Regular Article

Public beliefs about obesity relative to other major health risks:
Representative cross-sectional surveys in the USA, the UK, and Germany

Jutta Mata, PhD[1][2], Ralph Hertwig, PhD[1]

[1] Center for Adaptive Rationality (ARC), Max Planck Institute for Human Development, 14195 Berlin, Germany; [2] Department of Social Sciences, University of Mannheim, 68161 Mannheim, Germany

Correspondence to: Prof. Dr. Jutta Mata, Department of Social Sciences (Health Psychology), University of Mannheim, L13, 17, 68161 Mannheim, Germany. E-mail: mata@uni-mannheim.de, phone: +49-6121-181-2595.

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]). 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 cause also 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 to 93 years), the UK (607 male, 609 female; 18 to 93 years), and Germany (429 male, 544 female; 14 to 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 socio-economic 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 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).

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*	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
Socio-economic 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

		% USA	% UK	% Germany
	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		
	Post-graduate 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		
Size of place of residence	< 2000 inhabitants			5.8
	2000–19,999 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

Note. * In the USA and UK, respondents in this age group were 18 to 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).

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 versus 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"): (1) high taxes, (2) nutritional or warning labels, (3) limiting availability or consumption in public spaces, and (4) 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 .01 or below is regarded as small, an η^2 of about .06 as medium, and an η^2 of about

.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 re-calculated 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 (Figure 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.
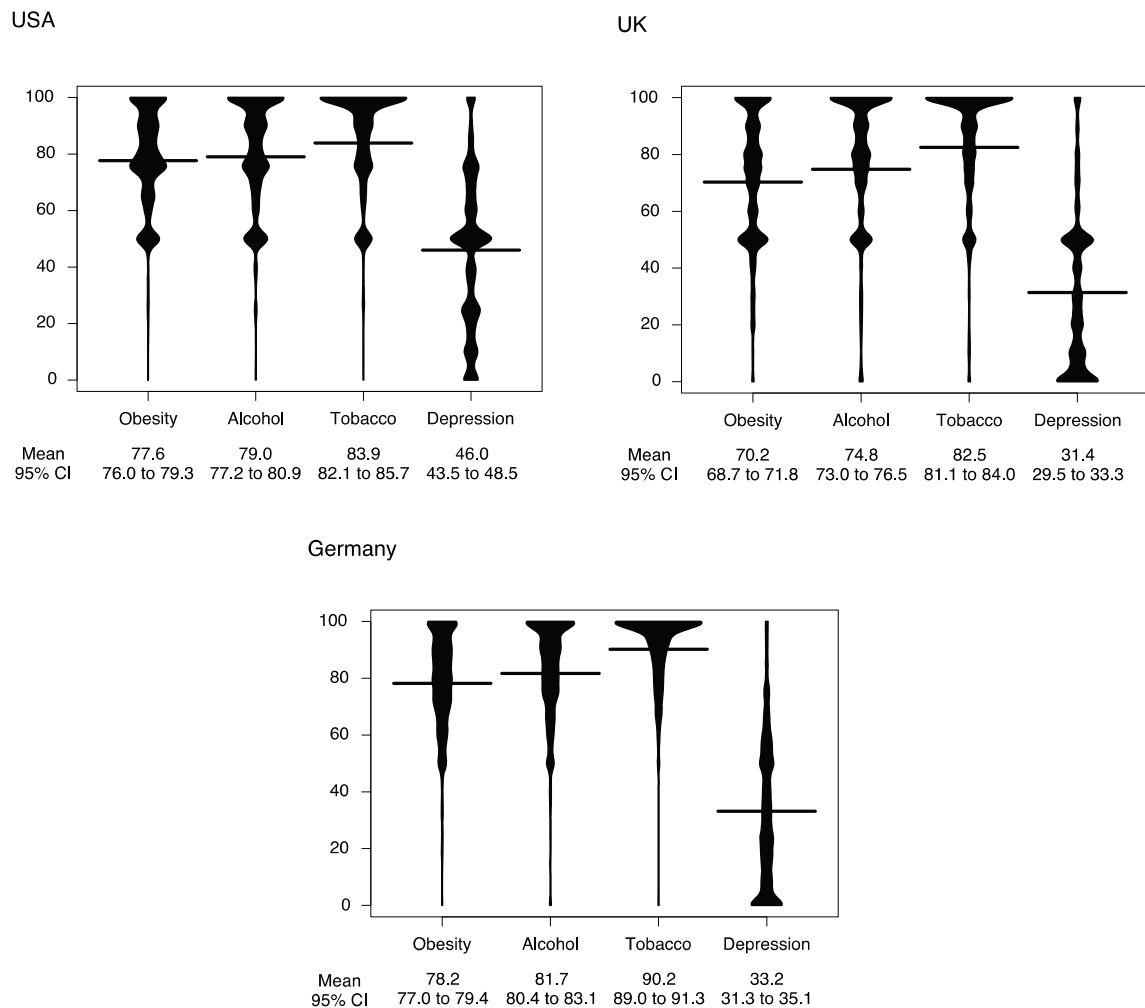
USA

	Obesity	Alcohol	Tobacco	Depression
Mean	77.6	79.0	83.9	46.0
95% CI	76.0 to 79.3	77.2 to 80.9	82.1 to 85.7	43.5 to 48.5

UK

	Obesity	Alcohol	Tobacco	Depression
Mean	70.2	74.8	82.5	31.4
95% CI	68.7 to 71.8	73.0 to 76.5	81.1 to 84.0	29.5 to 33.3

Germany

	Obesity	Alcohol	Tobacco	Depression
Mean	78.2	81.7	90.2	33.2
95% CI	77.0 to 79.4	80.4 to 83.1	89.0 to 91.3	31.3 to 35.1

Figure 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.

Three repeated-measures ANOVAs indicated that attributions of personal responsibility differed significantly across the four health risks, but were similar across the three countries. 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 Germany (see Table 2 for results of statistical significance tests).

