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# Asymmetric effects of obesity on loneliness among older Germans. Longitudinal findings from the Survey of Health, Ageing and Retirement in Europe

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## ABSTRACT

**Objectives:** The aim of this longitudinal study was to examine whether the onset and the end of obesity was associated with loneliness.

**Method:** Nationally representative longitudinal data from Germany were taken from the Survey of Health, Ageing and Retirement in Europe (wave 5 to wave 7;  $n = 10,446$  observations in the analytical sample). Using the three item loneliness scale (UCLA), loneliness was measured. According to the WHO thresholds, obesity was defined as  $BMI \geq 30 \text{ kg/m}^2$ . Asymmetric fixed effects (FE) regressions were used.

**Results:** Conventional FE regression analysis revealed that changes in obesity status were associated with changes in loneliness (men:  $\beta = -.19, p < .05$ ; women:  $\beta = .19, p < .05$ ). Asymmetric FE regressions showed that in men the onset of obesity was associated with a decrease in loneliness ( $\beta = -.31, p < .05$ ), whereas the end of obesity was not associated with loneliness. Asymmetric FE regressions showed that in women, the onset of obesity was associated with an increase in loneliness ( $\beta = .33, p < .01$ ), whereas the end of obesity was not associated with loneliness.

**Conclusion:** Findings showed that the onset of obesity has different consequences in terms of loneliness for older women and men in Germany, whereas the end of obesity was not associated with changes in loneliness scores. We recommend that future studies should distinguish between the onset and the end of obesity – which comes along with important practical implications. When older women report transitions to obesity, efforts to prevent loneliness may be of importance.

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Loneliness; obesity; excess weight; social isolation; social exclusion; overweight; adiposity; SHARE

## Introduction

Obesity is a frequent phenomenon in late life (Hajek et al., 2015). Moreover, it is a key (modifiable) risk factor for various health outcomes and it has been shown that obesity is associated with subsequent decreased health-related quality of life or worse mental health (Preiss, Brennan, & Clarke, 2013). In contrast, only very few studies exist that examine the link between obesity and loneliness.

For example, a recent cross-sectional study (Hajek & König, 2018) based on nationally representative data (individuals  $\geq 40$  years; Germany) showed that men with obesity did not differ in terms of social exclusion from men without obesity. In contrast, women with obesity had decreased social exclusion scores compared to women without obesity. The interaction terms (obesity  $\times$  sex) reached statistical significance. Another recent longitudinal study (Hajek & König, 2019b) conducted in Germany (again, based on nationally representative data) showed that obesity was associated with increased loneliness scores longitudinally in men, but not in women (with significant interaction terms).

Generally, it is plausible that the beginning of obesity in older age may lead to feelings of exclusion by family members or friends (Schumaker, Krejci, Small, & Sargent, 1985)

or they may feel stigmatized (Sikorski, Luppá, Brähler, König, & Riedel-Heller, 2012). Contrary, individuals with obesity may befriend with other individuals with obesity to better cope with the circumstances and thus may feel less lonely. However, in sum, we assume that these potential positive effects do not offset the negative impact. With regard to gender differences, we think that the negative impact of the beginning of obesity is significantly more marked in women due to media pressure and social norms for women (Lennon, Lillethun, & Buckland, 1999).

The end of obesity in older age may be frequently caused by an active, health-oriented lifestyle. Individuals experiencing the end of obesity may wish to live a more healthy life (e.g. to avoid serious health consequences like diabetes). However, particularly in very late life the end of obesity may be a sign of decreased mental health (e.g. due to the loss of the spouse) (Hajek et al., 2016) or an indicator of frailty (unintentional weight loss) (Bales & Ritchie, 2002). In total, we assume that most individuals evaluate the end of obesity positively. We assume that they may, for example, join sports club, may regain self-esteem, and may feel that they belong to the society. Moreover, we assume that all these factors may contribute to the fact that the end of obesity may reduce loneliness in both men and women.

To date, there is lack of studies investigating whether the beginning and the end of obesity are differently associated with changes in loneliness levels. Therefore, the aim of this longitudinal study was to examine whether the onset and the end of obesity was associated with loneliness. While conventional linear fixed effects (FE) regressions presume that effects of variables are symmetric (i.e. the effect of the onset of obesity on loneliness is the same as the effect of the end of obesity but in the opposite direction), it may be more realistic to presume asymmetric effects in our case. This means that these aforementioned effects are not the same (in absolute values). To this end, we additionally used asymmetric FE regressions which are described in further detail in the statistical analysis section (Allison, 2019). This knowledge would have important practical implications. When, for example, the beginning of obesity is associated with increased loneliness levels, whereas the end of obesity is not associated with changes in loneliness levels, this may help to develop programs that are more appropriate. This is also important because loneliness can increase morbidity and mortality (Luo, Hawkey, Waite, & Cacioppo, 2012).

