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Believing that certain foods are addictive is associated with support for obesity-related public policies

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ABSTRACT

Introduction. There is a growing body of evidence suggesting that certain foods may be addictive. Although evidence that nicotine is addictive generated support for anti-tobacco policies, little research has examined whether beliefs about the addictiveness of food are associated with support for policies to address overconsumption of nutritionally poor foods.

Methods. U.S. adults ($n = 999$) recruited from an online marketplace in February 2015 completed a survey. Using logistic regression, we examined the relationship between beliefs about the addictiveness of certain foods and support for twelve obesity-related policies while controlling for demographics, health status, political affiliation and ideology, beliefs about obesity, and attitudes towards food companies. We examined whether the association between beliefs about addictiveness and support for policies was consistent across other products and behaviors viewed as addictive (i.e., tobacco, alcohol, drugs, compulsive behaviors).

Results. In multivariable models, there was a significant association (OR; 95% CI) between beliefs about addictiveness and support for policies for compulsive behaviors (1.48; 1.26–1.74), certain foods (1.32; 1.14–1.53), drugs (1.23; 1.05–1.45), and alcohol (1.21; 1.08–1.36) but not for tobacco (1.11; 0.90–1.37). For foods, the association between beliefs about addictiveness and obesity-related policy support was the strongest between such beliefs and support for labels warning that certain foods may be addictive, industry reductions in salt and sugar, energy drink bans, and sugary drink portion size limits.

Conclusions. Overall, believing that products/behaviors are addictive was associated with support for policies intended to curb their use. If certain foods are found to be addictive, framing them as such may increase obesity-related policy support.

1. Introduction

Obesity and its related chronic diseases are pressing public health concerns (Ng et al., 2014). Similarities between the food and tobacco industries have led public health advocates to point to successful anti-smoking policies as potential strategies for addressing obesity (Roberto et al., 2015; Brownell and Warner, 2009; Yach et al., 2005; Mercer et al., 2003). Restrictions on cigarette advertising and cigarette taxes are largely supported by the American public (Farley et al., 2015; Pacheco, 2011; New York State Department of Health, 2013) and have contributed to a vast reduction in smoking prevalence (Centers for Disease Control and Prevention, n.d.-a; Gielen and Green, 2015; Jha et al., 2006). By contrast, similar obesity-related policies, like taxation of sugary drinks, have less public support (Barry et al., 2009; Gollust et al., 2014; Huang et al., 2015; Diepeveen et al., 2013). This may be, in part, because there are no safe levels of consumption for tobacco products, making regulation of foods more complex. Despite this difference, strategies used by food and tobacco companies to generate opposition for regulation are similar. For example, both industries have used personal responsibility rhetoric in an attempt to influence beliefs about the causes of excessive consumption of their products (Brownell and Warner, 2009; Friedman et al., 2015), and the discovery

Abbreviation: YFAS, Yale Food Addiction Scale.

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that nicotine was addictive played a major role in changing beliefs about smoking behaviors being a matter of choice (Gielen and Green, 2015; Oliver, 2006). The Surgeon General's 1988 report was the first to review the science of nicotine addiction, drawing comparisons between tobacco and drugs like heroin and cocaine (U.S. Department of Health and Human Services, 1988). The report garnered support for policies such as taxation on tobacco products, restrictions on advertising, and smoke-free indoor air laws (Pacheco, 2011; Warner, 1989).

A growing body of work suggests that certain foods have an addictive potential. In much the same way that tobacco manufacturers alter cigarette components to make them maximally enjoyable, manufacturers refine foods, adding ingredients like salt, sugar, and fat to enhance pleasure and reward (Gearhardt et al., 2012). Evidence from animal models, human physiology, and neuroimaging studies shows that hyper-palatable foods trigger behavioral and neurobiological changes consistent with an addictive process (Hone-Blanchet and Fecteau, 2014; Gearhardt et al., 2009a; Allen et al., 2012). Consumption of certain foods has been implicated in addictive-like eating behaviors, including symptoms of tolerance and withdrawal (Pursey et al., 2014). If it is the case that certain unhealthy foods have addictive potential, and should therefore be limited or abstained from, this knowledge could shift public beliefs about the need for government intervention to address overconsumption of these foods (Pomeranz and Roberto, 2014; Gearhardt et al., 2011).

Given the high public support for tobacco control following widespread knowledge that nicotine is addictive, we hypothesize that believing certain foods are addictive would be associated with greater support for obesity-related policies, but this has not been sufficiently studied (Pomeranz and Roberto, 2014). Previous research has measured beliefs about food addiction as a cause of obesity and found that people agreeing with such beliefs were more likely to support policies requiring labels warning that certain foods may be addictive (Barry et al., 2009). A recent study of 193 adults found that belief in food addiction was associated with greater support for obesity-related policies (Schulte et al., 2016). This study, however, did not evaluate the extent to which people believe foods high in refined sugar or added salt and fat are addictive in comparison to other foods or compared to more common addictive substances, like cigarettes. It is also unclear whether the association between beliefs about addictiveness and support for policies is unique to food, or a phenomenon that is consistent across traditional substances and behaviors of abuse, such as tobacco or alcohol. Additionally, there are variables that may confound the relationship between beliefs about addictiveness and support for policies that were not accounted for in past research, such as beliefs about causal attributions