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	$F(3, 1713)=561.75$, $p < .001$, $\eta^2 = .50$	O–A	$F(1, 571) = 1.48, p = .225, \eta^2 = .003$
		O–T	$F(1, 571) = 71.17, p < .001, \eta^2 = .11$
		O–D	$F(1, 571) = 678.95, p < .001, \eta^2 = .54$
UK	$F(3, 3108) = 1096.44$, $p < .001$, $\eta^2 = .51$	O–A	$F(1, 1036) = 53.25, p < .001, \eta^2 = .05$
		O–T	$F(1, 1036) = 230.94, p < .001, \eta^2 = .18$
		O–D	$F(1, 1036) = 1255.12, p < .001, \eta^2 = .55$
Germany	$F(3, 2580) = 1598.88$, $p < .001$, $\eta^2 = .65$	O–A	$F(1, 860) = 27.85, p < .001, \eta^2 = .03$
		O–T	$F(1, 860) = 294.39, p < .001, \eta^2 = .26$
		O–D	$F(1, 860) = 1814.81, p < .001, \eta^2 = .68$

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

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%

(Figure 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 in the UK (32.3%) or
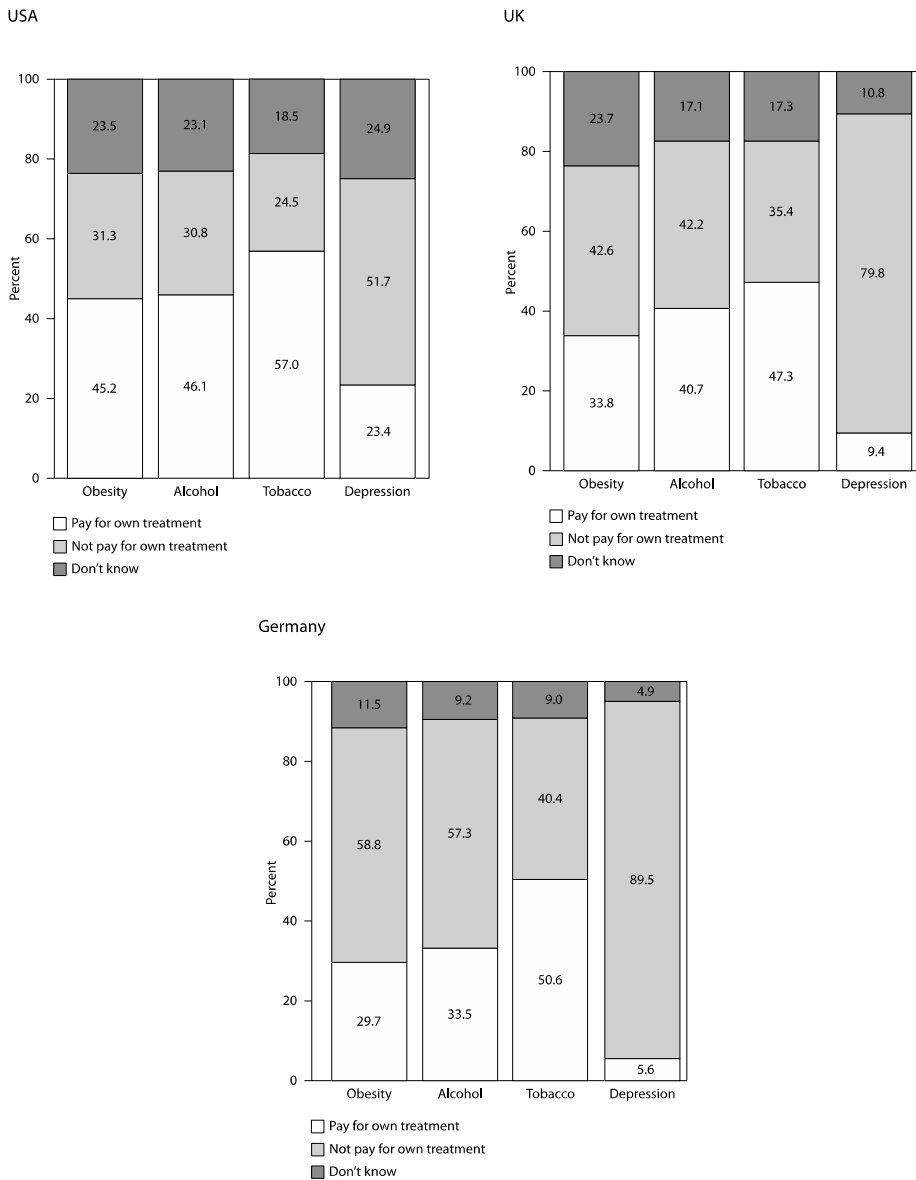
Germany (29.6%).

USA

100 ┐
│ 23.5 │ 23.1 │ 18.5 │ 24.9 │
80 ┤
│ 31.3 │ 30.8 │ 24.5 │ 51.7 │
60 ┤
│   │ 57.0 │   │
40 ┤ 45.2 │ 46.1 │   │   │
20 ┤   │   │ 23.4 │
0 ┘
  Obesity Alcohol Tobacco Depression

☐ Pay for own treatment
☐ Not pay for own treatment
■ Don't know

UK

100 ┐
│ 23.7 │ 17.1 │ 17.3 │ 10.8 │
80 ┤
│ 42.6 │ 42.2 │ 35.4 │ 79.8 │
60 ┤
│   │   │ 47.3 │   │
40 ┤ 33.8 │ 40.7 │   │   │
20 ┤   │   │   │ 9.4 │
0 ┘
  Obesity Alcohol Tobacco Depression

☐ Pay for own treatment
☐ Not pay for own treatment
■ Don't know

Germany

100 ┐
│ 11.5 │ 9.2 │ 9.0 │ 4.9 │
80 ┤
│ 58.8 │ 57.3 │ 40.4 │ 89.5 │
60 ┤
│   │   │ 50.6 │   │
40 ┤ 29.7 │ 33.5 │   │   │
20 ┤   │   │   │ 5.6 │
0 ┘
  Obesity Alcohol Tobacco Depression

☐ Pay for own treatment
☐ Not pay for own treatment
■ Don't know

Figure 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).

