

Public Beliefs About Obesity Relative to Other Major Health Risks: Representative Cross-Sectional Surveys in the USA, the UK, and Germany

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Abstract

Background Overweight and obesity are among the leading risk factors for death worldwide. Scientists believe that the increase in obesity is primarily due to environmental changes and thus favor obesity prevention measures targeting the environment. However, it is less clear what lay people perceive as causes of obesity, and which measures they deem acceptable and promising in fighting it.

Purpose This article compares lay beliefs about obesity with beliefs about other major health risks sharing certain similarities with obesity (alcohol and tobacco dependence, depression) in three countries with high obesity rates.

Methods Computer-assisted face-to-face interviews with representative samples in the UK ($N = 1,216$) and Germany ($N = 973$) and an online survey in the USA ($N = 982$) tapping beliefs about locus of responsibility, liability for treatment costs, and effectiveness of policy measures.

Results In each country, respondents attributed responsibility for obesity primarily to the individual; the same pattern emerged for alcohol and tobacco dependence, but not for depression ($ps < .01$). The higher the attribution of personal responsibility, the more strongly

respondents endorsed individual liability for treatment costs ($ps < .01$). Respondents judged information and fiscal policies as most and least effective, respectively, in obesity prevention.

Conclusions Respondents' views about obesity are similar to those about addictions; however, they regard fiscal and regulatory policies as less effective for obesity than for addictions. Raising awareness about environmental drivers of obesity and framing policy measures by reference to the fight against tobacco and alcohol could increase public support of obesity-targeted policies.

Keywords Representative survey • Personal responsibility • Obesity • Alcohol dependence • Tobacco dependence • Depression

Introduction

Overweight and obesity are among the leading risk factors for death worldwide [1]. Policymakers, scientists, and many citizens agree that the global obesity epidemic requires a forceful response. There is less agreement, however, about the form this response should take. Public health specialists generally attribute the rise in obesity over recent decades to dramatic environmental changes [2–4]. Accordingly, many proposed policy measures target the environment—for example, by imposing surcharges on products that directly harm health, contain no beneficial nutrients, and for which healthier alternatives are available (e.g., taxing obesogenic drinks [5]) or by restricting food marketing and sale (e.g., banning advertisements for high-sugar children's products [6]).

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It is less clear, however, what lay people think about the causes of the obesity epidemic and which measures they deem acceptable and promising in fighting it. Do they agree with the diagnosis of a primarily environmental disease or do they side with the food industry, regarding diet to be principally a matter of personal responsibility rather than a justified target of regulatory and fiscal measures [7]?

The goal of this study is to elicit and analyze lay beliefs about obesity as compared with other global health risks, with a focus on locus of responsibility, liability for treatment costs, and effectiveness of policy measures. To this end, we compare three countries with very high obesity rates [8]: the USA, the UK, and Germany. Any differences observed between the three countries are likely attributable to cultural, economic, or other differences, rather than to differences in obesity prevalence.

To provide a frame of reference for lay beliefs about obesity, we also obtained respondents' beliefs about three other major health risks: alcohol dependence, tobacco dependence, and depression. These risks were chosen, first, because they are hypothesized to share certain similarities with obesity and, second, because effective prevention and intervention policies have already been successfully implemented for some of them. In terms of similarities, it has been suggested that obesity should be categorized as a substance dependence, akin to alcohol or tobacco dependence [9]. Some individuals with obesity would indeed fulfill the criteria for substance dependence (e.g., continued use despite physical problems [10]). Other research has emphasized the links between obesity and stress, thus raising the possibility of obesity being a stress-related disorder, similar to depression: most prominent models of the etiology of depression assume that susceptible individuals are more likely to become depressed when faced with chronic stress or a stressful life event [11]. Chronic stress can also cause excessive consumption of high-calorie foods and, in turn, weight gain (see [12] for a review).

In terms of intervention and prevention policies, researchers and policymakers in all three countries have endorsed and implemented hard paternalistic interventions, such as fiscal and regulatory measures, as well as softer measures, such as public information campaigns and health warning labels, to combat alcohol and tobacco dependence. Although controversial when introduced, such measures now commonly meet with broad public approval. For example, surveys in the USA and Germany have shown that most people now support smoking bans in restaurants and other public areas [13, 14].

Public health researchers have suggested that the obesity epidemic should likewise be addressed by fiscal and regulatory measures [5, 10]. However, public support for such measures (e.g., taxes on high-calorie food

or supersized soft drinks) is presently low in Germany [15], the UK, and especially the USA [16].

Research Aims and Hypotheses

Our representative study of the US, UK, and German public compared lay beliefs about obesity with respect to the locus of responsibility, liability for treatment costs, and effectiveness of prevention policies with corresponding beliefs about alcohol dependence, tobacco dependence, and depression. In this article, we analyze the following questions.

Locus of responsibility

Does the public attribute obesity to personal responsibility, thus endorsing the causal model advocated by the food industry, or do they attribute it to changes in the environment, thus subscribing to the causal model advocated by many public health experts? Furthermore, how does obesity compare with addictions and depression in terms of lay attributions of responsibility?

Liability for treatment costs

If respondents attribute a health risk to personal responsibility, are they also more inclined to consider those afflicted as being individually liable for treatment costs? How does assignment of liability for treatment costs compare across obesity, addictions, and depression?

Effectiveness of policy measures

What kind of policy measures do respondents consider most effective in preventing obesity—and how does this compare with policies implemented to fight tobacco and alcohol dependence?

Methods

Respondents and Procedure

A total of 3,171 respondents from the USA (508 male, 474 female; aged 18–93 years), the UK (607 male, 609 female; 18–93 years), and Germany (429 male, 544 female; 14–99 years) were surveyed. All samples were representative of the country's population with respect to age, gender, region, and other participant characteristics described in Table 1. To account for cultural specificities, we assessed socioeconomic status differently in each country: in the USA, respondents gave their annual household income and level of education; in the UK, they indicated their social class (“upper middle class” to “lowest level of subsistence”) and whether they worked full-time; in Germany, respondents reported their type of work. In addition, respondents were representative with

Table 1 Respondent Characteristics (Weighted)