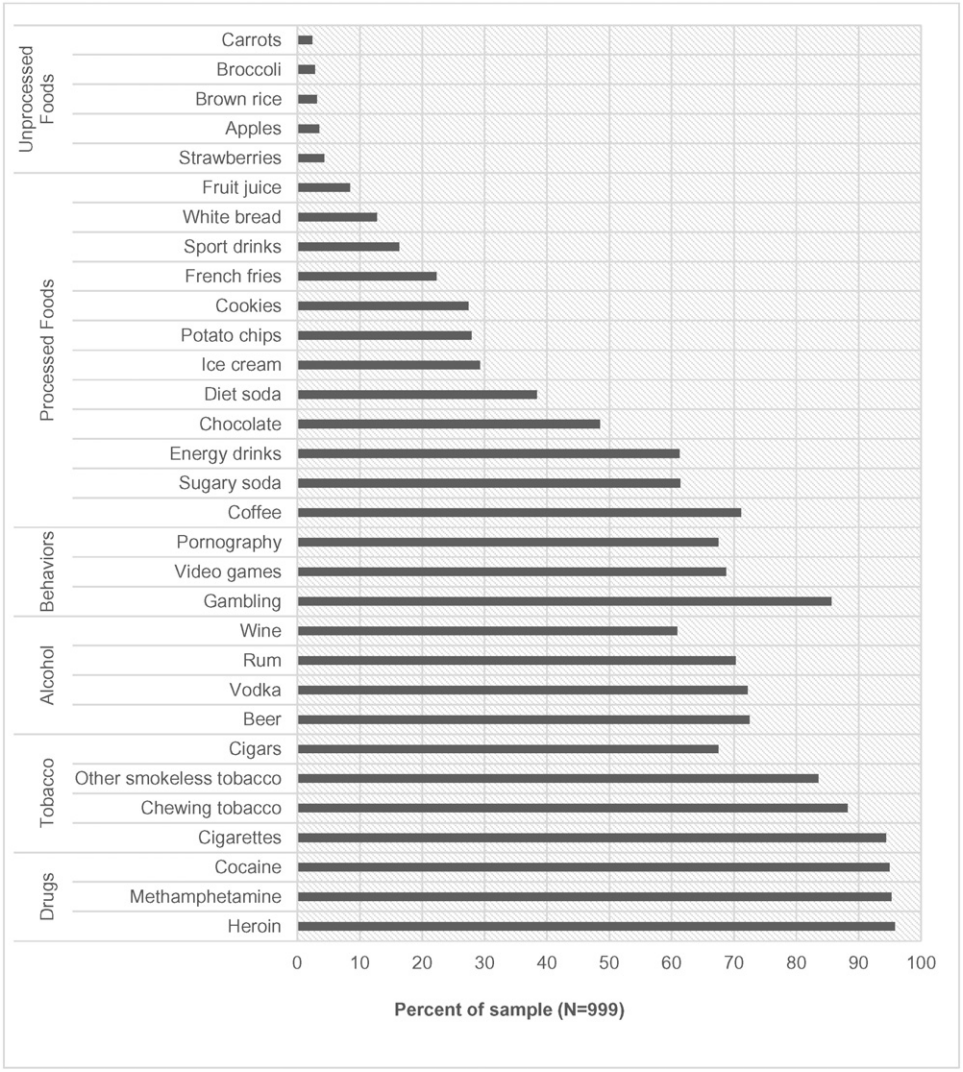

Fig. 1. Proportion of an online sample of 999 U.S. adults believing that products and behaviors are "highly addictive." Caption: Figure shows the proportion of 999 U.S. adults recruited through Amazon Mechanical Turk in February 2015 who perceive unrefined foods without added ingredients ("unprocessed foods"), refined foods or foods with added ingredients ("processed foods"), behaviors, alcohol, tobacco, and drugs as highly addictive. Highly addictive is defined as a score of at least 5 on a 7-point Likert scale.

and responsibility for obesity, attitudes towards food companies and brands, and liberal versus conservative ideology (Barry et al., 2009; Gollust et al., 2014).

The aims of the current study were to examine, via an online sample of U.S. adults, the relationship between beliefs about the addictiveness of foods and support for obesity-related policies. We also examined beliefs about addictiveness of tobacco, alcohol, drugs, and certain behaviors and support for policies designed to curb their use. We hypothesized that: 1) foods high in refined sugar, added salt, or added fat would be viewed as more addictive than foods without such ingredients, but not as addictive as traditional products and behaviors of abuse; and 2) the greater the belief that products/behaviors are addictive, the greater the support for policies targeting those products/behaviors.

2. Methods

2.1. Participants

Adults residing in the U.S. were recruited through Amazon Mechanical Turk, which is an online marketplace in which people are paid to complete individual tasks, in February 2015. Over one-thousand (1095) responses were collected, and 96 (8.8%) were excluded due to duplicate responses from IP addresses ($n = 69$), incomplete responses ($n = 25$), or survey completion in under five minutes ($n = 2$; mean completion time = 20 min). Nine-hundred-ninety-nine (999) participants, who provided informed consent at the start of the survey, were included in the analysis. This study was reviewed by the Office of Human Research Administration at Harvard Longwood Medical Area.