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.
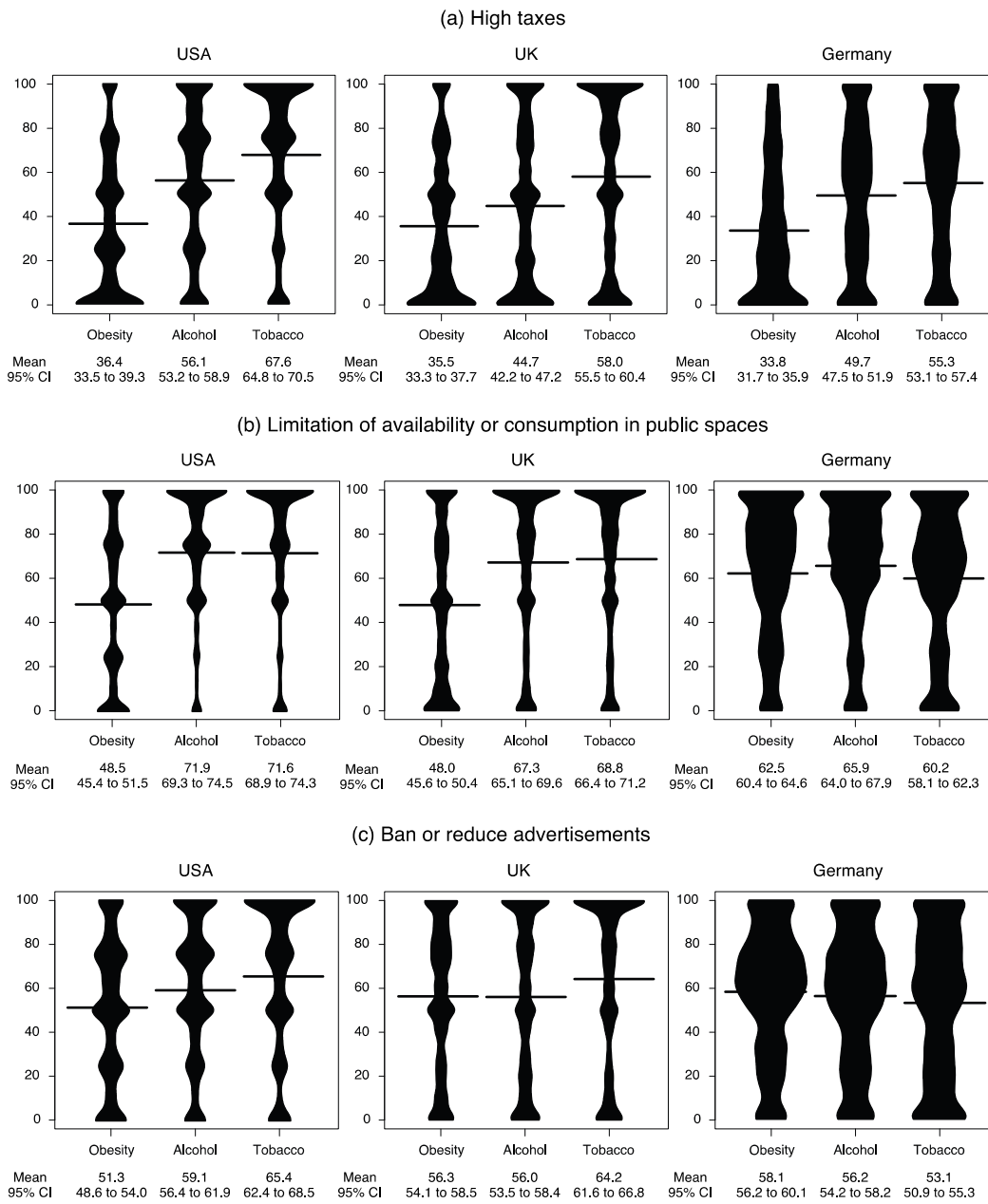
1 *Table 3*

2 Results of logistic regression analyses predicting how beliefs about individual responsibility for obesity/alcohol dependence/tobacco
3 dependence/depression relate to endorsements of individual liability for treatment costs. The odds ratios represent the increase in the
4 odds of endorsing individual liability for treatment costs, per additional point increase (up to a maximum of 100) in the attribution of
5 personal responsibility.
6

		Obesity			Alcohol dependence			Tobacco dependence			Depression		
	Factors included	*B* (SE)	OR	95% CI of OR	*B* (SE)	OR	95% CI of OR	*B* (SE)	OR	95% CI of OR	*B* (SE)	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 to 1.05	0.04 (0.01)	1.04	1.03 to 1.05	0.04 (0.01)	1.04	1.03 to 1.04	0.03 (0.004)	1.03	1.02 to 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 to 1.04	0.02 (0.003)	1.02	1.01 to 1.02	0.02 (0.003)	1.02	1.01 to 1.02	0.03 (0.004)	1.03	1.02 to 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 to 1.04	0.04 (0.01)	1.04	1.03 to 1.05	0.03 (0.01)	1.03	1.02 to 1.04	0.02 (0.01)	1.02	1.01 to 1.03