		% USA	% UK	% Germany
Gender	Male	48.4	49.0	48.8
	Female	51.6	51.0	51.2
Age	14–19 ^a	4.0	2.5	7.1
	20–29	17.2	18.3	13.6
	30–39	16.2	15.5	13.4
	40–49	15.9	18.7	19.3
	50–59	21.6	16.3	16.3
	60+	25.2	28.7	30.2
Socioeconomic status	Lowest level of subsistence		14.3	
	Working class		13.9	
	Lower middle class/skilled working class		49.5	
	Middle class		18.2	
	Upper middle class		4.0	
Employment status	In full-time work		55.0	
	Not in full-time work		45.0	
Type of work	Blue-collar worker			24.5
	White-collar worker			31.6
	Self-employed			7.5
	Retired/not in work			32.1
	Other			4.3
Annual household income	Under \$15,000	11.6		
	\$15,000–less than \$20,000	2.4		
	\$20,000–less than \$25,000	3.5		
	\$25,000–less than \$30,000	6.2		
	\$30,000–less than \$40,000	11.3		
	\$40,000–less than \$50,000	6.5		
	\$50,000–less than \$75,000	18.7		
	\$75,000–less than \$100,000	14.0		
	\$100,000–less than \$125,000	12.7		
	\$125,000–less than \$150,000	5.2		
	\$150,000 and over	7.9		
Education	Less than high school	11.0		
	High school graduate	30.1		
	Some college/2-year degree	29.1		
	College graduate	17.4		
	Postgraduate school	12.5		
Size of household	1 person		18.6	22.2
	2 persons		33.5	38.2
	3 persons		21.4	17.9
	≥4 persons		26.5	21.7
Race	Caucasian (White)	67.3		
	African-American (Black)	11.4		
	Asian or Pacific Islander	4.3		
	Hispanic	14.4		
	American Indian, Alaskan Native	2.7		

(Table 1 Continued)

Table 1 (Continued)

		% USA	% UK	% Germany
Size of place of residence	<2,000 inhabitants			5.8
	2,000–19,999 inhabitants			36.6
	20,000–99,999 inhabitants			27.5
	100,000–499,999 inhabitants			14.2
	≥500,000 inhabitants			15.9
Household net income (categories)	Low/below average	23.8	30.8	30.1
	Medium/about average	36.5	16.4	34.8
	High/above average	39.8	14.2	11.4
	No response	0.0	38.6	23.7

^aIn the USA and UK, respondents in this age group were 18–19 years old. High household net income = USA: \$75,000 and over; UK: £35,000 and over; Germany: €43,200 and over; medium income = USA: \$30,000–\$74,999; UK: £17,500–£34,999; Germany: €24,000–€43,199; low income = USA: less than \$30,000; UK: less than £17,500; Germany: less than €24,000. Samples were not representative with respect to the household net income category (last table row).

respect to race/ethnicity in the USA, with respect to size of household in Germany and the UK, and with respect to size of place of residence in Germany. The three samples were obtained using quota sampling, a systematic sampling method that determines the proportion of individuals to be sampled from each subcategory [17]. The resulting samples were stratified, and sampling weights were applied to reflect the population structure with respect to the subcategories described for each country (see below for details).

Respondents were recruited by an international market research company (Gesellschaft fuer Konsumforschung, GfK). In Germany and the UK, respondents participated in a computer-assisted personal interview in their homes. In the USA, respondents were recruited using address-based sampling (part of the KnowledgePanel[®]) and answered online questionnaires. Respondents without Internet access were provided with a laptop and free Internet access to complete the online surveys. In all three countries and independent of survey mode (face-to-face vs. online), participants sat in front of a computer screen and inserted their responses into the computer. The ethics committee of the Max Planck Institute for Human Development approved the study.

Interview Questions

The questions were developed in German and then translated into English by a certified translator for English and German. A block of questions was presented for each health risk; the order of presentation of the four blocks was randomized. With the exception of the name of the risk, the wording of the questions was identical across the four health risks: obesity, alcohol dependence, tobacco dependence, and depression. By way of illustration, we present the questions concerning obesity.

Locus of responsibility

“To what extent are obese individuals responsible for their weight themselves?” Responses were given on a scale from 0 to 100 (or “don’t know”; modified from [18]).

Liability for treatment costs

“Suppose obese individuals have to undergo treatment because they are not able to get their weight under control alone. Should these individuals bear the costs of treatment themselves?” Response options were “yes” and “no.” Respondents who answered “yes” were then asked what proportion (0%–100% or “don’t know”) of the treatment costs individuals should cover (modified from [19]).

Effectiveness of policy measures

“How effective is measure X in preventing obesity?” For obesity, alcohol dependence, and tobacco dependence, respondents rated the effectiveness of the following four policy measures on a scale from 0 to 100 (or “don’t know”): (i) high taxes, (ii) nutritional or warning labels, (iii) limiting availability or consumption in public spaces, and (iv) banning or limiting advertising. These measures were derived from the following references: high taxes (on junk food [5]; alcohol [20]; tobacco [21]); nutrition or warning labels (improved nutrition labels [22]; warning labels on alcohol [23] and tobacco [24]); limits on availability or consumption in public spaces (banning soda vending machines in schools and at the workplace [25]; policies to reduce general availability of alcohol [20]; policies making more places smoke free [21]); bans or limits on advertisements (for obesogenic foods and drinks [6, 26]; for alcoholic drinks [27]; for tobacco products [28]).

Statistical Analyses

To achieve representativeness of the data for the US, UK, and German populations, we applied sampling weights in the descriptive analyses. The sampling weights were different for each country and were based on the participant characteristics reported in Table 1 (i.e., the sampling weights for the USA were based on gender, age, annual household income, education, and race; the procedure for the UK and Germany was analogous). To control for the different sampling probabilities, we included the variables used to calculate the sampling weights in the parametric inference statistics (repeated-measures analyses of variance [ANOVAs], logistic regression analyses, and regression analyses). Effect sizes are given as η^2 . As a rule of thumb, an η^2 of about 0.01 or below is regarded as small, an η^2 of about 0.06 as medium, and an η^2 of about 0.14 or above as large [29]. Analyses were carried out using SPSS Version 24, including the Complex Surveys Package [30].

Only the German sample included participants younger than 18 years of age ($n = 38$ participants were between 14 and 17 years; 3.9% of the sample). To allow a more equivalent comparison of results across countries, we also recalculated all analyses, limiting the German

sample to participants aged 18 years and older. All coefficients from these analyses were equivalent in size and direction to those from the full sample.

Results

To What Extent Is the Individual Held Responsible?

In all three countries, respondents attributed high levels of responsibility for becoming obese to the individual (Fig. 1). Responsibility for alcohol dependence and, in particular, tobacco dependence was also primarily attributed to the individual. In contrast, across all countries, depressed individuals were held to be less responsible for their condition.

Three repeated-measures ANOVAs indicated that attributions of personal responsibility differed significantly across the four health risks, but were similar across the three countries. When comparing obesity with the other three health risks, within-subject contrasts indicated that by far the largest difference was between obesity and depression, followed by obesity and tobacco dependence in all three countries. The effect size of the difference between obesity and alcohol dependence was very small and was significant only in the UK and

