International Journal of Public Health (2019) 64:1139–1146
https://doi.org/10.1007/s00038-019-01295-0

ORIGINAL ARTICLE

Public beliefs about causes of obesity in the USA and in Germany

Olaf von dem Knesebeck[1] · Daniel Lüdecke[1] · Claudia Luck-Sikorski[2] · Tae Jun Kim[1]

Received: 25 February 2019 / Revised: 31 July 2019 / Accepted: 27 August 2019 / Published online: 4 September 2019

Abstract

Objectives Differences in public beliefs about causes of obesity between the USA and Germany are analyzed. We additionally examine the relevance of social characteristics of individuals with obesity for causal attributions in the two countries.

Methods National telephone surveys were conducted in both countries (total sample = 2802). Vignettes describing a person with obesity were used and varied according to gender, migration status, and occupational position. Beliefs about causes of obesity were assessed by 12 items, representing four dimensions ('sociocultural causes', 'behavior-related causes', 'somatic and psychological causes,' and 'educational and financial causes').

Results Respondents from the USA more strongly support sociocultural as well as educational and financial causes of obesity. When the person with obesity has a low occupational position or is a migrant, sociocultural causes are considered more important, whereas agreement to behavioral as well as somatic and psychological factors is less pronounced.

Conclusions In the USA, external causal attributions (i.e., causes that are beyond individual's control) seem to play a more important role than in Germany. In both countries, public causal beliefs about obesity vary according to social characteristics of the person afflicted.

Keywords Public beliefs · Causes · Obesity · Germany · USA

Introduction

Obesity is a major public health problem as the prevalence has globally increased continuously over the past decades (Ng et al. 2014). In Germany, about 24% of the adult population had a body mass index (BMI) $\geq$ 30 kg/m^2 in 2011 and was therefore considered to be obese (Mensink et al. 2013). In the USA, the overall age-adjusted prevalence of obesity was 37.7% for the years 2013–2014 (Flegal et al. 2016). In view of this increasing prevalence and the immense public health consequences, it is important to investigate and understand causes and risk factors of obesity. Although excess energy consumption (dietary intake) relative to energy expenditure (energy loss via metabolic and physical activity) is a major cause of obesity, genetic, physiologic, environmental, psychological, social, economic, and political factors also play an important role in explaining the etiology and increasing prevalence of obesity. (WHO 2007; Wright and Aronne 2012). These factors often interact in a complex way, as for example shown for genetic, behavioral, and environmental factors (Llewellyn 2018).

Public beliefs about causes of obesity commonly do not reflect this diversity and complexity. Causal beliefs are relevant because they have been found to be associated with health behavior (Wang and Coups 2010), stigmatizing attitudes and discrimination (Puhl and Heuer 2010) as well as attitudes toward policy interventions to reduce obesity

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00038-019-01295-0) contains supplementary material, which is available to authorized users.

✉ Olaf von dem Knesebeck
o.knesebeck@uke.de

Daniel Lüdecke
d.luedeck@uke.de

Claudia Luck-Sikorski
claudia.luck-sikorski@srh.de

Tae Jun Kim
t.kim@uke.de

[1] Department of Medical Sociology, University Medical Center Hamburg-Eppendorf, Martinistr. 52, 20246 Hamburg, Germany

[2] SRH, University of Applied Health Sciences, Neue Straße 28-30, 07548 Gera, Germany

prevalence (Beeken and Wardle 2013; Pearl and Lebowitz 2014). Furthermore, knowledge about causes or risk factors of health problems is an important aspect of health literacy (Sorensen et al. 2012). According to a systematic review by Sikorski et al. (2011), seven studies analyzed causal beliefs in representative population samples. Results show that causes which are under individual's control (e.g., lack of physical activity, lack of willpower, or overeating) are most frequently endorsed in population surveys (between 60 and 80% of the population). Bad food environment was also often considered to be an important cause (about 50%), while genetic factors were less often mentioned as important (about 30%). Agreement with other environmental factors was even less pronounced, while social and psychological factors have rarely been examined. Recent population studies (Beeken and Wardle 2013; Luck-Sikorski et al. 2017; Wang and Coups 2010) basically support the results of the systematic review.

