Hold the Salt! Effects of Sodium Information Provision, Sodium Content, and Hypertension on Perceived Cardiovascular Disease Risk and Purchase Intentions

Elizabeth Howlett, Scot Burton, Andrea Heintz Tangari, and My Bui

Excessive sodium intake is a major cause of hypertension, a significant risk factor for several forms of cardiovascular disease, including coronary heart disease, stroke, and heart failure. Despite this finding, the average intake among Americans is 150% of the maximum recommended level. The goal of this research is to obtain greater consumer insight into this important public health issue. The authors analyze data from the National Health and Nutrition Examination Survey 2005–2006 and conduct two experiments using a nationwide panel of consumers. The results indicate that hypertension status has a significant effect on consumers' attention to sodium on the Nutrition Facts panel (Study 1) and moderates the influence of sodium disclosure on perceived cardiovascular disease risk and purchase intentions for restaurant items (Study 2). In addition, the authors find that sodium level on a Nutrition Facts panel interacts with the provision of health-related sodium educational materials to influence disease risk perceptions and purchase intentions (Study 3). They offer potential implications of their findings for public policy makers, the public health community, and consumers.

Keywords: sodium consumption, salt, hypertension, Nutrition Facts panels

The numbers are staggering. Data from the National Health and Nutrition Examination Survey (NHANES) for 2005–2006 indicate that 81.1 million people in the United States have some form of cardiovascular disease (CVD), the leading cause of death and disability worldwide (Lloyd-Jones et al. 2010). The most prevalent form of CVD, hypertension (i.e., high blood pressure), affects 73.6 million people and, along with smoking and high cholesterol, is a major risk factor for the other forms of CVD, including coronary heart disease, stroke, and heart failure. An additional 28% of adults suffer from prehypertension (i.e., systolic blood pressure 120–139 mm HG or diastolic blood pressure 80–89 mm HG and not pharmacologically treated). Fortunately, hypertension, often called the "silent killer" because its devastating effects can strike without warning, is a modifiable risk factor for CVD.

A diet low in sodium, along with regular exercise and maintenance of a healthy weight, can substantially reduce the likelihood of developing high blood pressure (Miller et al. 2002). The major source of sodium in the American diet is sodium chloride, better known as salt. While salt plays a major role in human health by helping the body maintain its fluid balance, too many consumers are getting far too much of a good thing; a reduction in excessive salt intake would save countless lives and substantially decrease health care costs. Palar and Sturm (2009) estimate that by decreasing sodium consumption to recommended daily value maximum levels, 11 million fewer Americans would suffer from high blood pressure, and health care spending could be reduced by $18 billion. Furthermore, although the overconsumption of sodium is most notably associated with hypertension, it also causes damage to the heart, arteries, and kidneys and contributes to the development of osteoporosis (Alwyn et al. 2010).

Not surprisingly, the health care and public policy communities have focused more attention on the problem of excessive sodium consumption. The British government initiated a program to reduce sodium consumption in 2003

Elizabeth Howlett is a Professor (e-mail: ehowlett@walton.uark.edu), and *Scot Burton* is a Professor and Wal-Mart Chair (e-mail: sburton@walton.uark.edu), Department of Marketing, Sam M. Walton College of Business, University of Arkansas–Fayetteville. *Andrea Heintz Tangari* is Assistant Professor of Marketing, Wayne State University (e-mail: andrea.tangari@wayne.edu). *My Bui* is Assistant Professor of Marketing, Loyola Marymount University (e-mail: My.Bui-Nguyen@lmu.edu).
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(Food Standards Agency 2009). While sodium intake has been substantially reduced in the United Kingdom, there is still a long way to go to bring sodium intake to recommended levels; manufacturers of consumer packaged foods in 80 product categories were asked to reduce sodium levels to even more challenging levels by 2012. Similar initiatives are taking place in Canada, Australia, and New Zealand and throughout much of Europe.

In the United States, the National Salt Reduction Initiative, a New York City–led partnership of cities, states, and national health organizations, recently unveiled its proposed targets to guide a voluntary reduction of salt levels in packaged and restaurant foods (New York City Department of Health and Mental Hygiene 2010). A report issued by the Institute of Medicine (2010) also concludes that national action to reduce salt intake is imperative; potential suggestions include reductions through actions by major food manufacturers, as well as special initiatives and regulatory options through government agencies (Food and Drug Administration [FDA] 2010).

Why are sodium intake levels so high, and what can be done about it? Before these questions can be answered, a better understanding of the factors that influence consumers' intentions to purchase, or avoid purchasing, relatively high-salt foods is needed. This knowledge should help contribute to the development, and improved effectiveness, of sodium reduction initiatives. Although those who already suffer from hypertension or borderline hypertension have much to gain by limiting their salt consumption, all consumers receive health benefits from adhering to recommended levels. This is because the negative effects of excessive sodium consumption appear to be cumulative (He 1999; Lichtenstein et al. 2006) and sodium affects health conditions other than hypertension (Alwyn et al. 2010).

Thus, the overall goal of our research is to provide information to help policy makers and health care advocates better understand consumers' attention to sodium and formulate more effective strategies to reduce sodium intake levels. We begin with a brief review of the issue. Then, we use the results of analyses performed on NHANES data to assess the extent to which consumers, both those who suffer from hypertension and those who do not, attend to sodium information on the Nutrition Facts panel (NFP) when making food purchases. This provides an indication of hypertensive and nonhypertensive consumers' attention to sodium content relative to other nutrients. Next, we present findings from two between-subjects experiments that use a nationwide panel of consumers.

Our research addresses two broad questions across three studies. First, how does a consumer's hypertension status influence his or her attention to sodium information? Second, how does providing consumers with sodium education information moderate the influence of sodium content level and hypertension status on perceived CVD risk and purchase intentions? We conclude with a presentation of our findings from these three studies and offer implications for consumers, policy makers, and consumer welfare advocates.

Background

As we noted previously, numerous studies across various populations have shown that age-related increases in blood pressure levels are directly related to excessive sodium intake (e.g., Havas, Dickenson, and Wilson 2007; Vasan et al. 2001; Whelton et al. 2002). The 2005 Dietary Guidelines for Americans recommend that, in general, adults should not consume more than 2300 mg of sodium daily. According to the new 2010 guidelines, people who are 51 years of age and older; are African American; or have hypertension, diabetes, or chronic kidney disease should further reduce their intake to 1500 mg. However, the average daily intake of sodium for Americans over 2 years of age is now 3436 mg, almost 150% of the maximum recommended level of 2300 mg (Centers for Disease Control and Prevention [CDC] 2009b) and more than twice the 1500 mg recommendation. Given the strong positive relationship between sodium intake and the development of hypertension, the potentially disabling and deadly consequences associated with CVD and hypertension, and the increasing prevalence of hypertension within the United States, it is not surprising that diverse regulatory and public health agencies are attacking this issue with increased fervor. Research has shown that decreasing sodium intake can both prevent the development of hypertension in healthy people and lower high blood pressure levels of those already diagnosed with hypertension or prehypertension (Lichtenstein et al. 2006). In turn, the risk of atherosclerotic cardiovascular events and congestive heart failure will be considerably reduced.