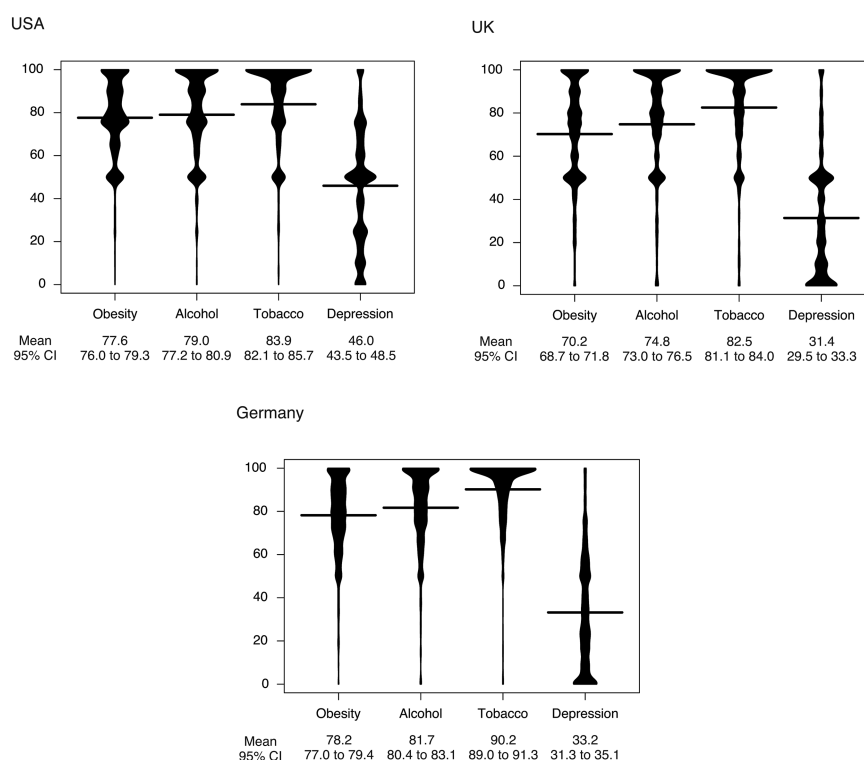


Fig. 1. Attributions of personal responsibility: “To what extent are obese individuals/alcohol-dependent individuals/individuals who smoke tobacco/individuals suffering from depression responsible for their weight/alcohol dependence/tobacco dependence/depression themselves?” (0: not responsible at all; 100: fully responsible). The plot widths represent the density of the raw data distributions; the bandwidth of each bean is determined by the difference between the smallest and largest density of the raw data per country. The lines represent the weighted mean. For exact p values, see Table 2.

Table 2 Statistical Difference Values for Answers to the Question “To What Extent Are Obese Individuals/Alcohol-Dependent Individuals/Individuals Who Smoke Tobacco/Individuals Suffering From Depression Responsible for Their Weight/Alcohol Dependence/Tobacco Dependence/Depression Themselves?”

	Main effect across the four health risks	Within-subject contrasts	
USA	$F(3, 1713) = 561.75, p < .001, \eta^2 = 0.50$	O–A	$F(1, 571) = 1.48, p = .225, \eta^2 = 0.003$
		O–T	$F(1, 571) = 71.17, p < .001, \eta^2 = 0.11$
		O–D	$F(1, 571) = 678.95, p < .001, \eta^2 = 0.54$
UK	$F(3, 3108) = 1096.44, p < .001, \eta^2 = 0.51$	O–A	$F(1, 1036) = 53.25, p < .001, \eta^2 = 0.05$
		O–T	$F(1, 1036) = 230.94, p < .001, \eta^2 = 0.18$
		O–D	$F(1, 1036) = 1255.12, p < .001, \eta^2 = 0.55$
Germany	$F(3, 2580) = 1598.88, p < .001, \eta^2 = 0.65$	O–A	$F(1, 860) = 27.85, p < .001, \eta^2 = 0.03$
		O–T	$F(1, 860) = 294.39, p < .001, \eta^2 = 0.26$
		O–D	$F(1, 860) = 1814.81, p < .001, \eta^2 = 0.68$

After Bonferroni corrections, only p values smaller or equal to .001 are considered statistically significant. *O* obesity; *A* alcohol dependence; *T* tobacco dependence; *D* depression.

Germany (see Table 2 for results of statistical significance tests).

To What Extent Should the Individual Be Liable for Treatment Costs?

About a third of respondents in the UK and Germany believed that obese people should bear the costs of their obesity treatment. This proportion was larger in the USA, at nearly 45% (Fig. 2). Across all three countries, individual liability for treatment costs was most strongly endorsed for tobacco dependence. As with attributions of personal responsibility, the pattern of findings for depression was distinct from that emerging for the other health risks: only a small proportion of respondents—and this proportion was again largest in the USA—believed that people with depression should pay for the costs of their treatment. Averaged across all four health risks, the proportion of respondents who considered the individual to be liable for treatment costs was considerably higher in the USA (43.2%) than in the UK (32.3%) or Germany (29.6%).

In each country, a Cochran's Q test for dependent binary variables showed that beliefs about individual liability for treatment costs differed across the four health risks (after Bonferroni corrections, only p values smaller or equal to .001 are considered statistically significant): USA: $Q(3) = 276.34, p < .001$; UK: Cochran's $Q(3) = 487.85, p < .001$; and Germany: $Q(3) = 552.45, p < .001$. To test for differences between beliefs about obesity and the other three health risks, we conducted McNemar tests using Bonferroni correction to adjust p values for multiple tests. Across the USA, UK, and Germany, there was no significant difference between beliefs about treatment liability for obesity versus alcohol dependence, USA: $X^2 = 0.37, p = .562$; UK: $X^2 = 11.27, p = .003$; Germany: $X^2 = 5.06, p = .025$. In all three countries, endorsement of individual liability for

treatment costs was significantly lower for obesity than for tobacco dependence, UK: $X^2 = 22.78, p < .001$; USA: $X^2 = 31.00, p < .001$; Germany: $X^2 = 118.87, p < .001$, and significantly higher for obesity than for depression, UK: $X^2 = 247.74, p < .001$; USA: $X^2 = 122.78, p < .001$; Germany: $X^2 = 188.82, p < .001$.

Was attribution of personal responsibility positively associated with the belief that individuals should be liable for treatment costs? We used logistic regression analyses to test for this association (see Table 3). Across all countries and health risks, for every additional point (up to a maximum of 100) that respondents attributed individual responsibility for a health risk, the odds of endorsing individual liability for its treatment costs increased significantly—by between 3% (UK, Germany) and 4% (USA) for obesity, and by between 2% and 4% for the other health risks. Consistent with the previous results, the odds of an increase were higher in the USA than in the UK or Germany.

Which Policy Measures Are Judged to Be Effective in Targeting Obesity?

We considered four policies designed to reduce the consumption of potentially harmful substances, such as sweet/fatty foods, alcohol, and tobacco: (i) high taxes, (ii) limiting availability or consumption in public spaces, (iii) regulating marketing (i.e., banning or limiting advertising), and (iv) labeling and warnings, see Fig. 3.