2.2. Measures

2.2.1. Beliefs about addictive potential

Participants were asked "On a scale from 1 (not at all addictive) to 7 (extremely addictive), please rate how addictive you think the following products or behaviors are for other people." Survey items regarding products and behaviors were presented in random order and grouped into categories for analysis, presented in Fig. 1: unrefined foods without added ingredients ("unprocessed") ($n = 5$), refined foods or foods with added ingredients ("processed") ($n = 12$), behaviors ($n = 4$), alcohol ($n = 4$), tobacco ($n = 4$), and drugs ($n = 4$). Although they contain caffeine, energy drinks, soda, and coffee (e.g., Starbucks Frappuccino) were classified as foods because many of them contain high amounts of added sugar. Marijuana and exercise were dropped prior to analysis due to low inter-item correlation in their respective categories ($\alpha = 0.25$ and 0.38, respectively). An addictiveness score was calculated for each category by averaging ratings across items within each category. Cronbach's α was 0.92 for "unprocessed" foods, 0.90 for "processed" foods, 0.71 for behaviors, 0.91 for alcohol, 0.92 for tobacco, and 0.94 for drugs. Beliefs about the addictiveness of foods with added ingredients were moderately correlated with beliefs about the addictiveness of alcohol and compulsive behaviors ($r = 0.45$ and 0.59, respectively), and beliefs about the addictiveness of alcohol and drugs were moderately correlated ($r = 0.62$).

2.2.2. Policy support

Participants rated 25 policies on a Likert scale from 1 (strongly oppose) to 5 (strongly support). Policies were selected from the literature and public opinion surveys, applied to manufacturers, retailers, and public places (e.g., schools), and varied in public acceptability (see Table 2). Policies were presented in random order and grouped into categories for analysis based on the potentially addictive product/behavior targeted: foods ($n = 12$), tobacco ($n = 6$), alcohol ($n = 1$), drugs ($n = 1$), and behaviors ($n = 5$). An average policy support score was calculated for each category, and Cronbach's α was 0.90 for obesity-related policies, 0.85 for tobacco-related policies, and 0.76 for policies targeting behaviors.

2.2.3. Demographic characteristics and health

Participants provided their age, sex, household income, and education level, and rated how strongly they agreed or disagreed with the following statement, "I care about living a healthy lifestyle" on a Likert scale from 1 (strongly disagree) to 5 (strongly agree). Race/ethnicity was measured because of variation in obesity prevalence across racial/ethnic groups (Ogden et al., 2014), which may affect support for obesity policies. Participants were asked race/ethnicity based on categories from the 2010 U.S. census, and categories were collapsed for analysis due to low representation within groups. Body mass index (BMI) (kg/m^2) was calculated using self-reported height and weight, and

Table 1
Demographic, health, and political characteristics of an online sample of U.S. adults ($N = 999$) surveyed in February 2015.

Demographic characteristics	n (%)	Health characteristics	n (%)	Political characteristics	n (%)
Sex		**Body mass index (BMI)(kg/m^2)**		**Party affiliation**	
Male	523 (52.4)	< 18.5	25 (2.5)	Strong Republican	71 (7.1)
Female	476 (47.6)	18.5–24.9	453 (45.3)	Republican	120 (12.0)
Age		25.0–29.9	295 (29.5)	Independent/Republican	57 (5.7)
18–44	789 (79.0)	Obese, BMI≥30.0	226 (22.6)	Independent	194 (19.4)
45–64	197 (19.7)	**Smoking**		Independent/Democrat	133 (13.3)
>65	13 (1.3)	Never	556 (55.7)	Democrat	241 (24.1)
Ethnicity		Former	215 (21.5)	Strong Democrat	183 (18.3)
Non-Hispanic	927 (92.8)	Current	228 (22.8)	**Political ideology**	
Hispanic or Latino/a	72 (7.2)	**Personal experience with addiction**		Extremely liberal	119 (11.9)
Race		Have ever struggled with weight	398 (39.8)	Liberal	252 (25.2)
White	800 (80.1)	Have ever struggled with alcohol	67 (6.7)	Slightly liberal	156 (15.6)
Black	59 (5.9)	Have ever struggled with tobacco	179 (17.9)	Moderate/no preference	223 (22.3)
Asian	77 (7.7)	Have ever struggled with addictive behaviors	104 (10.4)	Slightly conservative	108 (10.8)
Other race	20 (2.0)	Have ever struggled with drug use	33 (3.3)	Conservative	103 (10.3)
Two or more races	43 (4.3)	**Eating behaviors**		Extremely conservative	38 (3.8)
Education		Diagnosis of food addiction measured by the Yale Food Addiction Scale	51 (5.1)	**Region**	
Less than college	153 (15.3)			Northeast	231 (23.1)
Some college or technical school	323 (32.3)			Midwest	212 (21.2)
College degree	402 (40.2)			South	336 (33.6)
Graduate or professional education	121 (12.1)			West	220 (22.0)
Household income (USD)					
Less than $25,000	226 (22.6)				
$25,000–$49,999	289 (28.9)				
$50,000–$74,999	255 (25.5)				
$75,000 or more	229 (22.9)				

participants reported smoking status (never, former, some days, daily) and alcohol intake (number of drinking occasions per month and number of drinks per occasion). To measure personal experiences with addiction, participants were asked to "check as many of the following statements that are true for you." Five statements were provided about whether the person had ever struggled with weight, alcohol, tobacco, drugs, or addictive behaviors, and six statements about whether someone in the person's family had struggled with such products/behaviors. Each checked box received a score of "1" and items were summed to compute one value representing the person's experiences with addiction, and one value representing family members' experiences with addiction.