A healthy diet emphasizes fruits, vegetables, whole grains, no-fat or low-fat milk and milk products, lean meats, fish, poultry, and beans and is low in saturated fats, trans fats, cholesterol, sodium, and added sugar (U.S. Department of Health and Human Services [DHHS] 2005). Yet many consumers fail to follow this simple advice and instead consume a variety of processed foods. Furthermore, consumption of foods prepared outside the home continues to rise. This is unfortunate because the primary sources of salt in the American diet (approximately 77%) are processed and restaurant foods (Roberto, Agnew, and Brownell 2009). The natural salt content of food accounts for only approximately 10% of sodium consumption (U.S. DHHS 2005).

Hypotheses

Attention to Sodium Content

Although consumers can determine the sodium content of most processed foods and many restaurant menu items (albeit with greater effort), sales of foods that contain unhealthy levels of salt remain strong. It is unclear why this is the case. On the one hand, perhaps consumers are unaware of the "hidden" salt found in many foods, despite the availability of that information on NFPs and corporate websites. On the other hand, perhaps consumers know about the high sodium levels of many foods but do not care. In both cases, this may be due to a lack of understanding of the many long-term health-related consequences of cumulative, excessive sodium intake. Simply stated, many consumers may not consider sodium intake a personally relevant health issue (Bouwman, Koelen, and Hiddink 2008).

Indeed, prior survey research has suggested that typical consumers are relatively unconcerned about sodium content and may be less likely to attend to sodium information than calorie or fat levels (International Food Information Council [IFIC] 2009). In a national survey of more than 1000 consumers, 59% indicated that they were not concerned about their sodium intake. More specifically, increasing fiber and decreasing sugar were identified among the changes viewed as important steps toward a more healthful diet, and decreasing sodium intake was infrequently mentioned (IFIC 2009). Similarly, these IFIC data suggest that in general, consumers perceive nutrient information to vary in terms of its importance when asked to infer product healthfulness. Perhaps if more consumers fully understood the relationship between excessive sodium intake and both the development and exacerbation of hypertension, sodium intake levels would diminish.

To explore our specific research questions, we analyze data addressing attention to sodium and other nutrients from the NHANES 2005–2006 and conduct two experiments using nationwide samples of consumers. Given that consumers with hypertension already suffer from an ailment strongly influenced by diet, we expect them to be more attentive to nutrition information labeling. We base this assertion on the assumption that NFP information with cardiovascular-related health implications (e.g., sodium, saturated fat) is more personally relevant to consumers with hypertension (e.g., Bouwman, Koelen, and Hiddink 2008; Rothman and Schwartz 1998). Specifically, we expect consumers with hypertension to report paying greater attention to information in the NFP than consumers without hypertension. Prior research has shown that perceived personal relevance can have a significant influence on choice and evaluations by exerting certain cognitive and motivation influences (Jemmott, Ditton, and Croyle 1986). Given sodium's strong association with hypertension and that a food's sodium content level is more (less) personally relevant to consumers with (without) high blood pressure, for information provided on the NFP, the greatest difference in attention level between hypertensive and nonhypertensive consumers should be for sodium content.

H_1: Consumers with hypertension attend to sodium information on the NFP on food product packages more often than nonhypertensive consumers.

Influence of Sodium Disclosure on Perceived Risk and Purchase Intention

Following the same rationale regarding consumers' attention to sodium information in the NFP, we suggest that hypertension status influences how a food's sodium level affects perceived disease risk and purchase intentions. More specifically, if the consumer does not deem sodium to be personally relevant, not only is he or she unlikely to attend to NFP sodium information, but he or she also seems unlikely to give it much consideration during product evaluation and selection processes (Rothman and Schwartz 1998). Therefore, the disclosure of higher sodium content is unlikely to have any influence on the CVD risk perceptions and purchase intentions of consumers without high blood pressure; sodium is simply not a personally relevant nutritional issue (Bouwman, Koelen, and Hiddink 2008; IFIC 2009). However, given the strength of the positive association between hypertension and sodium intake, the sodium content of a food is likely to be a relatively important concern of those with hypertension.

H_2: Consumers' product evaluations are influenced by an interaction between the disclosure of sodium content and hypertension status. For hypertensive consumers, the disclosure of a food's sodium content affects (a) perceived CVD risk and (b) purchase intention. For consumers not diagnosed with high blood pressure, the disclosure of sodium content levels has no influence on perceived risk or purchase intention.

Study 1

Method

The NHANES is a cross-sectional study conducted continuously by the CDC, one of the largest operating components of the U.S. DHHS. To get a representative sample of the population, we used complex multistage probability sampling. Detailed descriptions of the data collection procedure are described elsewhere (CDC 2009a), and the NHANES website provides an especially rich description of the research methodology. A total of 12,862 people aged from less than 1 year to more than 80 years comprise the unweighted sample. However, given our interest in the relationship between hypertension status and sodium consumption, we only include participants aged 45 years and older to achieve more uniform cell sizes. Although hypertension can strike at any age, it more commonly affects older consumers. Our analyses contains 1798 total participants, with 922 (51.3%) reporting no hypertension and 876 (48.7%) reporting that they have high blood pressure. Approximately 54.6% (N = 981) of the sample are women and 45.4% (N = 817) are men. The sample represents a cross-section of Americans as follows: Mexican Americans, 10.8%; other Hispanic, 1.4%; non-Hispanic white, 61.3%; non-Hispanic black, 23.7%; and other or multiracial, 2.7%.

To assess attention to specific NFP information, participants were asked, "When you use the food label to decide about a food product, how often do you look for information about …?" Using this base question format, specific questions were asked about information available in the NFP including calories, calories from fat, saturated fat, sodium, and so forth. We measured responses on a five-point scale with endpoints of "always" (coded as 5) and "never" (coded as 1). To measure hypertension status, participants were asked, "Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?" Responses were coded as "yes" or "no."

Results

We analyzed data using a mixed analysis of variance in which hypertension status served as a between-subjects factor and nutrient type (e.g., sodium, fat, calories) was a within-subject factor. Because there is a significant impact of gender on the dependent measures but the interactions including gender are nonsignificant, we include it as a covariate. We expect consumers with hypertension to report that they look for NFP information more frequently than consumers