Findings furthermore indicate some country differences in causal beliefs, for example, between Germany and the USA where most of the studies have been conducted (Sikorski et al. 2011). However, international comparisons based on similar samples and measures are rare (Mata and Hertwig 2018). Furthermore, most studies do not consider social characteristics of the people with obesity [e.g., gender, ethnicity, and socioeconomic status (SES)] that are likely to have an impact on beliefs about obesity (Ferguson et al. 2009; Puhl et al. 2013). Thus, causal beliefs may not be generalized but can be expected to vary according to social characteristics of the person afflicted. In this regard, for example, Sikorski et al. (2012) used vignettes describing persons with obesity and differing age and gender and found some differences in causal attributions. Use of vignettes is quite common in stigma research, also to investigate interactions with social characteristics (Knesebeck et al. 2017).

Against this background, differences in public beliefs about causes of obesity between the USA and Germany are analyzed in an explorative study. These two countries have medium to high prevalence rates of obesity (Germany = 23.6%; US = 38.2%; OECD average = 19.5%, OECD 2017). It has been assumed that prevalence rates may influence perceptions and norms related to weight (Burke and Heiland 2018). Accordingly, a higher prevalence of obesity in a country may reinforce perceptions of obesity as a common phenomenon and promote causal attributions that are beyond individual's control. In addition, we examine the relevance of social characteristics (gender, ethnicity, and SES) of individuals with obesity for the causal attributions in the two countries.

Methods

Study and sample

Analyses are based on national telephone surveys (computer-assisted telephone interview, CATI) conducted in spring and summer 2017 in Germany and the USA. Samples consisted of adults aged 18 and older, living in private households. In Germany, 70% of the sample was drawn from all registered private telephone numbers at random, additional computer-generated numbers also allowed for ex-directory households (landline numbers). The other 30% of the sample consisted of randomly generated mobile phone numbers (Random Digit Dialing, RDD). In the USA, also a RDD sample was generated, consisting of 60% landline numbers and 40% mobile numbers. We decided to draw a larger proportion of mobile numbers for the US sample as there are more people who have a mobile phone but not a landline number in the USA (Häder and Sand 2019; Mills 2017). It was intended to have the same sample size in both countries. 1401 women and men voluntarily participated in each country (total sample $N = 2802$), reflecting a response rate of about 49% in Germany and 44% in the USA. These rates were calculated based on the net sample without units that were not eligible. Contacted persons were informed that participation in the study is voluntary and that they may withdraw from the study at any time. Moreover, they were informed that the information they provide will be kept confidential, and their name will not be shared. The Ethics Commission of the Medical Association in Hamburg reviewed and approved the study (No. PV5421). Comparisons with official statistics reveal that distribution of gender and age in both samples is similar to that in the general adult populations in Germany and in the USA. (Table 1). However, respondents aged 60 to 64 years are underrepresented in the German sample.

Vignettes

A written vignette describing a 46-year-old male or female person with obesity (female: height 5′5, weight 200 lb; male: height 5′9, weight 230 lb) was presented to the respondents. Persons in the vignettes varied according to gender, migration status (yes/no), and occupational position as an indicator of SES (low: cleaner/janitor, high: lawyer). As countries of origin of migrants differ between Germany and the USA, the migration vignettes were varied. In Germany, the respective person came from Turkey and has a Turkish name while in the USA the country of origin was Mexico. The eight vignettes (see Appendix in electronic supplementary material) were randomly

Table 1 Distribution of sex and age in the samples (N = 1401 in Germany and the USA, weighted) compared to official statistics of the general populations (2017)

	Germany			USA		
	Sample	Official statistics	P^d	Sample	Official statistics	P^d
Sex (female, %)	51.1	50.7[a]	0.877	51.2	50.8[c]	0.737
Age (groups, %)						
18–24	9.2	9.1[b]	0.004	12.3	12.4[c]	0.166
25–39	21.2	22.5[b]		25.8	26.2[c]	
40–59	34.3	35.6[b]		31.6	33.9[c]	
60–64	10.3	7.6[b]		9.4	7.8[c]	
> 65	25.1	25.1[b]		20.9	19.7[c]	

[a]Federal Office of Statistics: Statistical Yearbook 2017, p 26 (Available online: https://www.destatis.de/DE/Publikationen/StatistischesJahrbuch/StatistischesJahrbuch.html)

[b]Federal Office of Statistics: Statistical Yearbook 2017, p 84

[c]United States Census Bureau 2017 (Available online: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_1YR_S0101&prodType=table)

[d]Chi-square test: sample against official statistics

assigned to the respondents. Thus, each vignette was presented to about 175 respondents in each country. For the present analyses, the eight vignettes were pooled.