2.2.4. Eating behaviors

People who engage in addictive-like eating behaviors may be more likely to perceive certain foods as addictive for other people, and more likely to support obesity-related policies. Participants completed the Yale Food Addiction Scale (YFAS) (Gearhardt et al., 2009b), which is a 25-item self-reported measure modeled after the Diagnostic and Statistical Manual for Mental Disorders IV criteria for substance dependence that has been used to diagnose behavioral symptoms of food addiction (Pursey et al., 2014). In its preliminary validation, the YFAS showed good internal reliability (Kuder–Richardson $\alpha = 0.86$) and convergent validity, correlating with the emotional eating scale and eating troubles score ($r = 0.46$–0.61) (Gearhardt et al., 2009b). In this study, the YFAS was scored continuously based on the number of addictive-like eating behaviors reported, which ranged from 0 to 7.

2.2.5. Psychological characteristics

Psychological reactance is a reaction to limitations on choice and has been associated with lower support for persuasive health communications and higher susceptibility to addictive behaviors (Dillard and Shen, 2005; Miller et al., 2006). Hong's 11-item psychological reactance scale was administered, with response choices ranging from 1 (strongly agree) to 5 (strongly disagree). Scores for each individual were averaged, and ranged from 1 (most reactance) to 5 (least reactance) (Hong and Faedda, 1996). The scale has been found to have moderate internal consistency reliability (Cronbach's $\alpha = 0.77$) and is correlated with the Trait-Anger Scale (Hong and Withers, 1982) ($r = 0.38$) and Rimon's Brief Depression Scale (Keltingangas-Jarvinen and Rimon, 1987) ($r = 0.15$), which are part of the same construct (Hong and Faedda, 1996).

2.2.6. Political characteristics

Participants were asked "Generally speaking, do you think of yourself as a Republican, a Democrat, an Independent, or what?" If participants selected Independent or no preference, they were asked whether they are closer to the Democratic or Republican party. If participants selected Republican or Democrat, they were asked whether they are a strong or not very strong Republican/Democrat. From these responses, we created a 7-point scale (strong Republican, not very strong Republican, Independent leaning Republican, true Independent or no preference, Independent leaning Democrat, not very strong Democrat, strong Democrat). Participants were also asked "When it comes to politics, do you usually think of yourself as very liberal, slightly liberal, moderate or middle of the road, slightly conservative, extremely conservative, or haven't you thought much about this?" These questions have been used in prior public opinion polls, and are described in detail elsewhere (Gollust et al., 2014). U.S. region of residence (northeast, south, midwest, west), and trust in government (7-point Likert scale ranging from distrust very much to trust very much) were also measured.

2.2.7. Beliefs about obesity

Beliefs about the causal attribution and/or responsibility of obesity may impact support for policies (Barry et al., 2009; Wolfson et al., 2015). Participants were asked "if you could choose only one intervention to prevent obesity, which do you think would be most effective?" Choices ranged from individual-level to societal-level interventions, and included: 1) researching how a person's genetics may lead to excessive weight gain; 2) providing education to individuals to prevent eating too much or to increase physical activity; 3) changing the food or physical activity environments in which people live; and 4) changing government policies or economic systems that may affect a person's ability to live a healthy life. Other questions asked "indicate how strongly you believe each of the following factors contributes to weight gain by choosing a number 1–7, where 1 indicates the factor does not at all contribute to weight gain, and 7 indicates the factor very strongly contributes to weight gain." Factors contributing to

Table 2
Percent of sample ($N = 999$) supporting policies targeting processed food, tobacco, alcohol, drugs, and behaviors. Subjects were recruited via an online marketplace in February 2015. Support is defined as a rating of 4 (support) or 5 (strongly support) on a 5-point Likert scale. Policies are organized in order of most supported policies to least supported policies. Values are percentages.

1. Tobacco marketing to kids: "The government does not allow tobacco companies to market their products to children."	88.8
2. Tobacco warning labels: "The government requires tobacco companies to place warning labels on cigarettes, indicating that they are addictive."	82.5
3. Restrictions on smoking around hospitals: "Hospitals do not allow smoking within 25 ft of their buildings."	82.3
4. Restrictions on smoking in restaurants: "The government does not allow smoking in restaurants."	78.3
5. Pornography age limits: "The government does not allow pornography to be sold to people under 18 years of age."	74.6
6. Drug ban: "The government does not allow substances, such as cocaine, heroin, and methamphetamine, to be sold."	73.5
7. Video game warning labels: "The government requires video game manufacturers to place labels on games to indicate age-appropriateness."	73.0
8. Menu labeling in restaurants: "The government requires restaurants to list the number of calories in the food on their menus."	67.3
9. Tobacco vending restrictions: "The government does not allow cigarettes to be sold in vending machines."	67.0
10. Restrictions on gambling at school: "Schools do not allow gambling on school grounds."	66.3
11. Alcohol age limits: "The government does not allow alcohol to be sold to people under 21 years of age."	65.8
12. Gambling age limits: "The government does not allow people under 21 years of age to gamble in casinos."	63.9
13. Restrictions on sugary drinks in schools: "Schools do not allow sugary drinks, such as soda, to be sold in their vending machines or in their cafeterias."	61.1
14. Processed food warning labels: "The government requires food companies to place warning labels on foods high in added salt, sugar, or certain fats, indicating that such foods may be addictive."	59.8
15. Energy drink ban: "The government does not allow energy drinks linked to death in teenagers to be sold."	55.2
16. Restrictions on food marketing to kids: "The government does not allow food companies to advertise foods high in added salt, sugar, or certain fats during television programs watched primarily by children."	54.7
17. Industry salt reduction: "The government requires food companies to reduce the amount of salt added to packaged foods."	52.6
18. Industry sugar reduction: "The government requires food companies to reduce the amount of sugar added to packaged foods."	52.5
19. Sugary drink tax: "The government puts a tax of one penny per oz on sugary drinks like soda and uses revenue for health improvement programs."	47.3
20. Restrictions on tobacco advertising in stores: "The government does not allow stores, such as pharmacies, to display tobacco products behind the cash register."	45.5
21. Restrictions on farm subsidies: "The government ends farm subsidies for foods, like corn and sugar, used by food companies to make high-sugar processed foods."	44.6
22. Junk food tax: "The government taxes processed foods high in added salt, sugar, or certain fats, and requires stores and restaurants to provide discounts on fruits and vegetables."	43.3
23. Restrictions on food advertisements in hospitals: "Hospitals do not allow food advertisements inside their buildings."	41.8
24. Casino zoning: "The government does not allow casinos to open in certain geographical locations."	35.8
25. Sugary drink portion limits: "The government does not allow restaurants to sell sugary drinks larger than 16 oz."	25.6