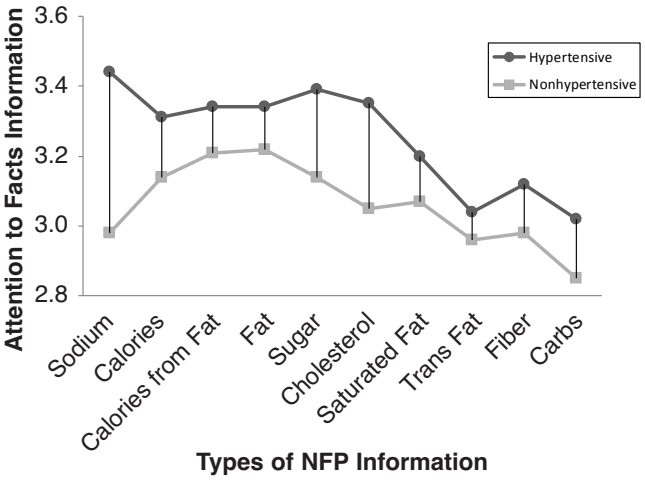
without hypertension and that differences in attention levels are greatest for sodium. The results show a significant interaction between hypertension status and nutrient type ($F(9, 1795) = 8.34$, $p < .01$). Figure 1 shows a plot of the interaction. Although in general, consumers with hypertension look for calorie and nutrient information more often than those without hypertension ($F(1, 1795) = 10.01$, $p < .01$), the strength of this positive association varies across nutrients. As we show in Figure 1, the greatest difference in attention level is for sodium ($F(1, 1795) = 43.46$, $p < .01$), consistent with H_1. Figure 1 also shows that consumers with hypertension look for sodium information (M = 3.44) significantly more often than all other nutritional information on the NFP, with the lone exception of sugar (M = 3.39). Sodium information is accessed more frequently than critical information linked to either CVD risk and/or weight control, such as calories (M = 3.31, $p < .05$), fat (M = 3.34, $p < .05$), and saturated fat (M = 3.20, $p < .05$). Among consumers without hypertension, sodium information is accessed significantly less frequently than calorie, saturated fat, and fat information ($p < .05$).

In addition to these findings, we also tested differences for consumers with high blood pressure who were on prescribed medication (90% of those with high blood pressure) and were not on medication (10%). Those on medication reported accessing sodium and cholesterol information significantly more often than those who were not on medication, but there were no differences for other nutrients.

Discussion

In support of H_1, consumers with hypertension attend to sodium information more frequently than consumers without hypertension. This pattern of differences between hypertensive and nonhypertensive consumers is also consistent across some (sodium, cholesterol, sugar, and calories), though not all (e.g., saturated fat, trans fat), nutrients with cardiovascular or weight-related health implications. This finding raises some concerns (e.g., why are so many at-risk consumers ignoring saturated and trans fat information?) that warrant further study.

Figure 1. Study 1: The Moderating Role of Hypertension Status on Attention to Different Nutrients in the NFP



Although Study 1 results provide support for H_1, they do not provide any insight into how the provision of sodium information influences consumers' disease risk perceptions and purchase intentions. In addition, while we conducted Study 1 within the context of NFP information, another primary source of salt in the American diet is food prepared in restaurants (Roberto, Agnew, and Brownell 2009). While one of the easiest and most effective ways to reduce sodium intake is to avoid both processed and restaurant foods with excessive amounts of added salt, practically, this is somewhat easier for consumers to do when purchasing processed food in a grocery store rather than when dining out. Sodium information is presented on the NFP of most packaged food products and is therefore easily accessible. Although many quick-service restaurant chains such as McDonald's and Subway have nutrition information available in stores (presented in brochures, pamphlets, posters, and so forth), it is seldom easily accessible and therefore unlikely to be utilized. Determining the sodium content of foods when dining at a typical table service restaurant (e.g., Olive Garden, Applebee's) can be even more challenging.

As the proportion of food dollars spent on away-from-home foods has grown, menu and menu board labeling has become a major policy issue across the country. Subsequently, restaurant menu labeling laws have been passed or implemented in cities (e.g., New York City, Seattle, Philadelphia) and states (e.g., Maine, Massachusetts, Oregon, California) across the country. Some localities (e.g., Philadelphia) require the provision of both calorie and sodium information. However, it should also be noted that the Patient Protection and Affordable Care Act (Pub. Law 111–148), signed into law in March 2010, mandates only the provision of calorie information on menus and menu boards of chain restaurants; information about sodium (and other nutrients) is only available on request. Thus, Study 2 examines the interaction between sodium information disclosure and consumer hypertensive status within the context of restaurant menu items from popular table-service restaurants.

Study 2

Method

Whereas Study 1 considers consumers' attention to nutritional information for packaged food products, Study 2 uses a $2 \times 2 \times 2$ mixed-factor design in the context of restaurant menu labeling. Sodium disclosure and hypertension status served as between-subjects factors, and the specific menu item served is a within-subject factor. Half the participants were presented menus with calorie information only, and half were provided menus with calorie, sodium, and saturated fat information. To assess hypertension status, participants were asked whether they had ever been told by a health professional that they have high blood pressure.

The two menu items were a grilled chicken sandwich (1240 calories) and fiesta lime chicken (1230 calories). The menu also presented brief descriptions of the items (e.g., "grilled chicken sandwich with applewood smoked bacon, Swiss and honey mustard dressing on a sesame seed or

wheat bun"); item presentation order was counterbalanced across participants. While both items were similar in calories (1240 and 1230, respectively) and saturated fat (14g and 16g, respectively), they differed substantially in terms of sodium level. The grilled chicken sandwich had 2510 mg of sodium, while the fiesta lime chicken item contained 4390 mg of sodium. These specific calorie and nutrient values were based on menu items served by national table service chain restaurants. Note that both items have high sodium levels (more than the recommended value level for a day), and thus this design offers a strong test of the effects of sodium level on the purchase intentions of nonhypertensive consumers for whom sodium is less personally relevant (Bouwman, Koelen, and Hiddink 2008).

The first dependent measure, perceived CVD risk, comprised two items, and each used a seven-point scale (1 = "strongly decrease risk," and 7 = "strongly increase risk") (Howlett, Burton, and Kozup 2008). Participants considered whether the meal, if consumed regularly, would increase or decrease their likelihood of (1) developing high blood pressure and (2) having a stroke. Responses to these questions were highly correlated (r = .92, $p < .0001$), and higher values indicate higher perceived risk. The second dependent measure, purchase intentions, also used two items. Participants were asked, "Given information on the menu, how likely are you to buy the (item name)?" Endpoints used were "very unlikely/very likely" and "very improbable/very probable." The correlation between the items was .98 for each of the two menu items. Study participants consisted of 189 adult consumers who were 40 years of age or older (average age was 53 years). Slightly more than one-half (53%) were women, and the median and modal education level was "some college." Participants were recruited through a national online marketing research panel, and the study was administered online.

Results

Table 1 presents the results of the mixed-design analyses of variance. Our concern focuses on whether the disclosure of more complete nutrient information, including sodium, on restaurant menus affects consumers' product evaluation processes differently than the provision of calorie information alone. More important, does hypertension status significantly influence the strength of these effects? As we predict in H_2, there is a significant interaction between hypertension status and sodium disclosure for CVD risk ($F(1, 185) = 4.24$, $p < .05$). As we show in Figure 2, the disclosure of sodium, in addition to disclosed calorie information, influences perceived CVD risk of only those consumers with hypertension. For consumers with hypertension, planned contrasts show that the perceived risk of CVD increases when there is a sodium disclosure on the menu ($F(1,185) = 22.7$, $p < .001$). As we shown in the top of Figure 2, this is not the case for consumers without hypertension ($F(1, 185) = 2.92$, $p > .05$).