7 *Note:* 95% CI: 95% confidence interval, OR: Odds ratio, SE: standard error.
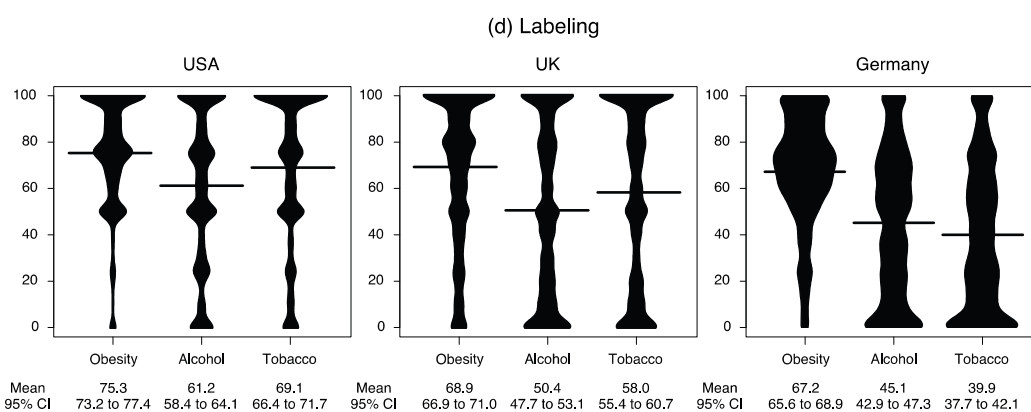8

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

10   We considered four policies designed to reduce the consumption of potentially harmful

11   substances, such as sweet/fatty foods, alcohol, and tobacco: (1) high taxes, (2) limiting availability

12   or consumption in public spaces, (3) regulating marketing (i.e., banning or limiting advertising), and

13   (4) labeling and warnings, see Figure 3.

(a) High taxes

		USA				UK				Germany	
	Obesity	Alcohol	Tobacco		Obesity	Alcohol	Tobacco		Obesity	Alcohol	Tobacco
Mean	36.4	56.1	67.6	Mean	35.5	44.7	58.0	Mean	33.8	49.7	55.3
95% CI	33.5 to 39.3	53.2 to 58.9	64.8 to 70.5	95% CI	33.3 to 37.7	42.2 to 47.2	55.5 to 60.4	95% CI	31.7 to 35.9	47.5 to 51.9	53.1 to 57.4

(b) Limitation of availability or consumption in public spaces

		USA				UK				Germany	
	Obesity	Alcohol	Tobacco		Obesity	Alcohol	Tobacco		Obesity	Alcohol	Tobacco
Mean	48.5	71.9	71.6	Mean	48.0	67.3	68.8	Mean	62.5	65.9	60.2
95% CI	45.4 to 51.5	69.3 to 74.5	68.9 to 74.3	95% CI	45.6 to 50.4	65.1 to 69.6	66.4 to 71.2	95% CI	60.4 to 64.6	64.0 to 67.9	58.1 to 62.3

(c) Ban or reduce advertisements

		USA				UK				Germany	
	Obesity	Alcohol	Tobacco		Obesity	Alcohol	Tobacco		Obesity	Alcohol	Tobacco
Mean	51.3	59.1	65.4	Mean	56.3	56.0	64.2	Mean	58.1	56.2	53.1
95% CI	48.6 to 54.0	56.4 to 61.9	62.4 to 68.5	95% CI	54.1 to 58.5	53.5 to 58.4	61.6 to 66.8	95% CI	56.2 to 60.1	54.2 to 58.2	50.9 to 55.3

14

15

Figure 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.

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, 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.

37   Table 4

38   *Statistical difference values for answers to the question "How effective is measure X in preventing*
39   *obesity/alcohol dependence/tobacco dependence/depression?"*

		Main effect across four health risks	Within-subject contrasts	
High taxes	USA	$F(2, 1368) = 294.14$, $p < .001$, $\eta^2 = .30$	O–A O–TD	$F(1, 684) = 227.95$, $p < .001$, $\eta^2 = .25$ $F(1, 684) = 486.30$, $p < .001$, $\eta^2 = .42$
	UK	$F(2, 2140) = 167.80$, $p < .001$, $\eta^2 = .14$	O–A O–T	$F(1, 1070) = 69.87$, $p < .001$, $\eta^2 = .06$ $F(1, 1070) = 313.31$, $p < .001$, $\eta^2 = .23$
	Germany	$F(2, 1792) = 171.86$, $p < .001$, $\eta^2 = .16$	O–A O–T	$F(1, 896) = 165.03$, $p < .001$, $\eta^2 = .16$ $F(1, 896) = 283.47$, $p < .001$, $\eta^2 = .24$
Limiting availability or consumption in public spaces	USA	$F(2, 1390) = 190.03$, $p < .001$, $\eta^2 = .22$	O–A O–T	$F(1, 695) = 242.30$, $p < .001$, $\eta^2 = .26$ $F(1, 695) = 270.55$, $p < .001$, $\eta^2 = .28$
	UK	$F(2, 2170) = 177.0$, $p < .001$, $\eta^2 = .14$	O–A O–T	$F(1, 1085) = 219.85$, $p < .001$, $\eta^2 = .17$ $F(1, 1085) = 274.25$, $p < .001$, $\eta^2 = .20$
	Germany	$F(2, 1846) = 15.26$, $p < .001$, $\eta^2 = .02$	O–A O–T	$F(1, 923) = 7.00$, $p = .008$, $\eta^2 = .01$ $F(1, 923) = 7.25$, $p = .007$, $\eta^2 = .01$
Banning or limiting advertising	USA	$F(2, 1330) = 73.79$, $p < .001$, $\eta^2 = .10$	O–A O–T	$F(1, 665) = 48.28$, $p < .001$, $\eta^2 = .07$ $F(1, 665) = 131.84$, $p < .001$, $\eta^2 = .17$
	UK	$F(2, 2174) = 35.0$, $p < .001$, $\eta^2 = .03$	O–A O–T	$F(1, 1087) = 0.57$, $p = .450$, $\eta^2 = .00$ $F(1, 1087) = 54.46$, $p < .001$, $\eta^2 = .05$
	Germany	$F(2, 1788) = 9.48$, $p < .001$, $\eta^2 = .01$	O–A O–T	$F(1, 894) = 1.62$, $p = .203$, $\eta^2 = .00$ $F(1, 894) = 16.74$, $p < .001$, $\eta^2 = .02$
Labeling and warnings	USA	$F(2, 1352) = 94.85$, $p < .001$, $\eta^2 = .12$	O–A O–T	$F(1, 676) = 164.93$, $p < .001$, $\eta^2 = .20$ $F(1, 676) = 33.88$, $p < .001$, $\eta^2 = .05$
	UK	$F(2, 2174) = 106.0$, $p < .001$, $\eta^2 = .09$	O–A O–T	$F(1, 1087) = 198.16$, $p < .001$, $\eta^2 = .15$ $F(1, 1087) = 59.81$, $p < .001$, $\eta^2 = .05$
	Germany	$F(2, 1834) = 384.96$, $p < .001$, $\eta^2 = .30$	O–A O–T	$F(1, 917) = 423.12$, $p < .001$, $\eta^2 = .32$ $F(1, 917) = 613.71$, $p < .001$, $\eta^2 = .40$