weight gain were adapted from McFerran & Mukhopadhyay's paper on lay theories of obesity, and included "being addicted to food" and "food companies making tasty foods high in added salt, sugar, and fat." (McFerran and Mukhopadhyay, 2013).

2.2.8. Favorability of industry

Liking of specific companies or brands may affect consumer attitudes and beliefs about certain products (Mills et al., 2013) and affects support for government policies intended to regulate such products (Gollust et al., 2014). Participants were shown images of food- ($n = 6$), alcohol- ($n = 4$) and tobacco- ($n = 4$) related brands, and asked to "rate how much you like the following brands on a scale from -4 (hate it) to 4 (love it)" (Supplement A). Participants were also asked "on a scale from 1 (dislike very much) to 7 (like very much), please rate how much you like the following institutions" and were presented with a list of food, alcohol, and tobacco retailers and manufacturers. An average rating for liking of 1) brands and 2) retailers/manufacturers was computed separately for questions about food, alcohol, and tobacco.

2.3. Statistical analysis

First, hierarchical linear regression was used to model the association between perceptions of the addictiveness of certain foods and support for obesity-related policies. The first model was unadjusted; the

Table 3
Results from hierarchical linear regression models showing the association between believing certain foods are addictive; demographic, health, and psychological characteristics; political characteristics; beliefs about obesity; and views of food companies and support for obesity-related policies ($N = 999$).

	Model 1		Model 2		Model 3		Model 4	
Beliefs about food addictiveness	b (SE)	*p*-value	b (SE)	*p*-value	b (SE)	*p*-value	b (SE)	*p*-value
Belief in the addictiveness of foods[a]	0.140 (0.024)	<0.001	0.101 (0.024)	<0.001	0.118 (0.022)	<0.001	0.107 (0.021)	<0.001
Demographic, health, and psychological characteristics	b (SE)	*p*-value	b (SE)	*p*-value	b (SE)	*p*-value	b (SE)	*p*-value
Age (years)			−0.009 (0.002)	<0.001	−0.006 (0.002)	0.012	−0.003 (0.002)	0.162
Sex: female (male is referent group)			0.255 (0.054)	<0.001	0.207 (0.051)	<0.001	0.172 (0.048)	<0.001
Race: Black (white is referent group)			0.105 (0.113)	0.351	−0.008 (0.107)	0.939	0.039 (0.101)	0.702
Race: Asian			0.112 (0.102)	0.274	0.015 (0.098)	0.881	0.036 (0.092)	0.694
Race: Other			−0.069 (0.111)	0.531	−0.064 (0.104)	0.538	−0.094 (0.097)	0.334
Ethnicity: Hispanic/Latino/a (non-Hispanic is referent group)			0.023 (0.104)	0.826	0.017 (0.098)	0.860	0.062 (0.091)	0.499
Income[b]			−0.041 (0.019)	0.029	−0.012 (0.018)	0.493	0.006 (0.017)	0.731
Education[c]			0.029 (0.025)	0.256	−0.008 (0.024)	0.749	−0.038 (0.023)	0.089
Care about living a healthy lifestyle[d]			0.234 (0.035)	<0.001	0.231 (0.033)	<0.001	0.195 (0.031)	<0.001
Struggle with weight, alcohol, drugs, tobacco, or behaviors[e]			0.009 (0.042)	0.835	0.014 (0.039)	0.722	−0.003 (0.037)	0.943
Family member struggles with weight, alcohol, drugs, tobacco, or behaviors[f]			0.022 (0.023)	0.334	−0.034 (0.022)	0.122	−0.033 (0.020)	0.102
Body mass index (kg/m^2)			−0.002 (0.004)	0.626	−0.001 (0.004)	0.874	0.003 (0.004)	0.529
Smoke: former (never is referent group)			0.038 (0.068)	0.578	0.017 (0.064)	0.787	0.007 (0.060)	0.913
Smoke: current, some days			0.022 (0.101)	0.825	−0.048 (0.095)	0.610	−0.027 (0.089)	0.764
Smoke: current, daily			0.162 (0.090)	0.073	−0.164 (0.085)	0.055	−0.071 (0.080)	0.372
Alcohol (drinks/month)			0.000 (0.001)	0.869	0.000 (0.001)	0.649	0.000 (0.001)	0.756
Addictive-like eating behaviors[g]			0.052 (0.021)	0.012	0.043 (0.019)	0.027	0.048 (0.018)	0.008
Psychological reactance[h]			0.109 (0.037)	0.004	−0.070 (0.037)	0.057	−0.056 (0.034)	0.104
Political characteristics	b (SE)	*p*-value	b (SE)	*p*-value	b (SE)	*p*-value	b (SE)	*p*-value
Party affiliation (strong Republican-strong Democrat)[i]					0.054 (0.021)	0.010	0.043 (0.020)	0.028
Political ideology (extremely liberal-extremely conservative)[j]					−0.114 (0.023)	<0.001	−0.086 (0.022)	<0.001
Region: midwest (northeast is referent group)					−0.073 (0.074)	0.318	−0.063 (0.069)	0.365
Region: south					−0.103 (0.066)	0.121	−0.078 (0.062)	0.206
Region: west					−0.079 (0.073)	0.280	−0.088 (0.069)	0.198
Trust in government[k]					0.047 (0.017)	0.005	0.070 (0.017)	<0.001
Beliefs about obesity	b (SE)	*p*-value	b (SE)	*p*-value	b (SE)	*p*-value	b (SE)	*p*-value
Believe societal level changes are most important for obesity prevention[l]							0.131 (0.020)	<0.001
Believe food addiction is a cause of weight gain[m]							0.041 (0.013)	0.002
Believe food companies are a cause of weight gain[m]							0.062 (0.014)	<0.001
Views of food companies	b (SE)	*p*-value	b (SE)	*p*-value	b (SE)	*p*-value	b (SE)	*p*-value
Liking of food companies[n]							−0.072 (0.023)	0.002
Liking of food-related brands[o]							−0.083 (0.016)	<0.001
Adjusted R-squared	0.034		0.130		0.237		0.334	