The plot for purchase intentions is shown at the bottom of Figure 2. As Table 1 shows, the interaction between hypertension status and sodium disclosure approaches significance ($F(1, 183) = 3.63$, $p = .058$). Similar to CVD risk, Figure 2 shows that the addition of information included on a restaurant menu with the calorie level does not affect the purchase intentions of consumers without hypertension ($F(1, 183) < 1$). However, for consumers diagnosed with high blood pressure, the disclosure of a menu item's sodium content significantly reduces purchase intentions ($F(1, 183) = 6.48$, $p < .02$). These findings extend the results of Study 1. When the consumer has been diagnosed with hypertension, the disclosure including sodium has a greater influence on

Table 1. Study 2: Effects of Menu Labeling Condition and Hypertension on CVD Risk Perceptions and Purchase Intentions

	Analysis of Variance F-Values	
Independent Variables	**CVD Risk Perceptions**	**Purchase Intentions**
Main Effects		
Menu label condition (ML)	20.53***	2.51
Hypertensive status (HS)	2.11	.02
Item type (IT)	4.79**	31.87***
Interaction Effects		
ML × HS	4.24**	3.63*
ML × IT	11.41***	5.11**
HS × IT	1.5	.02
ML × HS × IT	1.03	.71

*$p < .06$.
**$p < .05$.
***$p < .01$.

Figure 2. Study 2: The Moderating Role of Hypertension Status on the Effect of Menu Disclosure Condition

A: CVD Risk Perceptions

B: Purchase Intentions

his or her disease risk perceptions and purchase intentions. While Study 1 results indicate that hypertension status influences attention to NFP sodium information on product packaging, Study 2 findings show that hypertensive status also affects attention to sodium content levels during product evaluative processes of restaurant menu items.

Table 1 also shows a significant interaction between the nutrition disclosure and the specific menu item. Recall that while both items had similar calorie and saturated fat levels and relatively high levels of sodium, one item had a much higher sodium level than did the other. Results of the analyses show that while the additional nutrition information disclosure increases perceived CVD risk of both menu items, the effect is stronger for the higher-sodium item. For purchase intentions, disclosing sodium significantly decreases purchase intentions only for the higher-sodium item.[1]

Discussion

Study 1 results indicate that consumers with hypertension are more attentive to sodium information than consumers without hypertension, demonstrating this within the context of NFP information search. Study 2 extends these findings to a different context and methodology, a menu labeling experiment. The results show that hypertensive and nonhypertensive consumers respond differently to sodium information disclosure on a menu. Although sodium levels are high for both restaurant menu items (e.g., Center for Science in the Public Interest [CSPI] 2009), the purchase intentions of nonhypertensive consumers are not affected by the enhanced disclosure that includes sodium information. Thus, the pattern of results suggests that nonhypertensive consumers are not attentive to sodium information and consequently that information is not integrated into their product evaluation and choice processes.

These findings have important policy implications. The effects of excessive sodium intake are cumulative, and therefore it is important that all consumers (especially those middle-aged and older) limit their consumption of salty foods (Lichtenstein et al. 2006). Thus, while Studies 1 and 2 employ very different contexts and methodologies, both suggest that many consumers would benefit from a better understanding of the cumulative negative health effects of excessive sodium intake. In addition, while the grilled chicken sandwich had a more favorable sodium level than the fiesta chicken, it still had more than a day's worth of sodium, which is not an uncommon finding in dinner house restaurants (e.g., CSPI 2009). Surprisingly, the disclosure of sodium information did not have a significant effect on purchase intention for this item. This suggests that both hypertensive and nonhypertensive consumers may have some difficulty interpreting and using absolute values of sodium. Thus, both consumer segments may benefit from a sodium education campaign.

[1]While the pattern of results suggests a potential mediating role of CVD risk for the effects on purchase intentions, the mixed design that includes a within-subject factor restricts the use of regression-based testing for potential mediation. Given the pattern of findings, we explicitly propose and test the mediating role of CVD risk in Study 3.

Study 3

We conducted a third study to provide insight into the potential impact of a health-oriented sodium education campaign. If consumers better understood the negative health implications associated with long-term, excessive sodium intake, would sodium become more personally relevant and thus have a greater influence on consumers' evaluative processes? Therefore, the final experiment extends our prior research by addressing how purchase intentions and perceived CVD risk are influenced by sodium level, the provision of health-oriented sodium educational materials, and hypertension status. From a health perspective, less sodium is preferable to more sodium, so in general, we expect purchase intentions to be greater and perceived risk to be lower for the lower-sodium food. Regarding the presentation of educational materials, we suggest that it may play two roles. First, it may remind consumers about the link between salt consumption and hypertension that may not have previously been in their top-of-mind awareness during product evaluation processes. Second, many adult consumers may be unaware that everyone should be concerned about excessive sodium consumption, not just those who have already been diagnosed with high blood pressure. In this case, the provision of health-oriented information will be educational; purchase intentions should diminish, and diet-related disease risk perceptions should increase.

Although such main effects are important for consumer health and policy concerns, our primary interest focuses on potential interactions. We propose that the joint effect of hypertension status and product sodium level on the dependent measures is moderated by the provision of health-related sodium educational materials. Prior research has suggested many consumers lack the knowledge to attend to daily value information in a meaningful way (IFIC 2008, 2009; Viswanathan and Hastak 2002). Given the strength of the relationship between excessive sodium intake and high blood pressure, consumers who suffer from hypertension are likely to have greater knowledge of the health-related risks associated with a high-salt diet. This is because the first piece of advice often given to people diagnosed with hypertension is to limit sodium intake (Havas, Dickinson, and Wilson 2007). Therefore, they are more likely to be in the habit of attending to sodium content levels when making consumption choices than nonhypertensive consumers. Consistent with our prior findings and with H_2, hypertensive consumers are less likely to benefit from a sodium education campaign than nonhypertensive consumers. Even without the provision of educational materials, hypertensive consumers are more likely to be attentive to sodium levels, given the personal relevance of that information. Conversely, nonhypertensive consumers are less likely to be attentive to sodium content when sodium-related educational materials are not presented. Given the low perceived personal relevance of sodium implied by our results from Studies 1 and 2, we expect consumers in this segment to be more attentive to calories, other nutrients (e.g., fat, saturated fat), or specific product features (e.g., perceived taste, price). This suggests the following three-way interaction:

H_3: The provision (vs. absence) of health-related sodium educational materials moderates the interactive effects of hyper-

tension status and product sodium level on consumer evaluations. For nonhypertensive consumers provided with educational materials, higher product sodium levels have (a) a stronger negative effect on purchase intentions and (b) a stronger positive effect on CVD risk. The impact of the provision of educational materials on the effects of sodium level is less pronounced for hypertensive consumers.

Prior research has demonstrated that the effect of nutrition-related attributes (e.g., calorie content) and personal characteristics (e.g., health consciousness, motivation) on purchase intentions may be mediated by other product-related beliefs (Burton, Andrews, and Netemeyer 2000; Howlett, Burton, and Kozup 2008). In this study, we expect perceived CVD risk to mediate, or partially mediate, the effects on purchase intentions we hypothesized previously. That is, we predict the main and moderating effects of the independent variables on purchase intention to be partially or fully mediated through their influence on consumers' perceptions of personal CVD risk.