Measures

Based on a measure used in a previous study (Sikorski et al. 2012), beliefs about potential causes of obesity were assessed by using 12 items (Table 2). Respondents were asked to give their opinion on different potential causes on a four-point Likert scale (1 = totally disagree, 2 = disagree, 3 = agree, 4 = totally agree). A principal component analysis yielded a four-factor solution (total variance explanation: 54.4%; primary loadings $\geq$ 0.56; cross-loadings $\leq$ 0.31). The four factors comprised of three items each and were labeled 'sociocultural causes' (items: cultural influences, social environment, consequence of upbringing; explained variance (EV) 21.7%; mean inter-item correlation (MIIC) 0.30), 'behavior-related causes' (items: lack of physical activity, too much food, lack of willpower; EV 13.3%; MIIC 0.29), 'somatic and psychological causes' (items: inheritance, psychological

Table 2 Public beliefs about causes of obesity in the USA and Germany 2017 (weighted): Means, (standard deviations), and significances (P)

'A possible cause of obesity is…' (1 = totally disagree to 4 = totally agree)	USA (N = 1401)	Germany (N = 1401)	P*
Cultural influences	2.69 (0.67)	2.28 (0.86)	< 0.001
Social environment	2.70 (0.68)	2.60 (0.85)	< 0.001
Consequence of upbringing	2.79 (0.65)	2.54 (0.84)	< 0.001
Scale 'Sociocultural causes'	**2.72 (0.51)**	**2.47 (0.58)**	**< 0.001**
Lack of physical activity	3.12 (0.68)	3.16 (0.84)	0.222
Too much food	3.06 (0.67)	3.20 (0.74)	< 0.001
Lack of willpower	2.88 (0.67)	2.94 (0.73)	0.037
Scale 'Behavior-related causes'	**3.02 (0.51)**	**3.10 (0.55)**	**< 0.001**
Inheritance	2.69 (0.68)	2.87 (0.74)	< 0.001
Psychological stress	2.92 (0.63)	2.90 (0.75)	0.415
Disruption of metabolism	2.90 (0.61)	2.86 (0.71)	0.207
Scale 'Somatic and psychological causes'	**2.84 (0.45)**	**2.87 (0.51)**	**0.069**
Low education	2.30 (0.73)	1.98 (0.90)	< 0.001
Poor knowledge about diet	2.91 (0.68)	2.77 (0.89)	< 0.001
Low income	2.38 (0.77)	1.98 (0.93)	< 0.001
Scale 'Educational and financial causes'	**2.53 (0.52)**	**2.23 (0.65)**	**< 0.001**

*Significance of t test

stress, disruption of metabolism; EV 11.1%; MIIC 0.23), and 'educational and financial causes' (items: low education, poor knowledge about diet, low income; EV 8.3%; MIIC 0.32). For each of the subscales, a sum score was calculated and divided by the number of items. Thus, the four subscales have a range from 1 to 4, with higher values indicating stronger agreement.

The following sociodemographic characteristics of the respondents were introduced as covariates: Gender, age, education, and migration. Educational degree was categorized according to the International Standard Classification of Education (UNESCO 1997). Respondents were considered to have a migrant background when he/she or one of his/her parents were not born in the USA/Germany. Additionally, body mass index (BMI) of the respondents based on self-reports of weight and height was considered.

