in 2001–2002. Details about NHANES are provided elsewhere (23).

A total of 10,291 adults aged 20 or more years participated in the 1999–2002 NHANES; of these, 1,824 were excluded from analyses because they were pregnant (n = 559) or because of missing data on body mass index (n = 1,232), media use (n = 12), cigarette smoking status (n = 11), or physical activity levels (n = 10), leaving a study population of 8,467 participants.

Body mass index

Height and weight were measured in the NHANES Mobile Examination Center. Standing height was measured with a fixed stadiometer, and body weight was measured on a Toledo digital scale (24). Body mass index was calculated as weight (kg)/height (m)^2. Adults were categorized as having normal weight (body mass index: <25), being overweight (body mass index: 25.0–29.9), or being obese (body mass index: ≥30) (25).

Media use

Participants were asked about typical daily hours of media use by the question, "Over the past 30 days, on a typical day, how much time altogether did you spend on a typical day sitting and watching television or videos or using a computer outside of work?" Response categories (hours) were as follows: less than 1, 1, 2, 3, 4, 5 or more hours, or none. Media use was categorized for analysis as less than 1, 1, 2, 3, or 4 or more hours.

Cigarette smoking

Respondents were asked, “Have you smoked at least 100 cigarettes in your entire life?” and “Do you now smoke cigarettes every day, some days, or not at all?” Respondents who answered that they had smoked at least 100 cigarettes and currently smoke cigarettes every day or some days were classified as smokers. Respondents who answered that they had not smoked at least 100 cigarettes or do not currently smoke cigarettes were classified as nonsmokers. Former smokers were defined as those who had smoked at least 100 cigarettes but do not currently smoke cigarettes. We analyzed former smokers (n = 2,253) and never smokers (n = 4,328) separately and found that the odds ratios for overweight and obesity among daily media use categories were not significantly different. Thus, we felt it appropriate to combine never and former smokers for analysis.

Physical activity

Measurement of leisure-time physical activity was derived from a series of eight questions inquiring about frequency and duration of moderate- and vigorous-intensity leisure-time physical activities. Participants were first asked, “Over the past 30 days, did you do any vigorous activities for at least 10 minutes that caused heavy sweating or large increases in breathing or heart rate?” Respondents who answered “yes” were handed a card with a list of 24 vigorous-intensity activities and an “other” category and asked to report the frequency and duration of each listed activity that they had done. For moderate-intensity activity, participants were asked, “Over the past 30 days, did you do any moderate activities for at least 10 minutes that caused only light sweating or a slight to moderate increase in heart rate?” Respondents who answered “yes” were handed a card with a list of 32 moderate-intensity activities and asked to report the frequency and duration of each listed activity that they had done. Participants were categorized as regularly active (vigorous-intensity activity for ≥3 days and ≥60 minutes per week or moderate-intensity activity for ≥5 days and ≥150 minutes per week), irregularly active (≥10 minutes of moderate- or vigorous-intensity activity per week but less than regularly active), and inactive (<10 minutes of moderate- or vigorous-intensity activity per week) (26).

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Energy intake

The total daily energy intake was estimated from a 24-hour dietary interview inquiring about the foods and beverages consumed during the 24 hours prior to the interview (27). Total energy intake was expressed in kilocalories and divided into quartiles for analysis. The energy intake variable was also transformed as the log of total kilocalories/day; analytical results (not shown) were equivalent to those from the quartile analysis. Because NHANES dietary assessments changed between 1999–2000 and 2001–2002 (nutrient values were revised, and the software used to calculate intakes was upgraded), we analyzed the 2001–2002 data separately to determine if this change affected the study results. Results were equivalent to those of the 1999–2002 analysis; therefore, we included both cycles of data in the analysis.

Demographics

Demographic information was collected by a questionnaire administered during the household interview. The variables analyzed were sex, age, race/ethnicity (White non-Hispanic, Black non-Hispanic, Mexican American, other), and education (less than high school, high school, more than high school).

Statistical analysis

Data were analyzed using SUDAAN, version 9.0, software (SUDAAN Statistical Software Center, Research Triangle Institute, Research Triangle Park, North Carolina) to account for the complex sample selection design and to weight the sample to the US population. Multinomial regression was used to calculate the odds ratios and 95 percent confidence intervals of overweight and obesity compared with normal weight by categories of media use. Physical activity, age, gender, race/ethnicity, education, and energy intake were examined as potential covariates in the regression model. Effect modification by cigarette smoking was evaluated by adding an interaction term (cigarette smoking status × media use) to a statistical model of media use, cigarette smoking, physical activity, age, gender, race/ethnicity, education, and energy intake. Separate models were then analyzed for smokers and nonsmokers to examine smoking status as an effect modifier of the association between media use and overweight or obesity.