H_4: Perceived CVD risk mediates (a) the main effects of health-related sodium educational materials, sodium level, and hypertension status on purchase intentions and (b) the interactive effects between provision of health-related sodium educational materials, sodium content level, and hypertension status on purchase intentions.

Method

Overview

Consistent with Study 1, we examined sodium levels in the context of a packaged food item. We chose "frozen quick meals" (i.e., frozen, microwaveable dinners) as the target food category for several reasons. First, the U.S. market for frozen dinners/entrées is substantial; sales in 2005 were more than $8.6 billion (Packaged Facts 2006). Therefore, we chose this product because it is consumed across a variety of age, gender, lifestyle, and socioeconomic segments (Packaged Facts 2006). In addition, because frozen dinners typically comprise a complete meal, they have often been used in nutrition-related experiments (Ford et al. 1996; Keller et al. 1997; Kozup, Creyer, and Burton 2003; Levy, Fein, and Schucker 1996). Finally, sodium levels of frozen dinners vary substantially, which enabled us to create realistic experimental stimuli.[2]

Experimental Design

The design was a 2 (hypertension status: hypertensive vs. nonhypertensive) × 2 (sodium content level: high vs. low) × 2 (health-related sodium educational materials: provided vs. not provided) between-subjects factorial design. Sodium content level was manipulated in the NFP presented on the back panel package mock-up. In the lower-sodium condition, the meal contained 480 mg of sodium (i.e., 20% of the maximum recommended daily amount of sodium as noted on the NFP), while in the higher-sodium condition, the meal contained 1800 mg of sodium (i.e., 75% of the maximum recommended daily level). All other nutrient values in the panel were invariant across conditions. (For an example of the back-of-the-package stimuli, see Appendix A. The front panel of the package was invariant and is available on request.)

To determine hypertension status, participants were asked to indicate whether they had ever been diagnosed with high blood pressure; affirmative answers were coded as 1, and negative answers were coded as –1. For the sodium educational material manipulation, half the participants were presented with a brief 400-word essay that highlighted the relationship between excessive sodium consumption and the development of hypertension; sodium-related package claim guidelines (e.g., low sodium, very low sodium) were also discussed. The other participants were presented information about credit card fraud and identity theft.

Measures

We needed a specific sodium knowledge measure to determine whether the sodium education manipulation was effective. Therefore, we developed 12 multiple choice questions to assess consumers' health and marketing knowledge about salt (e.g., "For an average consumer, what is the Recommended Daily Intake (RDI) for sodium?" "Risk of high blood pressure is most likely to be reduced by eating a diet with…"). We used two primary sources of information to develop the measure: an article published in *Journal of the American Medical Association* (Havas, Dickinson, and Wilson 2007) and a food labeling guide prepared by the FDA (U.S. DHHS 2008).

We used two dependent measures in the analyses. The first measure, perceived CVD risk, comprised two items, each using a seven-point scale (1 = "strongly decrease risk," and 7 = "strongly increase risk") (Howlett, Burton, and Kozup 2008). Participants considered whether the meal, if consumed regularly, would increase or decrease their likelihood of (1) having a stroke and (2) increasing blood pressure. Responses to these questions were highly correlated ($r = .92$, $p < .0001$). Higher values indicate greater perceived vascular disease risk. Drawn from prior research, the second measure, purchase intention, comprised three items, each with a seven-point scale (Burton et al. 2006). For example, respondents were asked the following question: "How likely would you be to purchase the product, given the information shown?" (anchored by "very unlikely" and "very likely") ($\alpha = .98$). Higher values indicate greater purchase intentions. Note that for both these dependent measures, we summed items and then divided them by the number of items; we then used these means in subsequent analyses.

Participants and Procedure

Members of a nationwide Internet research panel served as participants. Data were collected from 321 respondents, and the data collection was restricted to consumers at least 45 years of age because the prevalence of high blood pressure tends to increase with age. Ages ranged from 45 to 77 years,

[2]For example, consistent with the high-sodium condition for our turkey-based frozen dinner stimulus, one serving of Boston Market's "Turkey Breast Medallions with Stuffing" has 1870 mg of sodium per serving, which is 78% of the recommended maximum daily value. In contrast, consistent with our low-sodium condition, Healthy Choice's "Slow Roasted Turkey Medallions with Vegetables" has only 460 mg of sodium (19% daily value) per serving.

with a mean age of 56 years. Approximately 36% (64%) of the sample were men (women), and 37% reported that they were currently being treated for hypertension.

First, a brief set of instructions was presented. Then, respondents were given a 400-word article about the health risks associated with a high-sodium diet (sodium education condition; see Appendix B) or a 400-word article on the dangers associated with identity theft (sodium education control). Respondents read the articles at their own pace and proceeded with the study upon completion. Next, a package mock-up (both front and back panels) of the product was presented. The front and back panels of the package mock-up were shown simultaneously, with the front panel appearing above the back panel. Finally, respondents answered a series of questions about the meal product, completed the 12-item measure designed to assess the effectiveness of the educational material manipulation, and provided demographic information.

Results

Initial Checks and Preliminary Analyses

First, we examined the effectiveness of the sodium educational material manipulation. The test comprised 12 multiple choice questions; correct responses were recoded as 1 and incorrect responses as 0. We summed items to create an overall index score with a theoretical range between 0 and 12. We attempted to determine if the article was an effective means for educating consumers about the potential negative health implications of excessive salt intake. As we expected, participants who read the article were more knowledgeable, as evidenced by a greater percentage of correct answers on the sodium information measure, than participants in the control condition (Ms = 7.0 vs. 5.2; $F(1, 313) = 50.4$, $p < .0001$). We also examined the effect of the sodium level manipulation on sodium perceptions (seven-point scale, anchored by "low" and "high"). The sodium level shown in the NFP had a significant effect on consumer perceptions of sodium ($F(1, 313) = 21.7$, $p < .001$), while not affecting perceptions of calories, fat, saturated fat, or sugar levels ($p > .10$ for all). In addition, these sodium perceptions were not affected by either the consumer's hypertension status ($F(1, 313) = 1.9$, $p > .15$) or the provision of health-related sodium educational materials ($F(1, 313) = .16$, $p > .15$).

Tests of Hypotheses

We expect consumers' purchase intentions and CVD risk perceptions to be influenced by both main and interaction effects. H_4 also predicts the mediating influence of perceived CVD risk. To test our predictions, we followed procedures that Muller, Judd, and Yzerbyt (2005) and Baron and Kenny (1986) recommend: We initially tested them using three primary regression models with independent variable levels coded as –1 and +1 (Irwin and McClelland 2001) and with follow-up tests for possible mediation. We mean-centered perceived CVD before creating the interaction terms involving perceived CVD.