Note: Subjects were recruited via an online marketplace in February 2015.
[a] Measured on a 7-point Likert scale ranging from 1 (not at all addictive) to 7 (extremely addictive).
[b] Quartiles (1 ≤$25,000; 2 = $25,000–$49,999; 3 = $50,000–$74,999; 4 = $75,000+).
[c] Quartiles (1 ≤college; 2 = some college or technical school; 3 = college degree; 4 = graduate school).
[d] Measured on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).
[e] Number of experiences (1–5).
[f] Number of experiences (1–6).
[g] Number of symptoms (0–7) measured using the Yale Food Addiction Scale.
[h] Average score on Hong's 11-item Psychological Reactance Scale, ranging from 1 (most reactance) to 5 (least reactance).
[i] Measured on a 7-point Likert scale ranging from 1 (strong Republican) to 7 (strong Democrat).
[j] Measured on a 7-point Likert scale ranging from 1 (extremely liberal) to 7 (extremely conservative).
[k] Measured on a 7-point Likert scale ranging from 1 (strongly distrust) to 7 (strongly trust).
[l] Response choices ranged from 1 = genetics research; 2 = education about nutrition or physical activity; 3 = environmental change; 4 = societal change.
[m] Measured on a 7-point Likert scale ranging from 1 (does not at all contribute to weight gain) to 7 (very strongly contributes to weight gain).
[n] Measured on a 7-point Likert scale ranging from 1 (dislike very much) to 7 (like very much).
[o] Measured on an 9-point Likert scale ranging from −4 (hate it) to 4 (love it).