40   *Note.* O: Obesity, A: alcohol dependence, T: tobacco dependence, D: depression. After Bonferroni
41   corrections, only *p* values smaller or equal to .001 are considered statistically significant.
42

43   We also conducted three repeated-measures ANOVAs comparing participants' judgments of the

44   effectiveness of the four policies in the context of obesity. Across all countries, the perceived

45   effectiveness differed significantly between the four policy areas (all *p*s < .001, η^2 between .20 and

46   .33; see Table S1 and Figure S1 in the Supplemental Material). We therefore conducted paired

47   comparisons to contrast the perceived effectiveness of the four policy measures. In all three

48   countries, the perceived effectiveness of taxation was lowest and that of labeling was highest. In the

49   UK, banning or limiting advertising was perceived as the second most effective policy measure and

50   limiting availability or consumption in public spaces as the third most effective; in Germany, this

51   order was reversed; and in the USA, these two policies were perceived as similarly effective (see

52   Table S1 for all statistical coefficients).

53   Does Level of Household Income Influence Beliefs About Locus of Responsibility, Liability for

54   Treatment Costs, and Effectiveness of Policy Measures?

55   Not only does the magnitude of the four health risks differ across socio-economic groups, the

56   four policies discussed may affect these groups differently (e.g., higher taxation). Therefore, we

57   tested how net household income related to locus of responsibility, liability for treatment costs, and

58   effectiveness of policy measures. To this end, we re-ran all analyses reported above, examining the

59   influence of three levels of household income in each country (low, medium, high). The following

60   patterns emerged (see Tables S2 to S5 in the Supplemental Material for the results of all statistical

61   tests): It was only in the USA that attributions of personal responsibility for the four health risks

62   differed by income level (interaction effect between the main effect across the four health risks and

63   household income, $F(3, 1713) = 5.30$, $p = .001$, $\eta^2 = .01$). This effect was driven by differences in

64   attributions of responsibility for obesity versus depression: People with a high or medium income

65   attributed almost twice as much responsibility for obesity than for depression to the individual (78.8

66   for obesity versus 42.6 for depression in the high income group; 78.8 for obesity versus 47.0 for

67   depression in the medium income group); in the low income group, the difference between the two

68   health risks was much smaller (73.7 for obesity versus 50.7 for depression). In contrast, we did not

69   find any influence of income level on attributions of responsibility for any of the four health risks in

70   the UK or Germany (Table S2).

71   Next, we examined whether income level influenced participants' beliefs about individual

72 liability for treatment costs across the health risks, running Cochran's Q tests separated by income

73 level. Across all three countries and income levels, the proportion of participants who believed that

74 afflicted individuals should pay for treatment themselves differed across the four health risks (Table

75 S3). Paired comparisons of obesity with each of the three other health risks revealed that income

76 level did not drive differences in the proportion of participants endorsing individual liability for

77 treatment costs for obesity versus alcohol dependence or obesity versus depression. Across the three

78 countries and income levels, a larger proportion of participants endorsed individual liability for

79 treatment costs for tobacco dependence than for obesity, but the difference in proportions was

80 significant in only five of the nine comparisons (three income levels × three countries).

81   Across the three countries, income level did not affect the relation between beliefs about

82 individual responsibility for a health risk and endorsements of individual liability for its treatment

83 costs (Table S4), with one exception: in the USA, for each decrease in income level (i.e., from high

84 to medium or medium to low), the odds of endorsing individual liability for the treatment costs for

85 depression were roughly halved. Further, income level did not affect the perceived effectiveness of

86 the policy measures across the three countries (Table S5).

87   **Discussion**

88 **Statement of Principal Findings**

89   Respondents in the USA, UK, and Germany attributed responsibility for obesity primarily to

90 the individual. This pattern of attribution also held for alcohol dependence and, to an even greater

91 extent, for tobacco dependence. Thus, in terms of personal responsibility, people placed obesity

92 closer to alcohol and tobacco dependence than to a stress-related mental disorder, depression.

93 Likewise, they placed obesity closer to substance dependencies in terms of perceived liability for

94   treatment costs, with similar patterns of findings emerging across the four health risks in all three

95   countries: Respondents' levels of endorsement of individual liability for treatment costs for obesity

96   were similar to those for alcohol dependence, and also much closer to those for tobacco dependence

97   than for depression. Furthermore, respondents who tended to attribute personal responsibility for

98   health risks also considered the individuals affected to be more accountable for the costs incurred.

99   Respondents in all three countries believed intelligible nutrition labeling—the least intrusive and

100   restrictive measure—to be the most effective policy (among those considered) for preventing

101   obesity, and taxes to be the least effective policy. Last but not least, across all three countries, the

102   level of household income had limited influence on respondents' beliefs about locus of

103   responsibility, liability for treatment costs, and effectiveness of policy measures.

104   **Strengths, Weaknesses, and Future Research**

105   To our knowledge, this is the first investigation to compare lay theories of obesity and of

106   other major health risks thought to share certain similarities with obesity. Further, it is the first study

107   to use the same items to elicit lay beliefs about major health risks across representative samples in

108   three countries. The findings identify a gap between lay and expert beliefs about the causes of

109   obesity: Although there is growing agreement among experts that the rapid weight gain of the last

110   four decades has been largely driven by the obesogenic modern food environment [31], lay people

111   in the three countries under investigation tend to hold the individual responsible. We also analyzed

112   the impact of one important indicator of socioeconomic status, namely, household income, across

113   the three countries. Future research needs to examine additional indicators of socioeconomic status.