How did respondents judge the effectiveness of these policies? For each country, we ran three repeated-measures ANOVAs, each comparing judgments of effectiveness of one policy across the three health risks (depression was not included in these analyses; see Table 4 for statistical parameters). In all three countries, taxation was judged as less effective in preventing obesity than in preventing alcohol or tobacco dependence. The effect sizes of the differences were consistently large,

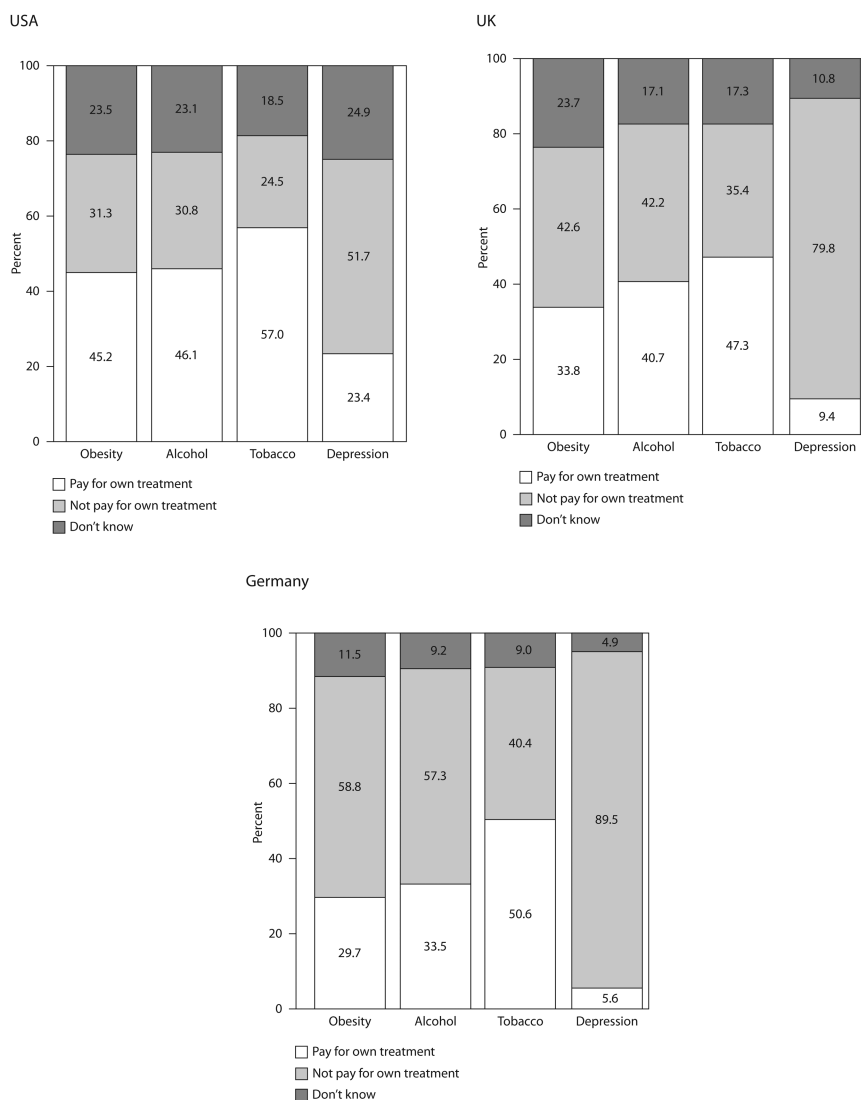


Fig. 2. Should afflicted individuals have to pay for treatment themselves? Proportions of responses, separately for the four health risks (alcohol: alcohol dependence, tobacco: tobacco dependence).

with the exception of a medium-sized difference for obesity versus alcohol in the UK. Furthermore, in all three countries, high taxes were considered to be less effective than any of the other policies in preventing obesity. Conversely, across all countries, understandable nutrition labeling was regarded as the most effective policy for preventing obesity. It was also considered to be substantially more effective than labels warning about the dangers of alcohol, and moderately more effective than labels warning about the dangers of tobacco products.

We also conducted three repeated-measures ANOVAs comparing participants' judgments of the effectiveness of the four policies in the context of obesity. Across all countries, the perceived effectiveness differed significantly between the four policy areas (all p s < .001, η^2 between 0.20 and 0.33; see Supplementary Table S1 and Supplementary Fig. S1). We therefore conducted paired

comparisons to contrast the perceived effectiveness of the four policy measures. In all three countries, the perceived effectiveness of taxation was lowest and that of labeling was highest. In the UK, banning or limiting advertising was perceived as the second most effective policy measure and limiting availability or consumption in public spaces as the third most effective; in Germany, this order was reversed; and in the USA, these two policies were perceived as similarly effective (see Supplementary Table S1 for all statistical coefficients).

Does Level of Household Income Influence Beliefs About Locus of Responsibility, Liability for Treatment Costs, and Effectiveness of Policy Measures?

Not only does the magnitude of the four health risks differ across socioeconomic groups, the four policies

Table 3 Results of Logistic Regression Analyses Predicting How Beliefs About Individual Responsibility for Obesity/Alcohol Dependence/Tobacco Dependence/Depression Relate to Endorsements of Individual Liability for Treatment Costs

Factors included	Obesity			Alcohol dependence			Tobacco dependence			Depression		
	<i>B</i> (<i>SE</i>)	OR	95% CI of OR	<i>B</i> (<i>SE</i>)	OR	95% CI of OR	<i>B</i> (<i>SE</i>)	OR	95% CI of OR	<i>B</i> (<i>SE</i>)	OR	95% CI of OR
USA												
Constant	−0.61 (0.64)	0.54		−0.16 (0.64)	0.85		−0.16 (0.68)	0.85		−0.80 (0.65)	0.45	
Proportion individual responsibility	0.04 (0.01)	1.04	1.03–1.05	0.04 (0.01)	1.04	1.03–1.05	0.04 (0.01)	1.04	1.03–1.04	0.03 (0.004)	1.03	1.02–1.04
UK												
Constant	−2.13 (0.47)	0.12		−1.20 (0.42)	0.30		−1.00 (0.43)	0.37		−3.27 (0.66)	0.04	
Proportion individual responsibility	0.03 (0.003)	1.03	1.03–1.04	0.02 (0.003)	1.02	1.01–1.02	0.02 (0.003)	1.02	1.01–1.02	0.03 (0.004)	1.03	1.02–1.04
Germany												
Constant	−2.59 (0.64)	0.08		−4.31 (0.64)	0.01		−3.36 (0.66)	0.04		−5.14 (0.99)	0.01	
Proportion individual responsibility	0.03 (0.01)	1.03	1.02–1.04	0.04 (0.01)	1.04	1.03–1.05	0.03 (0.01)	1.03	1.02–1.04	0.02 (0.01)	1.02	1.01–1.03

The ORs represent the increase in the odds of endorsing individual liability for treatment costs, per additional point increase (up to a maximum of 100) in the attribution of personal responsibility. 95% CI 95% confidence interval; OR odds ratio; SE standard error.

discussed may affect these groups differently (e.g., higher taxation). Therefore, we tested how net household income related to locus of responsibility, liability for treatment costs, and effectiveness of policy measures. To this end, we reran all analyses reported above, examining the influence of three levels of household income in each country (low, medium, high). The following patterns emerged (see Supplementary Tables S2–S5 for the results of all statistical tests): it was only in the USA that attributions of personal responsibility for the four health risks differed by income level (interaction effect between the main effect across the four health risks and household income, $F(3, 1713) = 5.30, p = .001, \eta^2 = 0.01$). This effect was driven by differences in attributions of responsibility for obesity versus depression: people with a high or medium income attributed almost twice as much responsibility for obesity than for depression to the individual (78.8 for obesity vs. 42.6 for depression in the high income group; 78.8 for obesity vs. 47.0 for depression in the medium income group); in the low income group, the difference between the two health risks was much smaller (73.7 for obesity vs. 50.7 for depression). In contrast, we did not find any influence of income level on attributions of responsibility for any of the four health risks in the UK or Germany (Supplementary Table S2).