RESULTS

Information on demographics, media use, physical activity, and body mass index by cigarette smoking status of the study population is provided in table 1. Cigarette smokers were more commonly men, were aged 20–34 years, had a high school education or less than a high school education, were inactive, had normal body weight, and were heavier users of media daily. In contrast, nonsmokers were more commonly women, had more than a high school education, were regularly active, and were lighter users of media daily than were smokers, and two thirds were overweight or obese. Cigarette smokers and nonsmokers were significantly different (p < 0.05) for all demographic characteristics except race/ethnicity. Obesity, media use, and physical activity differed between cigarette smokers and nonsmokers (table 2). The prevalence of obesity increased and regular physical activity decreased with more hours of daily media use in nonsmokers. Among nonsmokers, the prevalence of obesity doubled when comparing media use of less than 1 hour daily with media use of 4 or more hours daily. The prevalence of regular physical activity also decreased with increasing hours of daily media use in nonsmokers. In contrast, among
<table>
<thead>
<tr>
<th>Daily media use (hours)</th>
<th>&lt;1 hour</th>
<th>1 hour</th>
<th>2 hours</th>
<th>3 hours</th>
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<tbody>
<tr>
<td><strong>Nonsmokers</strong></td>
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<td><strong>Body mass index (kg/m²)</strong></td>
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<tr>
<td>Normal weight (&lt;25.0)</td>
<td>44.6</td>
<td>39.7, 49.6</td>
<td>40.2</td>
<td>35.7, 44.8</td>
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<td>Overweight (25.0–29.9)</td>
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<td>31.6, 38.1</td>
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<td>21.1, 29.6</td>
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<td>32.3, 40.6</td>
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<td>25.7, 34.1</td>
<td>32.2</td>
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<td>36.1, 51.8</td>
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<td>Overweight (25.0–29.9)</td>
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<tr>
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<td>Inactive</td>
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<td>35.9</td>
<td>29.3, 43.1</td>
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*Physical activity is defined as regularly active (vigorous-intensity activity for ≥3 days and ≥60 minutes per week or moderate-intensity activity for ≥5 days and ≥150 minutes per week), irregularly active (≥10 minutes of moderate- or vigorous-intensity activity per week but less than regularly active), and inactive (<10 minutes of moderate- or vigorous-intensity activity per week).
Table 3 shows the association between daily media use and overweight or obesity, with adjustment for cigarette smoking status (vs. normal weight) and demographic factors. The odds of overweight and obesity are significantly elevated with 2 or more hours of daily media use. Adding an interaction term (cigarette smoking status \(\times\) media use, \(p = 0.02\)) resulted in similar odds ratios for overweight and obesity but even higher odds ratios for obesity with increasing hours of daily media use.

Because effect modification by cigarette smoking was evident, data for smokers and nonsmokers were analyzed separately (table 4). Smokers with 4 or more hours of daily media use had nonsignificantly elevated odds ratios for overweight and obesity, after adjustment for demographics, physical activity, and energy intake, compared with smokers using less than 1 hour of media daily. Adjustment for the average number of cigarettes smoked per day in the past 30 days also did not change the results (data not shown).

Among nonsmokers, media use of 2 or more hours/day compared with less than 1 hour/day was significantly associated with being overweight or obese (table 4). After adjustment for demographics, physical activity level, and energy intake, nonsmokers using media 4 or more hours daily were significantly more likely to be overweight and almost 4 times more likely to be obese than were nonsmokers using media less than 1 hour daily. Adjustment for the average number of cigarettes smoked per day in the past 30 days also did not change the results (data not shown).

In this study, smokers did not have a significantly increased odds of obesity, even those smokers who used media 4 or more hours daily. A lower risk of obesity among smokers and nonsmokers using media 4 or more hours daily had nonsignificantly elevated odds of overweight and obesity. In contrast, nonsmokers who used media 4 or more hours a day were more likely to be overweight and almost four times more likely to be obese than were nonsmokers using media less than 1 hour daily. Adjustment for potential covariates—physical activity, energy intake, demographics—did not change the association between media use and overweight and obesity. This large discrepancy in the odds of obesity between smokers and nonsmokers who have several hours of daily media use points to smoking status as an effect modifier of the association between media use and obesity.

Research has shown that people who watch more television tend to consume more calories, have less healthy eating patterns, and are heavier than those watching less television (28, 29). Individuals may eat more while watching television because of the advertising cues for food and beverage products, some of which promote unhealthy products (30, 31). Physical activity is also lower among adults who watch more television (10–12), perhaps because the hours spent watching television displace time for participating in physical activity. Our analysis showed that the prevalence of regular physical activity was lower for both smokers and nonsmokers using media 4 or more hours daily than was the prevalence of physical activity for their counterparts using less than 1 hour of media daily. Although smokers in this study were heavier users of media than were nonsmokers, the prevalence of obesity was lower among smokers than among nonsmokers. This is consistent with studies that found that smokers watch more television than nonsmokers (32) and, in general, that smokers weigh less than nonsmokers (7, 14–17).