114   Although participants entered their survey responses into a personal computer in all three countries,

115   the different survey modes (computer-assisted face-to-face interviews in the UK and Germany

116   versus online surveys in the USA) may have affected responses (e.g., [32]). However, given the

117   similarity of responses and response patterns across the two survey modes (e.g., concerning

118 perceptions about individual responsibility for the four health risks), we believe that any impact of

119 the difference in survey modes is limited. Other potential limitations are that, like any self-report

120 measure, our surveys are subject to response bias, and that individual knowledge or attitudes may

121 also have influenced respondents' answers. Despite randomization of question blocks, moreover,

122 order effects are possible. Admittedly, our focus on countries with high obesity rates is also a

123 limitation, but our concern was to exclude the obesity rate itself as the cause of potentially divergent

124 public beliefs.

125 **Conclusion**

126 In 2014, more than 1.9 billion adults worldwide were overweight or obese [1]. The

127 fundamental cause of obesity is an energy imbalance between calories consumed and calories

128 expended. One of the two key levers to fight the obesity epidemic is therefore the number of daily

129 calories consumed. How this can be achieved will depend substantially on the framing of this health

130 crisis. If framed as a matter of personal (ir)responsibility, it will be addressed differently than if

131 framed as a crisis driven in no small part by other factors (e.g., an obesogenic environment,

132 corporate misbehavior, lack of government regulations).

133 It is important to acknowledge that obesity is brought about by myriad factors and is likely

134 the result of an interaction between environment and individual. Therefore, there is unlikely to be a

135 silver bullet—that is, a single lever that can be used to contain or even reverse the obesity epidemic.

136 Helping individuals with obesity to take responsibility for factors they can control (e.g., weight-

137 related behaviors) and not unduly attributing responsibility to those they cannot control (e.g.,

138 environmental characteristics) could attenuate some of the guilt, poor self-acceptance, and stigma

139 that people with obesity experience [33, 34]. That being said, behavioral interventions on obesity are

140 rarely successful in the long term [35–37]. Thus, focusing on prevention, particularly by designing

141   our modern environment to make it less obesogenic, will likely be a key force in combatting the

142   obesity epidemic.

143   There were some notable similarities and differences in views across countries. For instance,

144   US respondents were more likely to endorse individual liability for treatment costs than were

145   German or UK respondents. This finding is consistent with a pattern observed by Branson and

146   colleagues [16], showing the USA to stand out among wealthier nations as the country least in favor

147   of government interventions. It is also consistent with the degree of public funding of the healthcare

148   system: In 2013, 48% of healthcare costs in the USA were publicly funded, relative to 83% in the

149   UK and 77% in Germany [38].

150   Our results show that the US, UK, and German public strongly believe individuals to be

151   personally responsible for obesity and, similarly, for tobacco and alcohol dependence. Although it is

152   unclear to what extent the public has adopted the food and soda industries' framing of the problem

153   [7, 39], this belief has policy implications. For instance, attribution to individuals is, as our results

154   show, positively associated with the belief that individuals should be personally liable for treatment

155   costs. Furthermore, the public's emphasis on personal responsibility may also explain why

156   information (intelligent labeling) is rated to be most effective in preventing obesity, and taxation to

157   be least effective. The former can be interpreted as boosting the individual's competence to exercise

158   personal responsibility, whereas taxes on unhealthy food can be understood as a one-size-fits-all

159   penalty that is unfair to those who consume fast food only as a rare treat.

160   Yet public opinions change and evolve. In all three countries, respondents rated high taxes as

161   effective in reducing tobacco consumption. Over a period of decades, the US public has transformed

162   from a smoking-tolerant culture to one accepting and supporting bans on the marketing and

163   consumption of tobacco (e.g., creating smoke-free public places), as well as high taxation of tobacco

164   products [31]. Lessons learned in overcoming opposition to fiscal and regulatory inventions in the

165   context of smoking might help policymakers to raise public support for corresponding measures

166   addressing obesity [40].

167   Our results highlight one obesity-prevention measure that already enjoys public support,

168   namely, intelligible food labeling. In Germany and the UK, nutrition labels have been mandated by

169   EU regulations since December 2016 [41]. The UK has additionally implemented an improved

170   front-of-pack labeling system [42]. In May 2016, the US Food and Drug Agency (FDA) launched a

171   new, more comprehensive food label including a declaration of added sugars and realistic portion

172   sizes [43]. Despite this important progress, neither the EU nor the FDA legislation mandates

173   understandable and user-friendly *front-of-package* labeling (such as the traffic-light system), the

174   type of labeling that consumers consult most often [44].

175   Taxing of unhealthy foods and drinks, such as sugar-sweetened beverages, is still at an early

176   stage. The World Health Organization (WHO) recently called for a 20% tax on sugar-sweetened

177   beverages. Berkeley was the first US city to impose such a tax [45]. The UK government has

178   published draft legislation for a tax on sugar-sweetened drinks to begin in 2018 [46]. Germany is

179   currently not expected to impose such a tax (e.g., [47]).

180   First attempts to limit access to sugar-sweetened beverages and foods high in sugar, salt, or

181   fat have been made in schools: In 2005, both the UK government [48] and California [45] banned

182   vending machines selling such products. We are not aware of any plans in Germany to institute a

183   similar ban in public spaces. Regarding limits or bans on advertising, the UK has again implemented

184   the strongest and most far-reaching policies, with advertising of products high in fat, salt, or sugar

185   being banned from programs aimed at children aged between 4 and 15 years since 2008. In the

186   USA, the Children's Food and Beverage Advertising Initiative, launched in 2007, has issued a list of

187   products that may be advertised to children. However, in 2014, more than half of the products on the

188   list exceeded the recommended limit for saturated fat, trans fat, sugar, and sodium [49]. To our

189 knowledge, Germany does not restrict the content or timing of television advertisements aimed at

190 children (e.g., [50]).