Next, we examined whether income level influenced participants' beliefs about individual liability for treatment costs across the health risks, running Cochran's Q tests separated by income level. Across all three countries and income levels, the proportion of participants who believed that afflicted individuals should pay for treatment themselves differed across the four health risks (Supplementary Table S3). Paired comparisons of obesity with each of the three other health risks revealed that income level did not drive differences in the proportion of participants endorsing individual liability for treatment costs for obesity versus alcohol dependence or obesity versus depression. Across the three countries and income levels, a larger proportion of participants endorsed individual liability for treatment costs for tobacco dependence than for obesity, but the difference in proportions was significant in only five of the nine comparisons (three income levels \times three countries).

Across the three countries, income level did not affect the relation between beliefs about individual responsibility for a health risk and endorsements of individual liability for its treatment costs (Supplementary Table S4), with one exception: in the USA, for each decrease in income level (i.e., from high to medium or medium to low), the odds of endorsing individual liability for the treatment costs for depression were roughly halved. Further, income level did not affect the perceived effectiveness of the policy measures across the three countries (Supplementary Table S5).

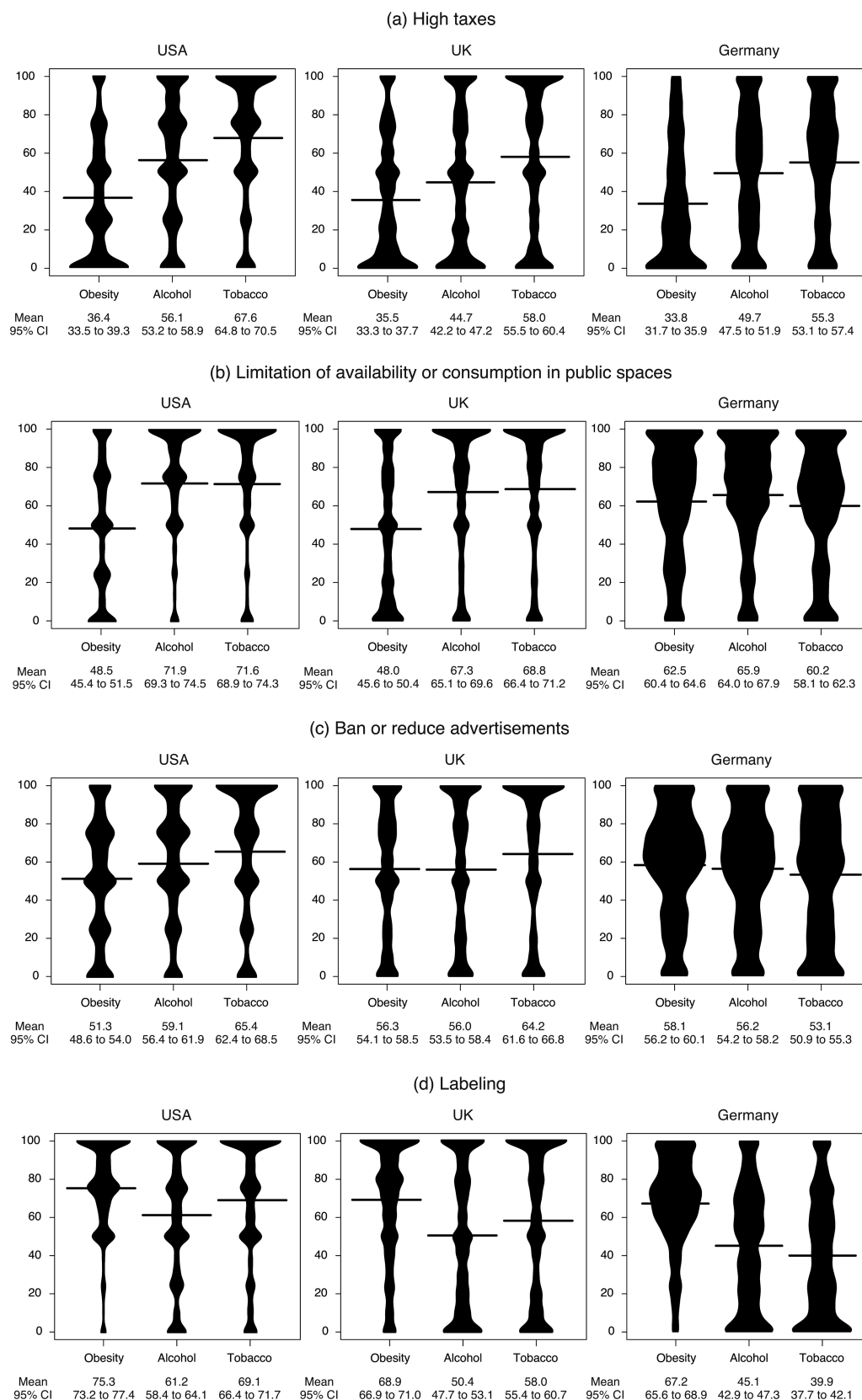


Fig. 3. Judgments of effectiveness of policies targeting obesity, alcohol dependence, and tobacco dependence (0: *no effect*; 100: *very strong effect*; alcohol: alcohol dependence, tobacco: tobacco dependence). The plot widths represent the density of the raw data distributions, the bandwidth of each bean is determined by the difference between the smallest and largest density of the raw data per country. The lines represent the weighted mean. For exact *p* values, see [Table 4](#).

Table 4 Statistical Difference Values for Answers to the Question “How Effective Is Measure X in Preventing Obesity/Alcohol Dependence/Tobacco Dependence/Depression?”