Analyses

For a comparison of the beliefs about causes of obesity between Germany and the USA, *t* tests were performed. These tests were chosen since all four dimensions of beliefs about causes of obesity rather followed a normal distribution, though scores for behavior-related causes were slightly skewed to the right. Means, standard deviations, and significances (*P* values) are reported. To analyze the relevance of social characteristics (gender, ethnicity, and SES) for causal attributions, the different vignettes were introduced in linear regression models, adjusted for the described covariates (gender, age, education, migration, and BMI, model 1). Interaction terms (country × vignette) were additionally calculated to consider country differences (model 2) in the association of social characteristics with causal beliefs. In advance, all models were checked whether they meet the necessary assumptions for linear regression like multicollinearity, normal distribution of residuals or heteroscedasticity. Results suggest that requirements for linear regression models are met. Unstandardized regression coefficients (*B*), 95% confidence intervals (CI), significances (*P*), and explained variances (R^2) are documented in the tables. Sample design weights were used for all analyses.

Results

Table 2 shows the comparison of the public beliefs about causes of obesity between the USA and Germany. Respondents from the USA more strongly support sociocultural causes of obesity, whereas German respondents significantly more often agree to behavior-related causes. A lack of physical activity and too much food are the two causes with the strongest endorsement in both countries. In terms of the somatic and psychological causes, there are no significant country differences for the subscale, while there is a significantly stronger agreement to educational and financial causes in the USA than in Germany.

Results of multiple linear regression analyses with regard to the subscale 'sociocultural causes' are documented in Table 3. Stronger support of these causes in the USA is confirmed in the multivariate analyses (model 1). Respondents significantly more often agree with sociocultural causes when the person in the vignette is a migrant or a cleaner/janitor (compared to a lawyer). In model 2, interaction effects (country x vignette) are additionally calculated. Differences in beliefs about sociocultural causes according to migration and SES of the person afflicted are significantly less pronounced in the USA compared to Germany.

Concerning behavior-related causes (Table 4), female respondents and those with a higher BMI significantly less often agree (model 1). There are no significant differences between the two countries in this causal belief. Moreover, the agreement is less pronounced when the person with obesity is a migrant or has a low SES. These differences do not significantly vary between the USA and Germany, i.e., interaction effects in model 2 are not significant.

Respondents' age is negatively associated with the belief that obesity is caused by somatic and psychological factors (Table 5, model 1). This belief is significantly less pronounced when the person in the vignette is a migrant or a cleaner/janitor, while it is more pronounced when the person is a woman. Again, differences between the vignettes do not significantly vary between the two countries (model 2).

Respondents from the USA significantly more often agree that educational and financial aspects contribute to obesity (Table 6, model 1). The agreement is significantly stronger when the person in the vignette is a cleaner/janitor. Explained variance (about 13%) is relatively high compared to the other subscales of causal attributions. Results from model 2 show that difference in agreement according to the occupational status in the vignette is significantly larger in Germany than in the USA.

Discussion

Based on public national telephone surveys in Germany and the USA, this study shows that respondents from the USA more strongly support sociocultural as well as educational and financial causes of obesity. Thus, in the USA, external causal attributions (i.e., causes that are beyond individual's control) seem to play a more important role than in Germany. Overall, however, behavior-related causes (especially 'too much food' and 'lack of physical

Table 3 Linear regression analysis (*public beliefs about sociocultural causes of obesity*) in Germany and the USA (2017, weighted): unstandardized regression coefficients (*B*), 95% confidence intervals (CI), significances (*P*)

	Model 1			Model 2		
	B	CI	*P*	*B*	CI	*P*
(Intercept)	2.48	2.35–2.61	< 0.001	2.41	2.27–2.55	< 0.001
Age	− 0.00	− 0.00–0.00	0.591	− 0.00	− 0.00–0.00	0.627
Female Gender (ref: male)	− 0.01	− 0.05–0.03	0.660	− 0.01	− 0.06–0.03	0.602
Education (ref: low)						
Medium	0.00	− 0.06–0.07	0.920	0.01	− 0.06–0.08	0.804
High	0.07	− 0.00–0.13	0.050	0.07	0.00–0.13	0.040
Migration (ref: no migration)	0.02	− 0.03–0.07	0.426	0.02	− 0.03–0.07	0.434
Body mass index	− 0.00	− 0.01 to − 0.00	0.040	− 0.00	− 0.01–0.00	0.068
Country USA (ref: Germany)	0.24	0.19–0.30	< 0.001	0.36	0.27–0.45	< 0.001
Vignette female (ref: male)	0.02	− 0.02–0.07	0.322	0.00	− 0.06–0.06	0.887
Vignette migration (ref: no migration)	0.08	0.04–0.13	< 0.001	0.14	0.08–0.20	< 0.001
Vignette cleaner (ref: lawyer)	0.10	0.06–0.15	< 0.001	0.18	0.12–0.24	< 0.001
USA × female vignette				0.04	− 0.04–0.13	0.327
USA × migration vignette				− 0.12	− 0.20 to − 0.03	0.008
USA × cleaner vignette				− 0.17	− 0.25 to − 0.08	< 0.001
Observations		2391			2391	
R^2		0.076			0.085	