In this study, smokers did not have a significantly increased odds of obesity, even those smokers who use media 4 or more hours daily. A lower risk of obesity among smokers does not imply that smoking should be used as a weight control practice, as a lower body weight does not counteract the damaging effects of smoking (15). Of course, smoking by itself confers many enormous and well-documented health risks, such as increased risks for stroke, heart disease, and lung and other cancers, and a decreased life span (33).
<table>
<thead>
<tr>
<th>Media use by smoking status</th>
<th>Body mass index (kg/m²)</th>
<th>Body mass index (kg/m²)</th>
<th>Body mass index (kg/m²)</th>
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<tr>
<td>Unadjusted odds ratio</td>
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<tr>
<td>Nonsmokers (n = 6,581)</td>
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<td>Smokers (n = 1,886)</td>
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<td>&lt; 1 hour</td>
<td>1.0</td>
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<td>1 hour</td>
<td>1.1</td>
<td>0.8, 1.5</td>
<td>1.3</td>
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<td>2 hours</td>
<td>1.6</td>
<td>1.3, 1.9</td>
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<td>3 hours</td>
<td>1.7</td>
<td>1.4, 2.1</td>
<td>2.5</td>
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<td>4 hours</td>
<td>1.6</td>
<td>1.3, 2.0</td>
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<td>p linear trend</td>
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* Adjusted for physical activity, defined as regularly active (≥10 minutes of moderate- or vigorous-intensity activity per week) and inactive (<10 minutes of moderate- or vigorous-intensity activity per week), and demographics, defined as gender, age, race/ethnicity, and education.

** Adjusted for physical activity, demographics, and energy intake.
The odds ratios for the association between media use and overweight and obesity were not attenuated when physical activity and energy intake were added to the statistical models. The Nurses’ Health Study also found that increased television viewing was related to increased risk of obesity, independent of physical activity and other confounders (12), and other research of television use and obesity has found that elevated risks of obesity remained after adjustment for activity level (7–11). High levels of daily media use may have such a strong effect on weight that moderate levels of physical activity may not be enough to mitigate the effect of hours of daily sedentary behavior.

It seems counterintuitive, nevertheless, that smokers who are heavier users of media do not have higher body mass indexes than do smokers who are lighter users, and these physiologic and biologic explanations do not fully explain this lack of an expected relation. Television viewers may perform other activities while watching television (i.e., viewing is not always a passive activity) (34), but it is unknown whether this is different between smokers and nonsmokers. In addition, for some people, television is used to provide background noise and companionship in a manner similar to that of radio (34). One possible explanation for our study results could be that heavier smokers may use television or computers in different ways than do lighter smokers or nonsmokers. Research is needed to confirm or refute this or other hypotheses that can help to explain this apparent paradox.

Findings from this analysis suggest that researchers assessing the association between body mass index and media should test for effect modification of cigarette smoking. Merely adjusting for smoking in statistical models masks the smoker/nonsmoker difference in the association between media use and overweight and obesity. As this research indicates, the association is different for smokers and nonsmokers. In this study, including both smokers and nonsmokers in the same model and adjusting for smoking status as a covariate resulted in odds ratios for overweight that were attenuated from the results of the model with nonsmokers but larger than the results from the model with smokers. However, stratification of the data by smoking status produced quite different results for smokers and nonsmokers.

This study has several limitations. First, NHANES is a cross-sectional study. Thus, the causal relation between media use and overweight or obesity cannot be determined. Second, the questions to ascertain media use and physical activity have not been formally validated and may not accurately identify the respondents’ true behavior. If these behaviors were not properly ascertained, this may have resulted in the lack of attenuation in the models after controlling for physical activity and energy intake. Third, the questions do not address whether people were doing other activities, such as eating or doing housework, while they were watching television. Identifying if and what people eat while watching television or using the computer would allow further assessment of dietary behaviors. Fourth, television and computer use are combined in the same question. However, the activities can be quite different. Because the roles of advertisements and usage activities (i.e., sitting versus typing) are different for watching television and using the computer, separating television and computer use would allow analysis to indicate whether one or both of these activities are associated with overweight and obesity. Fifth, energy intake data from the 24-hour dietary recall may not have captured diet on a “typical” day.

In conclusion, increased media use is positively associated with overweight and obesity among nonsmokers but much less, if at all, among smokers. This association was not diminished by adjustment for physical activity, demographic variables, or energy intake.

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Conflict of interest: none declared.

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