		Main effect across four health risks	Within-subject contrasts	
High taxes	USA	$F(2, 1368) = 294.14, p < .001, \eta^2 = 0.30$	O–A	$F(1, 684) = 227.95, p < .001, \eta^2 = 0.25$
			O–TD	$F(1, 684) = 486.30, p < .001, \eta^2 = 0.42$
	UK	$F(2, 2140) = 167.80, p < .001, \eta^2 = 0.14$	O–A	$F(1, 1070) = 69.87, p < .001, \eta^2 = 0.06$
			O–T	$F(1, 1070) = 313.31, p < .001, \eta^2 = 0.23$
	Germany	$F(2, 1792) = 171.86, p < .001, \eta^2 = 0.16$	O–A	$F(1, 896) = 165.03, p < .001, \eta^2 = 0.16$
			O–T	$F(1, 896) = 283.47, p < .001, \eta^2 = 0.24$
Limiting availability or consumption in public spaces	USA	$F(2, 1390) = 190.03, p < .001, \eta^2 = 0.22$	O–A	$F(1, 695) = 242.30, p < .001, \eta^2 = 0.26$
			O–T	$F(1, 695) = 270.55, p < .001, \eta^2 = 0.28$
	UK	$F(2, 2170) = 177.0, p < .001, \eta^2 = 0.14$	O–A	$F(1, 1085) = 219.85, p < .001, \eta^2 = 0.17$
			O–T	$F(1, 1085) = 274.25, p < .001, \eta^2 = 0.20$
	Germany	$F(2, 1846) = 15.26, p < .001, \eta^2 = 0.02$	O–A	$F(1, 923) = 7.00, p = .008, \eta^2 = 0.01$
			O–T	$F(1, 923) = 7.25, p = .007, \eta^2 = 0.01$
Banning or limiting advertising	USA	$F(2, 1330) = 73.79, p < .001, \eta^2 = 0.10$	O–A	$F(1, 665) = 48.28, p < .001, \eta^2 = 0.07$
			O–T	$F(1, 665) = 131.84, p < .001, \eta^2 = 0.17$
	UK	$F(2, 2174) = 35.0, p < .001, \eta^2 = 0.03$	O–A	$F(1, 1087) = 0.57, p = .450, \eta^2 = 0.00$
			O–T	$F(1, 1087) = 54.46, p < .001, \eta^2 = 0.05$
	Germany	$F(2, 1788) = 9.48, p < .001, \eta^2 = 0.01$	O–A	$F(1, 894) = 1.62, p = .203, \eta^2 = 0.00$
			O–T	$F(1, 894) = 16.74, p < .001, \eta^2 = 0.02$
Labeling and warnings	USA	$F(2, 1352) = 94.85, p < .001, \eta^2 = 0.12$	O–A	$F(1, 676) = 164.93, p < .001, \eta^2 = 0.20$
			O–T	$F(1, 676) = 33.88, p < .001, \eta^2 = 0.05$
	UK	$F(2, 2174) = 106.0, p < .001, \eta^2 = 0.09$	O–A	$F(1, 1087) = 198.16, p < .001, \eta^2 = 0.15$
			O–T	$F(1, 1087) = 59.81, p < .001, \eta^2 = 0.05$
	Germany	$F(2, 1834) = 384.96, p < .001, \eta^2 = 0.30$	O–A	$F(1, 917) = 423.12, p < .001, \eta^2 = 0.32$
			O–T	$F(1, 917) = 613.71, p < .001, \eta^2 = 0.40$

After Bonferroni corrections, only p values smaller or equal to .001 are considered statistically significant. O obesity; A alcohol dependence; T tobacco dependence; D depression.

Discussion

Statement of Principal Findings

Respondents in the USA, UK, and Germany attributed responsibility for obesity primarily to the individual. This pattern of attribution also held for alcohol dependence and, to an even greater extent, for tobacco dependence. Thus, in terms of personal responsibility, people placed obesity closer to alcohol and tobacco dependence than to a stress-related mental disorder, depression. Likewise, they placed obesity closer to substance dependencies in terms of perceived liability for treatment costs, with similar patterns of findings emerging across the four health risks in all three countries: respondents' levels of endorsement of individual liability for treatment costs for obesity were similar to those for alcohol dependence, and also much closer to those for tobacco dependence than for depression. Furthermore, respondents who tended to attribute personal responsibility for health risks also considered the individuals affected to

be more accountable for the costs incurred. Respondents in all three countries believed intelligible nutrition labeling—the least intrusive and restrictive measure—to be the most effective policy (among those considered) for preventing obesity, and taxes to be the least effective policy. Last but not least, across all three countries, the level of household income had limited influence on respondents' beliefs about locus of responsibility, liability for treatment costs, and effectiveness of policy measures.

Strengths, Weaknesses, and Future Research

To our knowledge, this is the first investigation to compare lay theories of obesity and of other major health risks thought to share certain similarities with obesity. Further, it is the first study to use the same items to elicit lay beliefs about major health risks across representative samples in three countries. The findings identify a gap between lay and expert beliefs about the causes of obesity: although there is growing agreement among experts that the rapid weight gain of the last four decades

has been largely driven by the obesogenic modern food environment [31], lay people in the three countries under investigation tend to hold the individual responsible. We also analyzed the impact of one important indicator of socioeconomic status, namely, household income, across the three countries. Future research needs to examine additional indicators of socioeconomic status. Although participants entered their survey responses into a personal computer in all three countries, the different survey modes (computer-assisted face-to-face interviews in the UK and Germany vs. online surveys in the USA) may have affected responses (e.g., [32]). However, given the similarity of responses and response patterns across the two survey modes (e.g., concerning perceptions about individual responsibility for the four health risks), we believe that any impact of the difference in survey modes is limited. Other potential limitations are that, like any self-report measure, our surveys are subject to response bias, and that individual knowledge or attitudes may also have influenced respondents' answers. Despite randomization of question blocks, moreover, order effects are possible. Admittedly, our focus on countries with high obesity rates is also a limitation, but our concern was to exclude the obesity rate itself as the cause of potentially divergent public beliefs.

Conclusion

In 2014, more than 1.9 billion adults worldwide were overweight or obese [1]. The fundamental cause of obesity is an energy imbalance between calories consumed and calories expended. One of the two key levers to fight the obesity epidemic is therefore the number of daily calories consumed. How this can be achieved will depend substantially on the framing of this health crisis. If framed as a matter of personal (ir)responsibility, it will be addressed differently than if framed as a crisis driven in no small part by other factors (e.g., an obesogenic environment, corporate misbehavior, lack of government regulations).

It is important to acknowledge that obesity is brought about by myriad factors and is likely the result of an interaction between environment and individual. Therefore, there is unlikely to be a silver bullet—that is, a single lever that can be used to contain or even reverse the obesity epidemic. Helping individuals with obesity to take responsibility for factors they can control (e.g., weight-related behaviors) and not unduly attributing responsibility to those they cannot control (e.g., environmental characteristics) could attenuate some of the guilt, poor self-acceptance, and stigma that people with obesity experience [33, 34]. That being said, behavioral interventions on obesity are rarely successful in the long term [35–37]. Thus, focusing on prevention, particularly by designing our modern environment to make it less

obesogenic, will likely be a key force in combating the obesity epidemic.

There were some notable similarities and differences in views across countries. For instance, US respondents were more likely to endorse individual liability for treatment costs than were German or UK respondents. This finding is consistent with a pattern observed by Branson and colleagues [16], showing the USA to stand out among wealthier nations as the country least in favor of government interventions. It is also consistent with the degree of public funding of the healthcare system: in 2013, 48% of healthcare costs in the USA were publicly funded, relative to 83% in the UK and 77% in Germany [38].