Ref reference category

Table 4 Linear regression analysis (*public beliefs about behavioral causes of obesity*) in Germany and the USA (2017, weighted): unstandardized regression coefficients (*B*), 95% confidence intervals (CI), significances (*P*)

	Model 1			Model 2		
	B	CI	*P*	*B*	CI	*P*
(Intercept)	3.37	3.25–3.50	< 0.001	3.38	3.24–3.51	< 0.001
Age	0.01	− 0.00–0.02	0.095	0.01	− 0.00–0.02	0.109
Gender (ref: male)	− 0.10	− 0.14 to − 0.06	< 0.001	− 0.10	− 0.14 to − 0.06	< 0.001
Education (ref: low)						
Medium	− 0.01	− 0.07–0.06	0.854	− 0.01	− 0.07–0.06	0.807
High	− 0.05	− 0.12–0.01	0.106	− 0.05	− 0.11–0.01	0.114
Migration (ref: no migration)	0.03	− 0.02–0.08	0.204	0.03	− 0.02–0.08	0.217
Body mass index	− 0.01	− 0.01 to − 0.00	0.002	− 0.01	− 0.01 to − 0.00	0.002
Country USA (ref: Germany)	− 0.03	− 0.09–0.02	0.241	− 0.04	− 0.13–0.04	0.327
Vignette female (ref: male)	− 0.03	− 0.07–0.01	0.126	− 0.04	− 0.10–0.01	0.131
Vignette migration (ref: no migration)	− 0.08	− 0.12 to − 0.04	< 0.001	− 0.04	− 0.10–0.01	0.147
Vignette cleaner (ref: lawyer)	− 0.10	− 0.15 to − 0.06	< 0.001	− 0.14	− 0.19 to − 0.08	< 0.001
USA × female vignette				0.03	− 0.06–0.11	0.556
USA × migration vignette				− 0.08	− 0.16–0.01	0.074
USA × cleaner vignette				0.07	− 0.01–0.16	0.086
Observations		2469			2469	
R^2		0.033			0.036	

Ref reference category

activity') reach the highest values of agreement in both countries. Results furthermore show that somatic and psychological factors are more strongly supported as causes of obesity in both countries when the person in the vignette is a woman. Ethnicity and SES of the person afflicted also have an impact on public beliefs about causes

Table 5 Linear regression analysis (*public beliefs about somatic and psychological causes of obesity*): in Germany and the USA (2017, weighted) unstandardized regression coefficients (*B*), 95% confidence intervals (CI), significances (*P*)

	Model 1			Model 2		
	B	CI	*P*	*B*	CI	*P*
(Intercept)	2.97	2.85–3.09	< 0.001	3.00	2.88–3.12	< 0.001
Age	− 0.02	− 0.03 to − 0.01	< 0.001	− 0.02	− 0.01 to − 0.03	< 0.001
Gender (ref: male)	0.00	− 0.04–0.04	0.872	0.00	− 0.04–0.04	0.835
Education (ref: low)						
Medium	− 0.01	− 0.07–0.05	0.708	− 0.01	− 0.07–0.05	0.670
High	− 0.01	− 0.07–0.05	0.770	− 0.01	− 0.07–0.05	0.729
Migration (ref: no migration)	− 0.03	− 0.08–0.02	0.206	− 0.03	− 0.08–0.02	0.202
Body mass index	0.00	− 0.00–0.00	0.678	0.00	− 0.00–0.00	0.780
Country USA (ref: Germany)	− 0.03	− 0.08–0.02	0.298	− 0.07	− 0.15–0.01	0.097
Vignette female (ref: male)	0.08	0.04–0.12	< 0.001	0.08	0.03–0.14	0.002
Vignette migration (ref: no migration)	− 0.04	− 0.08 to − 0.01	0.024	− 0.08	− 0.13 to − 0.02	0.005
Vignette cleaner (ref: lawyer)	− 0.05	− 0.08 to − 0.01	0.023	− 0.06	− 0.12 to − 0.01	0.020
USA × female vignette				− 0.02	− 0.09–0.06	0.701
USA × migration vignette				0.07	− 0.01–0.15	0.089
USA × cleaner vignette				0.04	− 0.04–0.11	0.351
Observations		2351			2351	
R^2		0.018			0.019	