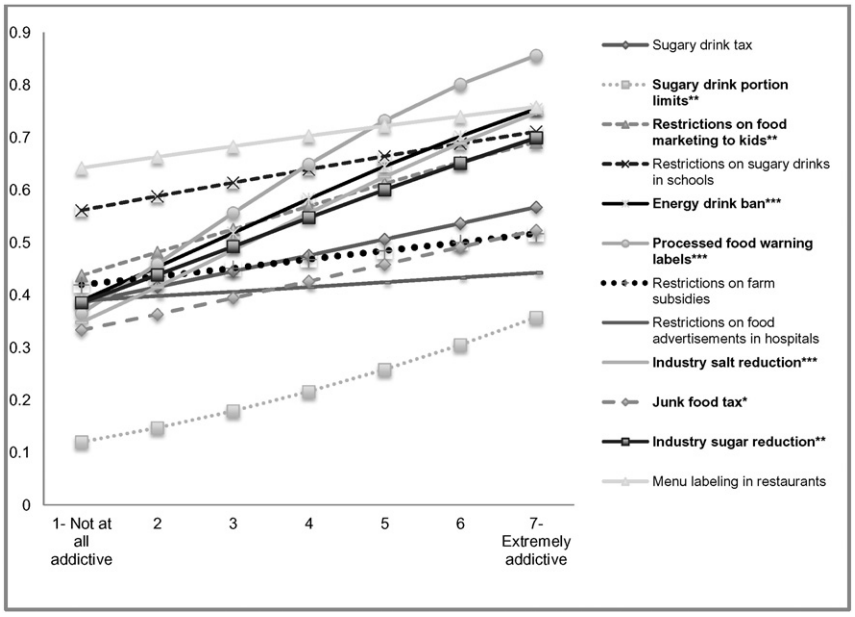

Fig. 2. Predicted probability of supporting 12 obesity-related policies by rating of food addictiveness. Caption: Figure shows the predicted probability of supporting 12 obesity-related policies by rating of food addictiveness, ranging from 1 (not at all addictive) to 7 (extremely addictive) in a sample of 999 U.S. adults recruited through Amazon Mechanical Turk in February 2015. Probabilities were estimated using logistic regression models adjusted for age, sex, race, ethnicity, income, education, care about living a healthy lifestyle, personal and family member experiences with addiction, body mass index, smoking, alcohol, addictive-like eating behaviors, psychological reactance, party affiliation, political ideology, region, trust in government, beliefs about obesity, and views of food companies and food-related brands. Boldface indicates statistical significance ($^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$).

second included demographics, health status, psychological characteristics, and eating behaviors; the third added political party affiliation, ideology, and trust in government; and the fourth added beliefs about obesity, and views on food brands, retailers, and manufacturers. Logistic regression models were used to estimate the probability of supporting each of the twelve obesity-related policies at each level of perceived addictiveness of certain foods, ranging from 1 (not at all addictive) to 7 (extremely addictive) while holding covariates at their means or reference groups. This analysis was done for food policies, but not for tobacco, alcohol, drugs, or behaviors.

Second, we compared the association between addictive potential and support for policies across all of the product and behavioral categories. Because the distributions of support for policies targeting tobacco and drugs were negatively skewed, logistic regression models were fitted, with policy support scores of 3 or less coded as "do not support" and values >3 coded as "support." Two models were fitted for each substance/behavior: 1) an unadjusted model and 2) a multivariable model adjusted for all characteristics listed in the fourth regression model described in the previous paragraph. All statistical tests were two-tailed ($P < 0.05$) and analyses were conducted using Stata Version 13 (College Station, TX).

Table 4
Logistic regression results from an online sample of U.S. adults ($N = 999$) surveyed in February 2015 showing the odds of supporting policies targeting drugs, tobacco, alcohol, behaviors, and foods for each unit increase in believing products/behaviors are addictive.

	Unadjusted model		Multivariate adjusted model*	
Products and behaviors	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Drugs	1.28 (1.12, 1.47)	<0.001	1.23 (1.05, 1.45)	0.010
Tobacco	1.21 (1.03, 1.42)	0.022	1.11 (0.90, 1.37)	0.324
Alcohol	1.27 (1.15, 1.41)	<0.0001	1.21 (1.08, 1.36)	0.001
Behaviors	1.53 (1.34, 1.75)	<0.001	1.48 (1.26, 1.74)	<0.001
Foods	1.31 (1.17, 1.48)	<0.001	1.32 (1.14, 1.53)	<0.001

* Adjusted for age, sex, race, ethnicity, income, education, care about living a healthy lifestyle, body mass index, smoking, alcohol, personal and family member experiences with addiction, addictive-like eating behaviors, psychological reactance, party affiliation, political ideology, region, trust in government, beliefs about obesity, and views on food-, alcohol-, and tobacco-related companies and brands.

3. Results

Participants are described in Table 1. The sample was predominantly between 18 and 44 years of age (79%), and mostly white (80%). The majority of participants reported at least some college (85%) and annual household incomes of less than $50,000 (52%). Fifty-two percent (52%) of participants were overweight or obese, and 5% met the criteria for food addiction as measured by the YFAS. A little over half of the participants were affiliated with the Democratic party (56%) and were of at least slightly liberal ideology (53%).

3.1. Beliefs about addictiveness of products and behaviors

Fig. 1 depicts the proportion of participants believing products and behaviors are highly addictive, defined as a score of at least 5 on a 7-point scale. Most participants believed drugs were highly addictive, but the percent of the sample that viewed other products as highly addictive ranged from 61% for wine, to 94% for cigarettes. Very few respondents believed foods without added salt, refined sugar, or added fat were highly addictive. Beliefs that foods high in refined sugar, salt, or fat are addictive ranged widely based on the type of food, with white bread viewed as addictive by only 13% whereas chocolate was viewed as addictive by 49% of participants. Sugary soda was seen as addictive by slightly more participants than wine.

3.2. Support for policies

Support for policies targeting drugs, tobacco, alcohol, and certain behaviors ranged from 64% for age limits on gambling to 89% for restrictions on tobacco marketing to children (Table 2). Among obesity policies, only menu labeling in restaurants (67%) and restricting sugary drinks in schools (61%) were highly supported. Sugary drink taxes (47%), restricting farm subsidies (45%), taxing junk food (43%), restricting food advertisements in hospitals (42%), and restricting portion sizes of sugary drinks (26%) were weakly supported.

3.3. Beliefs about the addictiveness of foods and obesity-related policy support

Table 3 shows the association between believing certain foods are addictive and support for obesity-related policies. In the unadjusted model, beliefs about food addictiveness alone explained 3.4% of the variance in policy support scores ($\beta = 0.14$ [s.e. $= 0.02$], $P < 0.001$). In the fully adjusted model, believing certain foods are more addictive was associated with greater support for obesity-related policies ($\beta = 0.11$ [0.02], $P < 0.001$). In sensitivity analyses, there was a modest reduction in the magnitude of the association after removing caffeinated beverages (i.e., energy drinks, coffee, sugary soda, diet soda); however, a strong, positive association between beliefs about the addictiveness of foods and policy support remained ($\beta = 0.09$ [0.02], $P < 0.001$).