Our results show that the US, UK, and German public strongly believe individuals to be personally responsible for obesity and, similarly, for tobacco and alcohol dependence. Although it is unclear to what extent the public has adopted the food and soda industries' framing of the problem [7, 39], this belief has policy implications. For instance, attribution to individuals is, as our results show, positively associated with the belief that individuals should be personally liable for treatment costs. Furthermore, the public's emphasis on personal responsibility may also explain why information (intelligent labeling) is rated to be most effective in preventing obesity, and taxation to be least effective. The former can be interpreted as boosting the individual's competence to exercise personal responsibility, whereas taxes on unhealthy food can be understood as a one-size-fits-all penalty that is unfair to those who consume fast food only as a rare treat.

Yet public opinions change and evolve. In all three countries, respondents rated high taxes as effective in reducing tobacco consumption. Over a period of decades, the US public has transformed from a smoking-tolerant culture to one accepting and supporting bans on the marketing and consumption of tobacco (e.g., creating smoke-free public places), as well as high taxation of tobacco products [31]. Lessons learned in overcoming opposition to fiscal and regulatory inventions in the context of smoking might help policymakers to raise public support for corresponding measures addressing obesity [40].

Our results highlight one obesity prevention measure that already enjoys public support, namely, intelligible food labeling. In Germany and the UK, nutrition labels have been mandated by EU regulations since December 2016 [41]. The UK has additionally implemented an improved front-of-pack labeling system [42]. In May 2016, the US Food and Drug Agency (FDA) launched a new, more comprehensive food label including a declaration of added sugars and realistic portion sizes [43]. Despite this important progress, neither the EU nor the FDA legislation mandates understandable

and user-friendly *front-of-package* labeling (such as the traffic light system), the type of labeling that consumers consult most often [44].

Taxing of unhealthy foods and drinks, such as sugar-sweetened beverages, is still at an early stage. The World Health Organization (WHO) recently called for a 20% tax on sugar-sweetened beverages. Berkeley was the first US city to impose such a tax [45]. The UK government has published draft legislation for a tax on sugar-sweetened drinks to begin in 2018 [46]. Germany is currently not expected to impose such a tax (e.g., [47]).

First attempts to limit access to sugar-sweetened beverages and foods high in sugar, salt, or fat have been made in schools: in 2005, both the UK government [48] and California [45] banned vending machines selling such products. We are not aware of any plans in Germany to institute a similar ban in public spaces. Regarding limits or bans on advertising, the UK has again implemented the strongest and most far-reaching policies, with advertising of products high in fat, salt, or sugar being banned from programs aimed at children aged between 4 and 15 years since 2008. In the USA, the Children's Food and Beverage Advertising Initiative, launched in 2007, has issued a list of products that may be advertised to children. However, in 2014, more than half of the products on the list exceeded the recommended limit for saturated fat, trans fat, sugar, and sodium [49]. To our knowledge, Germany does not restrict the content or timing of television advertisements aimed at children (e.g., [50]).

To summarize, the available public record suggests that, of the three countries surveyed, the UK has most forcefully implemented policies to target obesity. In the USA, a number of policies apply only at the city or state level; thus, there is considerable variation across the country. In Germany, comparably little effort seems to have been made to implement obesity prevention policies. This pattern mirrors the regulations and policies implemented to control tobacco consumption: on the Tobacco Control Scale, the UK ranks as the country most forcefully implementing tobacco control policies; Germany ranks 26th (among 31 ranked countries) [51]. The USA was not ranked on the Tobacco Control Scale but has implemented a number of regulatory measures [21]. Worldwide, countries are only now beginning to implement policies to curtail and prevent obesity. The efficacy of many of these policies, as well as their effects on different population groups, is yet to be evaluated. Yet effective policies also require public support. Understanding lay people's beliefs about what is possibly the most significant global risk to public health, and how those beliefs relate to public support of policy measures, promises to be an important step in orchestrating individual and collective responses to the obesity crisis.

Supplementary Material

Supplementary material is available at *Annals of Behavioral Medicine* online.

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Authors' Statement of Conflict of Interest and Adherence to Ethical Standards Authors Jutta Mata and Ralph Hertwig declare that they have no conflict of interest. All procedures, including the informed consent process, were conducted in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000.

Compliance with Ethical Standards

Authors' Contributions Jutta Mata (JM) and Ralph Hertwig (RH) conceived the paper and designed the study; JM coordinated the data collection and analyzed the data; JM and RH wrote the paper.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

1. World Health Organization. Fact sheet N°311: obesity and overweight. World Health Organization Media Centre. Available at <http://www.who.int/mediacentre/factsheets/fs311/en/>. Accessibility verified December 13, 2017.
2. Hill JO, Peters JC. Environmental contributions to the obesity epidemic. *Science*. 1998;280(5368):1371–1374.
3. Estabrooks PA, Fisher EB, Hayman LL. What is needed to reverse the trends in childhood obesity? A call to action. *Ann Behav Med*. 2008;36(3):209–216.
4. Sallis JF, Carlson JA, Mignano AM, et al. Trends in presentations of environmental and policy studies related to physical activity, nutrition, and obesity at Society of Behavioral Medicine, 1995–2010: a commentary to accompany the Active Living Research Supplement to Annals of Behavioral Medicine. *Ann Behav Med*. 2013;45(suppl 1):S14–S17.
5. Franck C, Grandi SM, Eisenberg MJ. Taxing junk food to counter obesity. *Am J Public Health*. 2013;103(11):1949–1953.
6. Harris JL, Pomeranz JL, Lobstein T, Brownell KD. A crisis in the marketplace: how food marketing contributes to childhood obesity and what can be done. *Annu Rev Public Health*. 2009;30:211–225.