Ref reference category

Table 6 Linear regression analysis (*public beliefs about educational and financial causes of obesity*): in Germany and the USA (2017, weighted) unstandardized regression coefficients (*B*), 95% confidence intervals (CI), significances (*P*)

	Model 1			Model 2		
	B	CI	*P*	*B*	CI	*P*
(Intercept)	2.10	1.97–2.24	< 0.001	2.02	1.88–2.17	< 0.001
Age	0.01	− 0.00–0.02	0.082	0.01	0.00–0.02	0.050
Gender (ref: male)	− 0.05	− 0.10 to − 0.01	0.020	− 0.05	− 0.10 to − 0.01	0.025
Education (ref: low)						
Medium	− 0.03	− 0.10–0.04	0.392	− 0.02	− 0.09–0.05	0.573
High	0.05	− 0.02–0.12	0.174	0.05	− 0.02–0.12	0.178
Migration (ref: no migration)	0.03	− 0.02–0.09	0.250	0.04	− 0.02–0.09	0.201
Body mass index	− 0.00	− 0.01–0.00	0.250	− 0.00	− 0.01–0.00	0.301
Country USA (ref: Germany)	0.29	0.23–0.35	< 0.001	0.42	0.32–0.51	< 0.001
Vignette female (ref: male)	− 0.02	− 0.06–0.03	0.420	− 0.03	− 0.09–0.03	0.352
Vignette migration (ref: no migration)	0.00	− 0.04–0.05	0.833	− 0.02	− 0.08–0.04	0.582
Vignette cleaner (ref: lawyer)	0.33	0.28–0.38	< 0.001	0.49	0.43–0.55	< 0.001
USA × female vignette				0.03	− 0.06–0.12	0.568
USA × migration vignette				0.05	− 0.04–0.14	0.250
USA × cleaner vignette				− 0.34	− 0.43 to − 0.25	< 0.001
Observations		2478			2478	
R^2		0.133			0.152	

Ref reference category

of obesity. When the person with obesity has a low SES (i.e., is a cleaner or janitor compared to a lawyer) or is a migrant (compared to a non-migrant), sociocultural causes are considered more important, whereas agreement to behavioral as well as somatic and psychological factors is less pronounced.

Beliefs about causes of obesity are relevant for public health as they have been found to be associated with health behaviors and attitudes. For example, people who endorse genetic attributions are less likely to be physically active or to eat fruit or vegetables (Wang and Coups 2010) while they are more likely to support free weight loss treatments and healthy lifestyle campaigns (Beeken and Wardle 2013). In contrast, behavior-related causal attributions are associated with greater reported levels of physical activity (Wang and Coups 2010) and stigmatizing attitudes (Puhl and Heuer 2010; Sikorski et al. 2011). Associations of behaviors and attitudes with beliefs about social or cultural causes of obesity have not yet been examined.

Stronger support for external causes in the USA may be a consequence of the elevated obesity prevalence. As Burke and Heiland (2018) recently pointed out, normalization of obesity can be seen as a consequence of increased prevalence. This process is characterized by shifting societal norms and perceptions concerning obesity. Since prevalence in the USA is higher than in Germany, normalization of obesity may be more pronounced in the USA. Externalization of causes can be expected to be one dimension of normalization when obesity is rather attributed to the general economic and social environment than to personal or individual characteristics. Another possible explanation for the country differences is that there might be a higher general awareness that social factors can influence health in the USA, compared to Germany. This assumption is supported by a recent comparative study (Knesebeck et al. 2018) on the public awareness of poverty as a determinant health.