Given that our primary focus was on the moderating effects of hypertension status and the sodium educational materials, we did not make explicit predictions regarding the main effects of the independent variables on the dependent measures. However, given the results of the prior studies, we expect that consumers' purchase intentions and perceived CVD risk will be influenced by sodium content level, hypertension status, and the educational material manipulation. The regression models (see Models 1 and 2 in Table 2) test the main effects of the manipulations and the potential moderating roles of sodium educational material provision and hypertension status on consumers' purchase intentions and CVD risk perceptions, respectively. As we expected, purchase intentions are greater when (1) sodium level is low ($\beta = –.20$, $t = –3.69$, $p < .001$), (2) con-

Table 2. Study 3: Tests of the Moderating Role of Sodium Educational Materials and the Mediating Role of Perceived CVD Risk

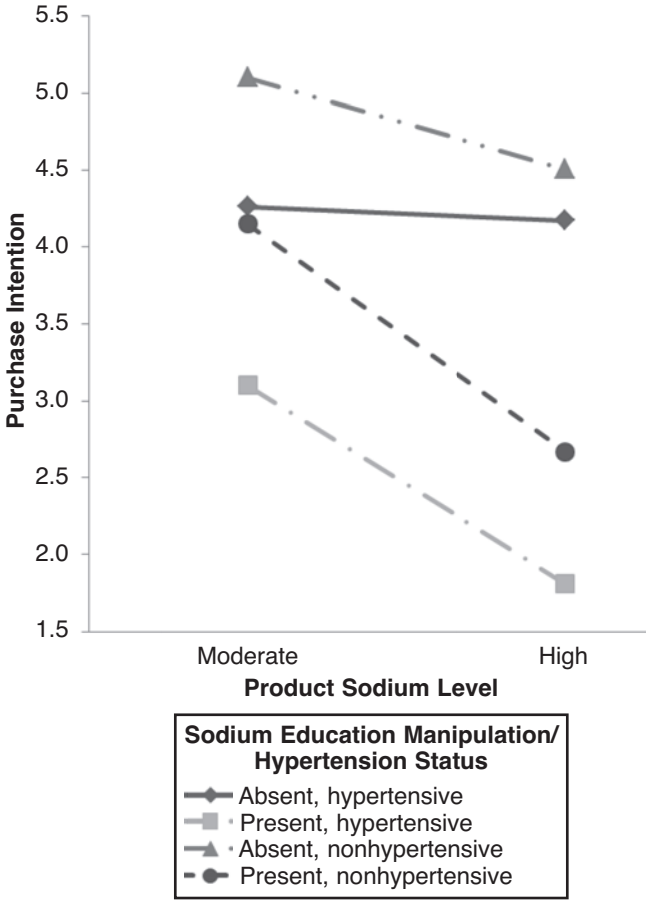
	Model 1: Purchase Intention		Model 2: Perceived CVD Risk		Model 3: Purchase Intention	
Independent Variables	**Standardized Coefficients**	**t-Values**	**Standardized Coefficients**	**t-Values**	**Standardized Coefficients**	**t-Values**
Hypertension status (HTS)	–.17	–3.30***	.13	2.44*	–.14	–3.04**
Education manipulation (EM)	–.36	–6.77***	.22	3.98***	–.25	–5.25***
Sodium level (SL)	–.20	–3.69***	.19	3.44***	–.10	–2.14*
HTS × EM	–.04	–.78	– .02	–.30	–.04	–.73
HTS × SL	.04	.72	–.17	–3.04**	–.06	–1.23
EM × SL	–.12	–2.24*	.14	2.60**	–.01	–.16
EM × SL × HTS	–.02	–.33	.03	.55	–.06	–1.16
CVD × EM					–.13	–2.71**
CVD × HTS					–.03	–.63
CVD × SL					–.03	–.53
Perceived CVD risk					–.52	–10.83***

*$p < .05$.
**$p < .01$.
***$p < .001$.
Notes: Model 1 assesses effects on purchase intentions. Model 2 assesses effects on perceived CVD risk (the potential mediator). Model 3 addresses effects on purchase intention when the proposed mediator (perceived CVD risk) and the interactions with the mediator are also included as a predictor. The analysis for Model 3 includes all higher-order effects, but for ease of reporting, we include only the most relevant effects in the table.

sumers are not being treated for hypertension (β = –.17, t = –3.30, $p < .001$), and (3) consumers have not received educational material (β = –.36, t = –6.77, $p < .0001$). In addition, as shown in Model 2, perceived CVD risk is higher when (1) sodium level is high (β = .19, t = 3.44, $p < .001$), (2) consumers are being treated for hypertension (β = .13, t = 2.44, $p < .015$), and (3) consumers received educational material (β = .22, t = 3.99, $p < .0001$).

H_3 predicts a three-way interaction of the sodium educational material manipulation, sodium content level, and hypertension status. We expect educational materials to moderate the interactive effects of hypertension status and sodium level on consumer evaluations. When educational materials are provided, we expect purchase intention to be lower and perceived CVD risk to be higher for the higher-sodium product, but only for the nonhypertensive consumers. Contrary to this expectation, H_3 was not supported. However, the results of the analyses indicate a two-way interaction between the education manipulation and sodium level (t = –2.24, $p < .05$). As the bottom two lines in Figure 3 show, the presence (vs. absence) of sodium educational materials reduced purchase intentions for the higher-sodium product for both hypertensive and nonhypertensive consumers. For the nonhypertensive consumers, as sodium levels increased, purchase intention means fell from 4.15 to 2.67 (F = 12.6, $p < .001$), while for the hypertensive consumers, means fell from 3.10 to1.81 (F = 7.24, $p < .01$). Thus, the plot shows that the provision of educational materials has a favorable effect for both nonhypertensive and hypertensive consumers. However, note that when hypertensive consumers were provided with information, purchase intention for the products varying in sodium level is, in general, lower.

Figure 3. Study 3: The Moderating Role of Sodium Education on Hypertension Status and Sodium Product Disclosure Level on Purchase Intentions



This pattern of results is also consistent for perceived personal CVD risk. There is a significant two-way interaction between the education manipulation and sodium level (t = 2.60, $p < .005$) and between hypertension status and sodium level (t = –3.04, $p < .005$). For both consumers with and without hypertension, perceived CVD risk is substantially higher for the high-sodium product than for the low-sodium product, but only when educational materials were presented. Likewise, and consistent with H_2, perceived CVD risk is substantially higher for the high-sodium product than for the low-sodium product, but only for those participants with hypertension. For consumers not diagnosed with high blood pressure, sodium content levels have little influence on perceived CVD risk.

Test of the Mediating Role of CVD Risk

The final hypothesis focuses on the potential mediating effects of perceived CVD risk. For testing mediation, we follow procedures outlined by Muller, Judd, and Yzerbyt (2005). The results shown in Table 2, Model 1, indicate that hypertension status, the education manipulation, sodium content level, and the education manipulation × sodium level interaction influence purchase intentions. There is no significant hypertension status × sodium level interaction ($p > .10$). Therefore, we do not further test the potential mediating effects of this interaction hypothesized in H_4. Next, as we show in Table 2, Model 2, there are main effects for hypertension status, the sodium educational material manipulation, sodium content level, and the education manipulation × sodium level interaction on the proposed mediator, perceived CVD risk ($ps < .05$ or better). Third, there is a significant effect of perceived CVD risk (the mediator) on purchase intentions (β = –.52, $p < .0001$), as we show in Model 3.