7. Brownell KD, Warner KE. The perils of ignoring history: Big Tobacco played dirty and millions died. How similar is Big Food? *Milbank Q*. 2009;87(1):259–294.
8. World Health Organization. Data for saving lives. WHO Global InfoBase. Available at <https://apps.who.int/infobase/Comparisons.aspx>. Accessibility verified December 13, 2017.
9. Marcus MD, Wildes JE. Obesity: is it a mental disorder? *Int J Eat Disord*. 2009;42(8):739–753.
10. Gearhardt AN, Corbin WR, Brownell KD. Food addiction: an examination of the diagnostic criteria for dependence. *J Addict Med*. 2009;3(1):1–7.
11. Hammen C. Stress and depression. *Annu Rev Clin Psychol*. 2005;1:293–319.
12. Adam TC, Epel ES. Stress, eating and the reward system. *Physiol Behav*. 2007;91(4):449–458.
13. Gilpin EA, Lee L, Pierce JP. Changes in population attitudes about where smoking should not be allowed: California versus the rest of the USA. *Tob Control*. 2004;13(1):38–44.
14. Mons U, Jazbinsek D, Kahnert S. Smoke-free restaurants in Germany 2012: majority of smokers in favor of smoking ban for the first time [in German]. Available at http://www.dkfz.de/de/tabakkontrolle/download/Publikationen/AdWfP/AdWfP_Rauchfreie_Gaststaetten_2012.pdf. Accessibility verified December 13, 2017.
15. Morgan A. Germans (75%) reject extra taxes on unhealthy foods [in German]. mingle-Trend. Available at <http://mingle-trend.respondi.com/de/deutsche-75-lehnen-extras-teuer-auf-ungesunde-lebensmittel-ab/>. Accessibility verified December 13, 2017.
16. Branson C, Duffy B, Perry C, et al. Acceptable behaviour? Public opinion on behaviour change policy. London: Ipsos MORI: Social Research Institute. Available at <https://www.ipsos.com/sites/default/files/publication/1970-01/sri-ipsos-mori-acceptable-behaviour-january-2012.pdf>. Accessibility verified December 13, 2017.
17. Särndal C-E, Swensson B, Wretman J. *Model Assisted Survey Sampling*. New York, NY: Springer; 1992.
18. McFerran B, Mukhopadhyay A. Lay theories of obesity predict actual body mass. *Psychol Sci*. 2013;24(8):1428–1436.
19. Sikorski C, Luppia M, Schomerus G, Werner P, König HH, Riedel-Heller SG. Public attitudes towards prevention of obesity. *PLoS One*. 2012;7(6):e39325.
20. Room R, Babor T, Rehm J. Alcohol and public health. *Lancet*. 2005;365(9458):519–530.
21. World Health Organization. WHO Report on the Global Tobacco Epidemic, 2011 warning about the dangers of tobacco. Geneva: World Health Organization. Available at http://www.who.int/tobacco/global_report/2011/en/index.html. Accessibility verified December 13, 2017.
22. Hawkes C. *Nutrition Labels and Health Claims: The Global Regulatory Environment*. Geneva: World Health Organization; 2004.
23. Thomson LM, Vandenberg B, Fitzgerald JL. An exploratory study of drinkers views of health information and warning labels on alcohol containers. *Drug Alcohol Rev*. 2012;31(2):240–247.
24. Hammond D. Health warning messages on tobacco products: a review. *Tob Control*. 2011;20(5):327–337.
25. Taber DR, Chiqui JF, Powell LM, Chaloupka FJ. Banning all sugar-sweetened beverages in middle schools: reduction of in-school access and purchasing but not overall consumption. *Arch Pediatr Adolesc Med*. 2012;166(3):256–262.
26. McClure AC, Tanski SE, Gilbert-Diamond D, et al. Receptivity to television fast-food restaurant marketing and obesity among U.S. youth. *Am J Prev Med*. 2013;45(5):560–568.
27. Smith LA, Foxcroft DR. The effect of alcohol advertising, marketing and portrayal on drinking behaviour in young people: systematic review of prospective cohort studies. *BMC Public Health*. 2009;9:51.
28. Harris F. Effects of the 2003 advertising/promotion ban in the United Kingdom on awareness of tobacco marketing: findings from the International Tobacco Control (ITC) Four Country Survey. *Tob Control*. 2006;15:iii26–iii33.
29. Cohen J. *Statistical Power Analysis for the Behavioral Science*. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
30. IBM Corp. *IBM SPSS Statistics for Macintosh, Version 24.0*. Armonk, NY: IBM Corp.; 2016.
31. Rozin P. The process of moralization. *Psychol Sci*. 1999;10(3):218–221.
32. Duffy B, Smith K, Terhanian G, et al. Comparing data from online and face-to-face surveys. *Int J Mark Res*. 2005;47(6):615–639.
33. Carr D, Friedman MA. Is obesity stigmatizing? Body weight, perceived discrimination, and psychological well-being in the United States. *J Health Soc Behav*. 2005;46(3):244–259.
34. Puhl RM, Heuer CA. The stigma of obesity: a review and update. *Obesity (Silver Spring)*. 2009;17(5):941–964.
35. Fildes A, Charlton J, Rudisill C, Littlejohns P, Prevost AT, Gulliford MC. Probability of an obese person attaining normal body weight: cohort study using electronic health records. *Am J Public Health*. 2015;105(9):e54–e59.
36. Jeffery RW, Drewnowski A, Epstein LH, et al. Long-term maintenance of weight loss: current status. *Health Psychol*. 2000;19(1S):5–16.
37. Wing RR, Phelan S. Long-term weight loss maintenance. *Am J Clin Nutr*. 2005;82(1 suppl):222S–225S.
38. OECD. Health at a Glance 2015. OECD Publishing. Available at http://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2015_health_glance-2015-en. Accessibility verified December 13, 2017.
39. Nestle M. *Soda Politics: Taking on Big Soda (and Winning)*. Oxford, UK: Oxford University Press; 2015.
40. Marteau TM, Hollands GJ, Fletcher PC. Changing human behavior to prevent disease: the importance of targeting automatic processes. *Science*. 2012;337(6101):1492–1495.
41. The European Parliament and the Council of the European Union. Regulation (EU) No 1169/2011 of the European Parliament and of the Council. *Off J Eur Union*. 2011;304:18–63.
42. Department of Health, Government of the United Kingdom. 2010 to 2015 government policy: obesity and healthy eating. Available at <https://www.gov.uk/government/publications/2010-to-2015-government-policy-obesity-and-healthy-eating/2010-to-2015-government-policy-obesity-and-healthy-eating>. Accessibility verified December 13, 2017.
43. U.S. Food & Drug Administration. Changes to the Nutrition Facts Label. U.S. Department of Health and Human Services. Available at <http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm385663.htm>. Accessibility verified December 13, 2017.
44. Grunert KG, Wills JM, Fernández-Celemin L. Nutrition knowledge, and use and understanding of nutrition information on food labels among consumers in the UK. *Appetite*. 2010;55(2):177–189.
45. World Health Organization. Fiscal policies for diet and prevention of noncommunicable diseases: technical meeting report, May 5–6, 2015, Geneva, Switzerland. Available

- at <http://apps.who.int/iris/bitstream/10665/250131/1/9789241511247-eng.pdf>. Accessibility verified December 13, 2017.
46. BBC News. UK pushes ahead with sugar tax. Available at <http://www.bbc.com/news/health-38212608>. Accessibility verified December 13, 2017.
47. Süddeutsche Zeitung. What would a sugar tax bring? [in German]. Available at <http://www.sueddeutsche.de/gesundheit/ernaehrung-was-wuerde-eine-zuckersteuer-bewirken-1.3206627>. Accessibility verified December 13, 2017.
48. Dimbleby H, Vincent J. The School Food Plan. Available at http://www.schoolfoodplan.com/wp-content/uploads/2013/07/School_Food_Plan_2013.pdf. Accessibility verified December 13, 2017.
49. Schermbeck RM, Powell LM. Nutrition recommendations and the Children's Food and Beverage Advertising Initiative's 2014 approved food and beverage product list. *Prev Chronic Dis.* 2015;12:1–6.
50. Capacci S, Mazzocchi M, Shankar B, et al. Policies to promote healthy eating in Europe: a structured review of policies and their effectiveness. *Nutr Rev.* 2012;70(3):188–200.
51. Joossens L, Raw M. The tobacco control scale 2010 in Europe. Available at https://www.krebshilfe.de/fileadmin/Downloads/PDFs/Kampagnen/TCS_2010_Europe.pdf. Accessibility verified December 13, 2017.