191   To summarize, the available public record suggests that, of the three countries surveyed, the

192 UK has most forcefully implemented policies to target obesity. In the USA, a number of policies

193 apply only at the city or state level; thus, there is considerable variation across the country. In

194 Germany, comparably little effort seems to have been made to implement obesity prevention

195 policies. This pattern mirrors the regulations and policies implemented to control tobacco

196 consumption: On the Tobacco Control Scale, the UK ranks as the country most forcefully

197 implementing tobacco control policies; Germany ranks 26th (among 31 ranked countries) [51]. The

198 USA was not ranked on the Tobacco Control Scale but has implemented a number of regulatory

199 measures [21]. Worldwide, countries are only now beginning to implement policies to curtail and

200 prevent obesity. The efficacy of many of these policies, as well as their effects on different

201 population groups, is yet to be evaluated. Yet effective policies also require public support.

202 Understanding lay people's beliefs about what is possibly the most significant global risk to public

203 health, and how those beliefs relate to public support of policy measures, promises to be an

204 important step in orchestrating individual and collective responses to the obesity crisis.

205

206   **References**

207 1. World Health Organization. Fact sheet N°311: Obesity and overweight. *World Health*

208   *Organization Media centre* http://www.who.int/mediacentre/factsheets/fs311/en/ (Published

209   June 2016, accessed 9 February 2017)

210 2. Hill JO, Peters JC. Environmental contributions to the obesity epidemic. *Science* 1998; 280:

211   1371–1374.

212 3. Estabrooks PA, Fisher EB, Hayman LL. What is needed to reverse the trends in childhood

213   obesity? A call to action. *Ann Behav Med* 2008; 36: 209–216.

214   4. Sallis JF, Carlson JA, Mignano AM, et al. Trends in presentations of environmental and policy

215   studies related to physical activity, nutrition, and obesity at Society of Behavioral Medicine,

216   1995–2010: A commentary to accompany the Active Living Research Supplement to Annals

217   of Behavioral Medicine. *Ann Behav Med* 2013; 45 (Suppl 1): S14–17.

218   5. Franck C, Grandi SM, Eisenberg MJ. Taxing junk food to counter obesity. *Am J Public Health*

219   2013; 103: 1949–1953.

220   6. Harris JL, Pomeranz JL, Lobstein T, et al. A crisis in the marketplace: How food marketing

221   contributes to childhood obesity and what can be done. *Annu Rev Public Health* 2009; 30:

222   211–225.

223   7. Brownell KD, Warner KE. The perils of ignoring history: Big tobacco played dirty and

224   millions died. How similar is big food? *Milbank Q* 2009; 87: 259–294.

225   8. World Health Organization. Data for saving lives. *WHO Global InfoBase*

226   https://apps.who.int/infobase/Comparisons.aspx (accessed 9 February 2017).

227   9. Marcus MD, Wildes JE. Obesity: Is it a mental disorder? *Int J Eat Disord* 2009; 42: 739–753.

228   10. Gearhardt AN, Corbin WR, Brownell KD. Food addiction: An examination of the diagnostic

229   criteria for dependence. *J Addict Med* 2009; 3: 1–7.

230   11. Hammen C. Stress and depression. *Annu Rev Clin Psychol* 2005; 1: 293–319.

231   12. Adam TC, Epel ES. Stress, eating and the reward system. *Physiol Behav* 2007; 91: 449–458.

232   13. Gilpin EA, Lee L, Pierce JP. Changes in population attitudes about where smoking should not

233   be allowed: California versus the rest of the USA. *Tob Control* 2004; 13: 38–44.

234   14. Mons U, Jazbinsek D, Kahnert S. Smoke-free restaurants in Germany 2012: Majority of

235   smokers in favor of smoking ban for the first time [in German].

236   http://www.dkfz.de/de/tabakkontrolle/download/Publikationen/AdWfP/AdWfP_Rauchfreie_G

237   aststaetten_2012.pdf (2012, accessed 9 February 2017).

238 15. Morgan A. Germans (75%) reject extra taxes on unhealthy foods [in German]. *mingle-Trend*

239   http://mingle-trend.respondi.com/de/deutsche-75-lehnen-extrasteuer-auf-ungesunde-

240   lebensmittel-ab/ (2011, accessed 9 February 2017).

241 16. Branson C, Duffy B, Perry C, et al. *Acceptable behaviour? Public opinion on behaviour*

242   *change policy*. London: Ipsos MORI: Social Research Institute https://www.ipsos-

243   mori.com/DownloadPublication/1454_sri-ipsos-mori-acceptable-behaviour-january-2012.pdf

244   (2012, accessed 9 February 2017).

245 17. Särndal C-E, Swensson B, Wretman J. *Model Assisted Survey Sampling*. New York: Springer,

246   1992.

247 18. McFerran B, Mukhopadhyay A. Lay theories of obesity predict actual body mass. *Psychol Sci*

248   2013; 24: 1428–1436.

249 19. Sikorski C, Luppa M, Schomerus G, et al. Public attitudes towards prevention of obesity.

250   *PLoS ONE* 2012; 7: e39325.

251 20. Room R, Babor T, Rehm J. Alcohol and public health. *The Lancet* 2005; 365: 519–530.

252 21. World Health Organization. *WHO Report on the Global Tobacco Epidemic, 2011 Warning*

253   *About the Dangers of Tobacco*. Geneva: World Health Organization

254   http://www.who.int/tobacco/global_report/2011/en/index.html (2011, accessed 9 February

255   2017).

256 22. Hawkes C. *Nutrition labels and health claims: The global regulatory environment*. Geneva:

257   World Health Organization, 2004.

258 23. Thomson LM, Vandenberg B, Fitzgerald JL. An exploratory study of drinkers views of health

259   information and warning labels on alcohol containers: Warning labels on alcohol containers.