Differences between Models 1 and 3 assess whether the impact of the predictor variables on the dependent variable is reduced after including the mediator, perceived CVD risk, in the regression model. As results in Model 3 show, the coefficients for the main effects of hypertension status and the provision of educational materials, though still significant, are reduced with the inclusion of the mediator in the model. In addition, the effects of sodium content level and the moderating impact of educational material on sodium content level effects are no longer significant, indicating mediated moderation. To ensure significance of the mediating effect of perceived CVD risk, we also performed Sobel tests (Baron and Kenny 1986, Sobel 1982). The results of the Sobel tests show a statistically significant indirect effect associated with the mediator for the effect of sodium content level (z = –3.29, $p < .001$), hypertension status (z = –2.39, $p < .02$), the education manipulation (z = –3.75, $p < .001$), and the moderating effect of education on

the impact of sodium content level ($z = -2.52$, $p < .02$) on purchase intention. These results support the mediating effect of perceived CVD risk, with the exception of the hypertension status × sodium level interaction. They offer support for H_{4a} and partial support for the mediated moderation predicted in H_{4b}.

Although not hypothesized, Model 3 results shown in Table 2 also reveal an interaction between the perceived risk of CVD and the provision of educational materials ($\beta = -.14$, $t = -3.12$, $p < .01$). This finding indicates that the effects of perceived CVD risk on purchase intentions has differing effects depending on whether educational materials are provided. More specifically, the effect of perceived CVD risk on purchase intention is stronger (more negative) when educational materials are provided than when that information is not available. Overall, this pattern of findings highlights the important influence disease-related risk perceptions have on consumers' purchase intentions as consumers are made aware of the relationship between long-term, excessive sodium consumption and the development of hypertension.

General Discussion

Conclusions and Implications for Public Policy and Consumer Health

Put simply, Americans consume too much salt. Reducing the average daily intake of sodium to 2300 mg could potentially prevent almost 100,000 deaths and 66,000 strokes per year and save billions of dollars in health care costs (Liebman 2010; Palar and Sturm 2009). Unfortunately, only approximately 20% of the U.S. population currently follows the recommended level. Reducing sodium intake can provide both health and financial benefits; health interventions designed to reduce sodium intake are estimated to be more cost-effective than medications used to reduce high blood pressure (Bibbins-Domingo et al. 2010). For Americans without high blood pressure, keeping sodium intake levels at more healthful levels can diminish the likelihood of developing hypertension later in life.

Momentum to develop and implement public policy initiatives to reduce excessive salt consumption is rapidly gaining strength. In 2010, two members of Congress, Senator Tom Harkin and Representative Rosa DeLauro, urged the FDA to move quickly to address this problem (Layton 2010). The purpose of this research is to provide some additional insight into why sodium intake levels are excessively high and address several questions raised by the Institute of Medicine regarding factors related to consumers' attention to product sodium. The first study analyzes data from the NHANES and indicates that consumers diagnosed with hypertension attend to sodium information on the NFP more frequently than nonhypertensive consumers. In addition, as we show in Figure 1, relative to the other types of nutrient information found on the NFP, hypertensive consumers report attending to sodium information most frequently. This study suggests the *potential* impact of sodium information provision. However, note that the mean frequency of sodium search only reaches 3.4 on a five-point scale. The results also indicate that consumers without hypertension do not look for sodium information on the NFP very frequently. Attention to calories, fat, calories from fat, and sugar all exceed attention to sodium level. Given the cumulative effects of excessive sodium intake, nonhypertensive consumers' failure to attend to sodium content levels may potentially create significant future health problems (Lichtenstein et al. 2006).

Study 2 explores consumers' attention to sodium disclosures in the context of restaurant menu items. The results of this study show that the disclosure of sodium levels for high-sodium foods (added to a disclosure that includes only calories) affects the purchase intentions and perceived CVD risk for hypertensive consumers but not for nonhypertensive consumers. Consistent with Study 1, the findings suggest that there is a substantial opportunity to increase nonhypertensive consumers' attention to sodium. In addition, while the disclosure of sodium level significantly decreases purchase intentions for hypertensive consumers, purchase intentions remained relatively high (mean of 3.83 on a seven-point scale) for these restaurant items even though they contain more than a full day's worth of sodium. These findings suggest that there is an opportunity for greater integration of sodium content into the product evaluation processes of hypertensive, as well as nonhypertensive, consumers.

Given that findings from Studies 1 and 2 indicate that consumers may benefit from a better understanding of the relationship between excessive sodium intake and the development of chronic diseases such as hypertension, Study 3's purpose is to determine whether the provision of health-related sodium education materials increased the impact of sodium content levels. The sodium education manipulation had favorable effects (e.g., lower purchase intentions, higher CVD risk perceptions) for both hypertensive and nonhypertensive consumers. While purchase intentions are lower for hypertensive consumers than for nonhypertensive consumers across conditions, the pattern of results in Study 3 suggests that an education campaign could benefit all consumers by raising their consideration of sodium content information. This pattern follows from Study 1 and Study 2 results, which show that while there is greater attention to sodium from hypertensive consumers, their mean purchase intention levels in Study 2 and attention to NFP sodium information in Study 1 suggest a substantial opportunity for improvement.

Given that media coverage and recent health promotions have tended to emphasize calories and negative nutrients such as saturated and trans fat, the relative need to increase attention to excessive sodium levels (without further education about health consequences) probably is not surprising to many health care professionals. Attending to and using sodium levels in evaluations for packaged goods may be more challenging because it is listed well after several other nutrients on the NFP and thus may get lost among the other pieces of information. Furthermore, relative to the other nutrient levels, sodium content levels are typically larger (milligram levels in the hundreds or thousands) and thus may be more difficult for many consumers to interpret. In most U.S. markets, such difficulties are exacerbated for restaurant items, for which sodium information must be obtained online or specifically requested at the point of purchase.

From a consumer health and policy perspective, these effects associated with the provision of sodium educational materials and the mediating effect of perceived CVD risk suggest that a highly effective public relations campaign emphasizing the health-related impact of sodium may be of potential benefit to many consumers. Specific reasons that even nonhypertensive adults should monitor sodium intake in the context of their daily diets should be articulated. Similarly, physicians and other health care providers' communication efforts could effectively spur middle-aged (or older) consumers who are not hypertensive yet are at risk for hypertension in the long run to give greater consideration to sodium levels (Lichtenstein et al. 2006). The results also suggest that there are substantial benefits to hypertensive consumers from such a public relations campaign. If feasible, sodium point-of-purchase information for product categories typically high in sodium would be of potential benefit to both hypertensive and nonhypertensive consumers.

There also may be some specific concerns about consumers' awareness of the often distressingly high levels of sodium in restaurant foods. A recent report noted that among 17 restaurant chains, "85 out of 102 meals had more than a day's worth of sodium, and some had more than four days' worth" (CSPI 2009). Such levels are clearly outside most consumers' sodium expectation levels (Burton, Howlett, and Tangari 2009). Although sodium levels for chain restaurant meals are disclosed in some markets (e.g., Philadelphia), the Patient Protection and Patient Affordable Care Act that will soon go into effect requires only a calorie disclosure on menus and menu boards (Tangari et al. 2010). Furthermore, although sodium information must be made available on request, there are substantial concerns that the majority of consumers will not request it without some additional external motivation (Roberto, Agnew, and Brownell 2009). If the FDA (2010) views sodium levels as a substantial health issue, where operationally feasible (e.g., table service restaurant menus), perhaps adding sodium information to the calorie disclosure should be considered. The current FDA regulations, in which sodium information must be requested by consumers, appear to increase the need and potential benefit of education campaigns that would enhance attention to sodium and its utilization in product evaluations.