Results of this study indicate that public causal beliefs about obesity vary according to social characteristics of the person afflicted. Overall, external causal attributions are more pronounced while behavior-related causes are considered less important when the person with obesity has a low SES or is a migrant, especially in Germany. It is known that behavior-related causal attributions are inked to stigmatizing attitudes (Sikorski et al. 2011). This is in line with the attribution theory which states that believing the condition to be under a person's control determines greater stigmatizing reactions (Weiner et al. 1988). Against this background, our results do not indicate that deprived social groups with obesity like people with a low SES or a migrant background are rather held responsible for their condition and are thus faced with 'double stigma' (Knesebeck et al. 2017). Nonetheless, perceived weight discrimination was found to be more pronounced among less wealthy individuals in an English study (Jackson et al. 2015).

When interpreting our results, some limitations have to be considered. First, more than half of the individuals eligible for the study were not available or refused to participate. Although comparison with official statistics revealed a similar distribution of gender and age in our samples (Table 1), we cannot rule out a selection bias due to non-response. Given the number of vignettes (eight) and the corresponding number of subjects that were exposed to each vignette (n = 175), the sample size was rather small. Second, analyses are based on a cross-sectional design. Thus, no conclusions on causal relationships can be drawn. Third, although there are some empirical studies measuring and analyzing public beliefs about causes of obesity in Germany (Hilbert et al. 2007; Luck-Sikorski et al. 2017; Sikorski et al. 2011, 2012) and the USA (Sikorski et al. 2011; Wang and Coups 2010), there is no instrument that can be considered sufficiently validated, especially for comparative studies. This also holds true for the measure used in our study. It was based on an instrument used in a study by Sikorski et al. (2012). However, some items and the scale were modified. Thus factor analyses as well as the four subscales have to be verified in the future. Fourth, while we consider it a strength that we used vignettes as a standardized stimulus, these vignettes had to be short to be included in a telephone survey. It is disputable whether variation of one sentence is sufficient to express different social conditions. Moreover, the vignette had to be kept in mind throughout large parts of the interview. Fifth, we did not consider respondent's lifestyle that may have an impact on causal beliefs. Finally, the study was conducted in two high-income countries and results cannot be generalized to other countries. In view of these limitations, future comparative studies on public beliefs about causes of obesity should include other (middle- and low-income) countries. We propose to use vignettes in such studies as they provide a standardized stimulus and the opportunity to vary characteristics of the afflicted person. Using multiple vignettes, however, requires large sample sizes.

In conclusion, our results show that external causal attributions of obesity seem to play a more important role in the USA than in Germany. Overall, however, behavior-related causes (especially 'too much food' and 'lack of physical activity') reach the highest values of agreement in both countries. Moreover, public causal beliefs about obesity vary according to social characteristics of the person afflicted. As this is one of the first studies on country differences and social variations in causal beliefs about obesity, more research is needed to understand the patterns of variation. Results of such studies can be used to shape interventions that aim to increase public awareness of the

multiple causes of obesity and thereby improve health literacy and reduce obesity stigma. In this regard, our results indicate that there is a strong public belief in the importance of behavior-related factors while there is less awareness of genetic, environmental, psychological, social, economic, and cultural causes. This may be a starting point for public information and anti-stigma campaigns as many of the latter (external) causes are beyond the responsibility and control of the afflicted individual and thus, are expected to be associated with reduced stigma. Country differences suggest that the need for such campaigns is even more pronounced in Germany than in the USA.

Funding This study is part of the joint research project 'Nutrition, Health and Modern Society: Germany and the USA' and is funded by the Volkswagen Foundation.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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. Ethics Commission of the Medical Association Hamburg approved the data collection procedure (No. PV5421).