We used logistic regression to examine support for each food policy individually. Believing certain foods are addictive was significantly and positively associated with support for seven policies: sugary drink portion size limits; restrictions on food marketing to children; banning energy drinks; food warning labels; mandatory industry salt and sugar reduction; and a junk food tax (Fig. 2). Beliefs about the addictive potential of foods were not significantly associated with support for the other five policies.

3.4. Beliefs about the addictiveness of substances and behaviors and policy support

Overall, believing that substances/behaviors are addictive was significantly associated with support for policies intended to curb their abuse in all unadjusted models (Table 4). The association between perceptions of tobacco's addictiveness and support for policies targeting tobacco was attenuated in the multivariable model, but this association for other substances/behaviors remained significant. In the multivariable model, the magnitude of association (OR; 95% CI) was the highest for behaviors (1.48; 1.26–1.74), followed by foods (1.32; 1.14–1.53), drugs (1.23; 1.05–1.45), and alcohol (1.21; 1.08–1.36).

4. Discussion

Results from this study suggest that believing certain foods are addictive is associated with support for obesity-related policies; however, this relationship varied by policy type. The magnitude of the association between beliefs about food addictiveness and support for policies was highest for warning labels, salt reduction, and energy drink bans. Believing certain foods are addictive was significantly associated with support for sugary drink portion limits, which was the least supported policy in our sample. There were some policies for which beliefs about a food's addictiveness did not predict policy support. For example, holding stronger beliefs about food's addictive potential was associated with supporting junk food taxes, but not sugary drink taxes. There was also no association between beliefs about addictiveness and support for menu labeling, possibly because labeling policies were already strongly supported.

Few studies have examined whether beliefs about food addiction impact support for policies, and findings are inconsistent. In a survey of 479 adults, respondents who believed food addiction was a cause of obesity were not more likely to view policy initiatives as an effective way to address obesity (Lee et al., 2013). In contrast, national data from 1009 U.S. adults found that people believing that food addiction was a cause of obesity were more likely to support warning labels on certain foods, compared to those who did not believe food addiction caused obesity (Barry et al., 2009). A recent study of 193 adults recruited from an online platform asked participants three questions about their belief in the addictiveness of food, and found a significant positive association with overall support for obesity-related initiatives (Schulte et al., 2016). These results were replicated in our study, and findings were robust to further adjustment for other demographic and health characteristics, political ideology, beliefs about the causal attribution/responsibility of obesity, trust in government, and attitudes towards popular food and beverage brands.

The results from this paper provide consistent evidence that beliefs about the addictiveness of a product or behavior are associated with policy support. In fully adjusted models, results were consistent for all products/behaviors except tobacco, which was surprising, and likely due to high support for tobacco control policies in our sample as well as most participants in our sample perceiving tobacco as addictive, leaving little variation in the exposure and outcome variables. These results suggest that, generally, people are more amenable to government policies that target substances or behaviors commonly accepted as addictive.

The current study has strengths and limitations. Participants were recruited through Amazon Mechanical Turk, which limits generalizability of findings. Compared to the general population, this sample is younger and more highly educated, and includes a lower proportion of Black and Hispanic individuals (United States Census Bureau, n.d.). Low representation among Black and Hispanic individuals is particularly concerning given the high burden of obesity in these populations (Ogden et al., 2014). Smoking and overweight/obesity prevalence are slightly lower than national statistics (Centers for Disease Control and Prevention, n.d.-b; Centers for Disease Control and Prevention, Division of Nutrition, Physical Activity and Obesity, n.d.), and prevalence of food addiction is low, compared to estimates from a meta-analysis (although most studies included in the meta-analysis were conducted among patients with other diagnosed eating disorders, and the prevalence estimate in this study is comparable to an estimate from a community-dwelling cohort of nurses) (Pursey et al., 2014; Flint et al., 2014). The sample was socioeconomically and geographically diverse, and the proportion of respondents in the sample supporting obesity policies was similar to a nationally representative survey conducted in 2012, suggesting that participant views align well with national public opinion on obesity policies (Gollust et al., 2014). Future studies should explore whether the relationship between beliefs about the addictiveness of foods and support for obesity-related policies can be replicated in a nationally representative sample. This study was cross-sectional, and there is a possibility that unmeasured variables may account for the observed association. That we observed a similar relationship between perceived addictiveness and policy support across a range of potentially addictive products and behaviors gives us greater confidence in our conclusions.

5. Conclusions

For tobacco, framing smoking as an addiction increased public awareness of the industry's role in manipulating products to exploit physiological vulnerabilities and drew particular attention to at-risk groups, like children, who were targeted by companies as potential lifelong clients (Warner, 1989; Nathanson, 1999). Evidence that nicotine was addictive made nicotine-containing products an easier target for policy action (Warner, 1989). If science ultimately concludes that certain food ingredients may trigger an addictive process, the use of a food addiction message may be an effective strategy to increase policy support, particularly for policies, like sugary drink portion limits, that are currently weakly supported by the American public.

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Conflict of interest statement

The authors declare that there are no conflicts of interest.

Transparency document

The Transparency document associated with this article can be found, in the online version.

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