In our mediation analysis for perceived vascular disease risk in Study 3, we find that perceived cardiovascular disease risk fully mediates the effect of the education manipulation × sodium level interaction and the main effect of sodium level on purchase intentions. This indicates the importance of increasing the awareness of the link to CVD risk across all adult consumers. In addition, the pattern of the effects of the product sodium level across hypertensive and nonhypertensive consumers was intriguing. The difference in product sodium levels had a more pronounced effect on perceived CVD risk and purchase intentions, particularly for nonhypertensive consumers. Thus, sodium is more closely linked to CVD risk perceptions than to purchase intentions, in which perceived taste, product size, description, and so forth, have substantial effects that generally exceed the importance of sodium level. Low (high) sodium may also be linked to taste-related inferences similar to the "unhealthy = tasty intuition" (Raghunathan, Naylor, and Hoyer 2006), suggesting that, at least for some consumers, CVD perceptions may increase for a higher-sodium product while there is little (or a positive) effect on purchase intentions. This highlights an important problem with processed foods and restaurant menu items; sodium is used as a taste enhancer, and thus most restaurants seem unlikely to reduce sodium levels without outside encouragement. This reinforces the need for initiatives that encourage processed food manufacturers and restaurant chains to decrease product sodium levels (e.g., New York City Department of Health and Mental Hygiene 2010). In addition, further research should extend our findings by examining effects for a broader range of sodium levels, how these levels interact with both perceived and objective taste evaluations, and whether there are substantial differences in taste assessments across consumers with and without hypertension.

Limitations and Further Research

Given that sodium has emerged as a pressing consumer health issue, the results of this study suggest several opportunities for further research. This study focuses on packaged processed foods and restaurant menu items, which account for the majority of U.S. sodium consumption. Further research could focus on sodium levels of nonprocessed foods, which are generally much lower and effects may differ. Similarly, for both the frozen food category and table service restaurant foods used in our experiments, in general, sodium levels are relatively high, but there are some very low-sodium products on the market for these categories. Although research examining effects related to consumers' decreasing purchase intentions for moderate- to very high-sodium products seems appropriate when these sodium levels dominate the categories, adding very low-sodium alternatives to test the boundary conditions of findings, particularly for hypertensive consumers, is also an important extension.

In addition, there has been considerable previous interest in assessing the potential interaction between nutrient content and health claims on the front of a package and NFP nutrient information, including more simplistic graphic formats (e.g., Garretson and Burton 2000; Mitra et al. 1999; Viswanathan, Hastak, and Gau 2009). However, to our knowledge, there has been relatively little emphasis on the interaction between low-sodium claims and NFP sodium information. This dearth of research represents an opportunity for further study. In addition, the FDA has considerable interest in the relationship between standardized front-of-package nutrient information (that would include sodium) and NFP information. Consistent with several previous nutrition studies (Andrews, Netemeyer, and Burton 1998; Howlett, Burton, and Kozup 2008), in this study we conceptualized and treated the sodium education manipulation (and resulting knowledge) of consumers as a moderator of effects of sodium content level. However, consumer knowledge may also be viewed as a mediator of effects of sodium information from a different theoretical perspective.

We acknowledge that these findings are subject to the limitations related to any experiment conducted outside normal purchasing and consumption environments. As indicated previously, we used only two levels of sodium in each of our experiments. Therefore, a further examination of

boundary conditions is warranted. In addition, the dependent measures did not include actual purchase behaviors. Only several food products served as the stimuli, and exposure to the product did not occur in a grocery store, restaurant, or consumption setting. We also examined the effect of an education manipulation that we view as including information about sodium and its consequences for health that could be communicated in major public relations campaign or coverage from the popular press. While our manipulation is similar to prior nutrition study manipulations (e.g., Howlett, Burton, and Kozup 2008), exposure conditions differ, and it is not clear that our findings would generalize directly to effects of a major public health or education campaign.

Despite such possible threats to external validity common to these types of experiments, our results suggest some potentially important public health implications. Specifically, more effective communication regarding sodium and its health consequences could favorably affect the influence of a product's sodium content level on product evaluations and choices across both hypertensive and nonhypertensive consumers. Our findings related to specific aspects of sodium information suggest specific areas that might be targeted in communications. Given the millions of cases of hypertension that could be eliminated, the thousands of lives saved each year by reductions in cardiovascular-related disease and the billions of dollars that could be saved in decreased health care costs by keeping sodium consumption within the recommended daily level, effective communication efforts appear to have substantial public health benefits.

Appendix A. Study 3: Sodium Level Manipulation (Highest Sodium Condition)

Appendix B. Study 3: Sodium Level Manipulation (Highest Sodium Condition)

Salt: The Forgotten Killer

While a small amount of salt—sodium chloride—is necessary for health, the amount in the typical American diet is a major cause of high blood pressure (hypertension) which is associated with stroke and heart disease. Reducing sodium consumption by half would save an estimated 150,000 lives per year. Most of the sodium we eat (77%) comes from processed and restaurant foods.

Dietary guidelines recommend that adults in general should consume no more than 2,300 mg of sodium per day (about 1 teaspoon). However, if you are 40 years of age or older, African American, or have high blood pressure you should consume no more than 1,500 mg per day.

Appendix B. Continued

•Why should I be concerned about salt? I don't have high blood pressure.

You may not have high blood pressure right now, but you probably will at a later point in your life. Consider these facts: 65 million Americans adults have high blood pressure, another 45 million people have "prehypertension" and about 90 percent of Americans will eventually develop hypertension. African Americans' rate of hypertension is 60% greater and the rate of deaths due to stroke is 40% greater than that of the general population. Increased blood pressure causes about two-thirds of strokes and almost half of all heart attacks around the world. One recent study found that people who are pre-hypertensive and cut back on sodium reduced their chances of developing cardiovascular disease by 25% and their risk of dying from it by 20%.

•Children need to watch their salt intake!

A recent study in the journal *Hypertension* shows that reducing salt intake in children quickly lowers their blood pressure. If their blood pressure remains lower, those kids may experience lower rates of heart attack and stroke as they age. High blood pressure can strike at any age.

•How can I use nutrition labels to help me choose wisely?

Pay close attention to information on product packages. Look for products labeled *sodium-free* (5 mg or less per serving), *very low sodium* (35 mg or less per serving), or *low sodium* (140 mg or less per serving). Main meal products with a *healthy* claim must contain 600 mg or less. Be sure to read Nutrition Facts panels. Products that contain more than 20% of the Recommended Daily Value are considered *high sodium*.

Based on reports from Centers for Disease Control and the Center for Science in the Public Interest.

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