260   *Drug Alcohol Rev* 2012; 31: 240–247.

261   24. Hammond D. Health warning messages on tobacco products: A review. *Tob Control* 2011; 20:

262   327–337.

263   25. Taber DR. Banning all sugar-sweetened beverages in middle schools: Reduction of in-school

264   access and purchasing but not overall consumption. *Arch Pediatr Adolesc Med* 2012; 166:

265   256.

266   26. McClure AC, Tanski SE, Gilbert-Diamond D, et al. Receptivity to television fast-food

267   restaurant marketing and obesity among U.S. youth. *Am J Prev Med* 2013; 45: 560–568.

268   27. Smith LA, Foxcroft DR. The effect of alcohol advertising, marketing and portrayal on

269   drinking behaviour in young people: Systematic review of prospective cohort studies. *BMC*

270   *Public Health* 2009; 9: 51.

271   28. Harris F. Effects of the 2003 advertising/promotion ban in the United Kingdom on awareness

272   of tobacco marketing: Findings from the International Tobacco Control (ITC) Four Country

273   Survey. *Tob Control* 2006; 15: iii26–iii33.

274   29. Cohen J. *Statistical power analysis for the behavioral science*. 2nd ed. Hillsdale (NJ):

275   Lawrence Erlbaum Associates, 1988.

276   30. IBM Corp. Released 2016. *IBM SPSS Statistics for Macintosh, Version 24.0*. Armonk, NY:

277   IBM Corp.

278   31. Rozin P. The process of moralization. *Psychol Sci* 1999; 10: 218–221.

279   32. Duffy B, Smith K, Terhanian G, et al. Comparing data from online and face-to-face surveys.

280   2005; 47: 615–639.

281   33. Carr D, Friedman M. Is obesity stigmatizing? Body weight, perceived discrimination, and

282   psychological well-being in the United States. *J Health Soc Behav* 2005; 46: 244–259.

283   34. Puhl RM, Heuer CA. The stigma of obesity: A review and update. *Obes Silver Spring Md*

284   2009; 17: 941–964.

285   35. Fildes A, Charlton J, Rudisill C, et al. Probability of an obese person attaining normal body

286   weight: Cohort study using electronic health records. *Am J Public Health* 2015; 105: e54–e59.

287   36. Jeffery RW, Epstein LH, Wilson GT, et al. Long-term maintenance of weight loss: Current

288   status. *Health Psychol* 2000; 19: 5–16.

289   37. Wing RR, Phelan S. Long-term weight loss maintenance. *Am J Clin Nutr* 2005; 82: S222–

290   S225.

291   38. OECD. *Health at a Glance 2015*. OECD Publishing http://www.oecd-ilibrary.org/social-

292   issues-migration-health/health-at-a-glance-2015_health_glance-2015-en (2015, accessed 9

293   February 2017).

294   39. Nestle M. *Soda Politics: Taking on Big Soda (and Winning)*. Oxford, UK: Oxford University

295   Press, 2015.

296   40. Marteau TM, Hollands GJ, Fletcher PC. Changing human behavior to prevent disease: The

297   importance of targeting automatic processes. *Science* 2012; 337: 1492–1495.

298   41. The European Parliament and the Council of the European Union. Regulation (EU) No

299   1169/2011 of the European Parliament and of the Council. *Off J Eur Union* 2011; 304: 18–63.

300   42. Department of Health, Government of the United Kingdom. *2010 to 2015 government policy:*

301   *Obesity and healthy eating* https://www.gov.uk/government/publications/2010-to-2015-

302   government-policy-obesity-and-healthy-eating/2010-to-2015-government-policy-obesity-and-

303   healthy-eating (2015, accessed 9 February 2017).

304   43. U.S. Food & Drug Andministration. Changes to the Nutrition Facts Label. *U.S. Department of*

305   *Health and Human Services*

306   http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/La

307   belingNutrition/ucm385663.htm (2017, accessed 9 February 2017).

308   44. Grunert K, Wills J, Fernández-Celemín L. Nutrition knowledge, and use and understanding of

309   nutrition information on food labels among consumers in the UK. *Appetite* 2010; 55: 177–189.

310   45. World Health Organization. *Fiscal policies for diet and prevention of noncommunicable*

311   *diseases: Technical meeting report, 5-6 May 2015, Geneva, Switzerland.*

312   http://apps.who.int/iris/bitstream/10665/250131/1/9789241511247-eng.pdf (2016, accessed 9

313   February 2017).

314   46. BBC News. UK pushes ahead with sugar tax. http://www.bbc.com/news/health-38212608

315   (2016, accessed 9 February 2017).

316   47. Süddeutsche Zeitung. What would a sugar tax bring? [in German]

317   http://www.sueddeutsche.de/gesundheit/ernaehrung-was-wuerde-eine-zuckersteuer-bewirken-

318   1.3206627 (2016, accessed 9 February 2017).

319   48. Dimbleby H, Vincent J. *The School Food Plan* http://www.schoolfoodplan.com/wp-

320   content/uploads/2013/07/School_Food_Plan_2013.pdf (2013, accessed 9 February 2017).

321   49. Schermbeck RM, Powell LM. Nutrition recommendations and the Children's Food and

322   Beverage Advertising Initiative's 2014 approved food and beverage product list. *Prev Chronic*

323   *Dis* 2015; 12: 1–6.

324   50. Capacci S, Mazzocchi M, Shankar B, et al. Policies to promote healthy eating in Europe: A

325   structured review of policies and their effectiveness. *Nutr Rev* 2012; 70: 188–200.

326   51. Joossens L, Raw M. The tobacco control scale 2010 in Europe

327   https://www.krebshilfe.de/fileadmin/Downloads/PDFs/Kampagnen/TCS_2010_Europe.pdf

328   (2011, accessed 9 February 2017).

329