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

References

Beeken RJ, Wardle J (2013) Public beliefs about the causes of obesity and attitudes towards policy initiatives in Great Britain. Public Health Nutr 16:2132–2137

Burke MA, Heiland FW (2018) Evolving societal norms of obesity. JAMA 319:221–222

Ferguson C, Kornblet S, Muldoon A (2009) Not all created equal. Differences in obesity attitudes between men and women. Women's Health Issues 19:289–291

Flegal KM, Kruszon-Moran D, Carroll MD et al (2016) Trends in obesity among adults in the United States, 2005 to 2014. JAMA 315:2284–2291

Häder S, Sand M (2019) Samples for telephone surveys. In: Häder S et al (eds) Telephone surveys in Germany. Springer, Wiesbaden, pp 45–80

Hilbert A, Rief W, Brähler E (2007) What determines public support of obesity prevention? J Epidemiol Community Health 61:585–590

Jackson SE, Steptoe A, Beeken RJ et al (2015) Perceived weight discrimination in England: a population-based study of adults aged 50 years. Int J Obes 39:858–864

Knesebeck Ovd, Kofahl C, Makowski A (2017) Differences in depression stigma towards ethnic and socio-economic groups in Germany—exploring the hypothesis of double stigma. J Affect Disord 208:82–86

Knesebeck Ovd, Vonneilich N, Kim TJ (2018) Public awareness of poverty as a determinant of health—survey results from 23 countries. Int J Public Health 63:165–172

Llewellyn CH (2018) Genetic susceptibility to the "obesogenic" environment: the role of eating behavior in obesity and an appetite for change. Am J Clin Nutr 108:429–430

Luck-Sikorski C, Riedel-Heller SG, Phelan JC (2017) Changing attitudes towards obesity—results from a survey experiment. BMC Public Health 17:373

Mata J, Hertwig R (2018) Public beliefs about obesity relative to other major health risks: representative cross-sectional surveys in the USA, the UK, and Germany. Ann Behav Med 52:273–286

Mensink GBM, Schienkiewitz A, Haftenberger M et al (2013) Overweight and obesity in Germany: results of the German Health Interview and Examination Survey for Adults (DEGS1). Bundesgesundheitsblatt–Gesundheitsforsch–Gesundheitsschutz 56:786–794

Mills GJ (2017) Investigating the use of cellular telephone numbers for the computer-assisted telephone interview operation in the American Community Survey. American Community Survey Research and Evaluation Report Memorandum Series #ACS17-RER-16. Washington: United States Census Bureau

Ng M, Fleming T, Robinson M et al (2014) Global, regional and national prevalence of overweight and obesity in children and adults 1980-2013: a systematic analysis. Lancet 384:766–781

OECD (2017). Obesity update 2017. http://www.oecd.org/health/obesity-update.htm. Accessed 30 July 2019

Pearl RL, Lebowitz MS (2014) Beyond personal responsibility: effects of causal attributions for overweight and obesity on weight-related beliefs, stigma, and policy support. Psychol Health 29:1176–1191

Puhl RM, Heuer CA (2010) Obesity stigma: important considerations for public health. Am J Public Health 100:1019–1028

Puhl RM, Luedicke J, Heuer CA (2013) The stigmatizing effect of visual media portrayals of obese persons on public attitudes: does race or gender matter? J Health Commun 18:805–826

Sikorski C, Luppa M, Kaiser M et al (2011) The stigma of obesity in the general public and its implications for public health—a systematic review. BMC Public Health 11:661

Sikorski C, Luppa M, Brähler E et al (2012) Obese children, adults and senior citizens in the eyes of the general public: results of a representative study on stigma and causation of obesity. PLoS ONE 7:e46924

Sorensen K, van den Broucke S, Fullam J et al (2012) Health literacy and public health: a systematic review and integration of definitions and models. BMC Public Health 12:80

United Nations Educational, Scientific and Cultural Organization (UNESCO) (1997) International Standard Classification of Education. UNESCO, Geneva

Wang C, Coups EJ (2010) Causal beliefs about obesity and associated health behaviors: results from a population-based survey. Int J Behav Nutr Phys Act 7:19

Weiner B, Perry RP, Magnusson J (1988) An attributional analysis of reactions to stigmas. J Pers Soc Psychol 55:738–748

World Health Organization (2007). The challenge of obesity in the WHO European Region and the strategies for response—summary. http://www.euro.who.int/__data/assets/pdf_file/0008/98243/E89858.pdf. Accessed 25 Oct 2018

Wright SM, Aronne LJ (2012) Causes of obesity. Abdom Imaging 37:730–732