## Methods

### Sample

For our current study, data were used from wave 5 to wave 7 from the Survey of Health Ageing, and Retirement in Europe (SHARE) (Börsch-Supan et al., 2008). The fifth wave took place in 2013, the sixth wave took place in 2015 and the seventh wave took place in 2017. The SHARE study is a widely known study of individuals  $\geq 50$  years (without an upper age limit) and residing in private households in Europe and Israel. In the selected household, all individuals  $\geq 50$  years and their potential partners (without age restrictions) were interviewed. More precisely, in the SHARE study, the data collection is based on computer-assisted personal interviewing (CAPI). Face-to-face interviews with the interviewers are performed using a laptop. Some exceptions exist like end-of-life interviews (if a respondent died). They were conducted with a proxy face-to-face (CAPI) or by telephone (CATI), covering data regarding the last year of life of the respondent.

In wave 5, the respondent-level response rates were low ( $<30\%$ ) only in Luxembourg, whereas moderate ( $30\text{--}40\%$ ) to high ( $50\%$  and over) response rates were found in all other countries. Similar response rates in the countries included in the SHARE study were also observed in wave 6 and wave 7. In wave 5, the retention rate was  $80\%$  or higher in two thirds of countries, whereas one third of countries had lower retention rates. With respect to gender or age, there is little evidence for attrition bias, whereas the oldest old are more likely to drop out. Further details are provided by (Malter & Börsch-Supan, 2015) (wave 5), (Malter & Börsch-Supan, 2017) (wave 6) (Bergmann, Scherpenzeel, & Börsch-Supan, 2019) (wave 7) and a general overview over the survey participation is provided by (Bergmann, Kneip, De Luca, & Scherpenzeel, 2019). Additional details with regard to the SHARE study in general have been given elsewhere (Börsch-Supan et al., 2013). Due to data constraints, previous waves were excluded. In our study, we exclusively focused on Germany. The analytical sample was composed of 10,446 observations. During waves 1 to 4, SHARE has been reviewed and approved by

the Ethics Committee of the University of Mannheim several times. Wave 5 of SHARE and the continuation of the project have been reviewed and approved by the Ethics Council of the Max-Planck-Society (most recently in 2018). Prior to the CAPI interview, oral consent was given. This consent procedure was approved by the Ethics Committees.

### Outcome measure

The three-item version (Hughes, Waite, Hawkey, & Cacioppo, 2004) of the Revised UCLA Loneliness scale (Russell, Peplau, & Cutrona, 1980; Russell, Peplau, & Ferguson, 1978) was used to measure loneliness. The three items were as follows: (i) How often do you feel you lack companionship? (ii) How often do you feel isolated from others? (iii) How often do you feel left out? (in each case: 'often', 'some of the time', 'hardly ever or never'). This scale ranges from 3 to 9, with higher scores indicating higher levels of loneliness. Favorable psychometric properties have been reported for this instrument (Hughes et al., 2004).

### Independent variables

To quantify obesity, self-reported weight (kg) and height (meter) were used. Obesity was defined as body-mass-index (BMI)  $\geq 30 \text{ kg/m}^2$ . Covariates included in our regression model were: Age, marital status [married, living together with spouse/registered partnership; others (including: never married; divorced; widowed; married, living separated from spouse)] and household net income. Furthermore, it was adjusted for: self-rated health (from 1 (excellent) to 5 (poor)), functional impairment (adapted from Lawton and Brody (Lawton & Brody, 1969); Instrumental Activities of Daily Living Index; sum of difficulties when performing (i) managing money, (ii) taking medication and (iii) telephone calls; from 0 to 3, higher values indicate higher functional impairment), chronic diseases (count score; including for example: hypertension, diabetes, stroke or heart attack; yes/no), and depressive symptoms (European Depression (EURO-D) scale (Castro-Costa et al., 2007), with 12 items, ranging from 0 to 12, with higher scores indicating more depressive symptoms). The selection of chronic conditions included in the SHARE study has been made in close cooperation with physicians. In total, it was adjusted for age, marital status, household net income, self-rated health, functional impairment, chronic diseases and depressive symptoms in regression analysis.

### Statistical analysis

Because it is important to control for factors which are unobserved in loneliness research (Hajek & König, 2019a), we used (conventional) linear FE regressions in our study. They deliver unbiased estimates under rather weak assumptions. More precisely, a main attraction of FE regressions is that they are not biased when time-constant factors (observed time-constant factors like sex and unobserved time-constant factors like genetic factors) are systematically associated with the explanatory variables and the outcome measure. In contrast, widely used regression techniques like pooled OLS regressions or random effects (RE) regressions provide inconsistent estimates when such an association is present (Brüderl & Ludwig,

2015). Our statistical choice was underlined by Sargan-Hansen tests (Hausman-tests with cluster-robust standard errors; Sargan-Hansen statistic was 126.0,  $p < .001$  for the total sample). In contrast to RE regressions, FE regressions solely exploit within-variations over time (i.e. changes within individuals over time). Therefore, FE estimates can only be generalized to individuals with changes over time (average treatment effect on the treated).

As outlined in the introduction section, conventional FE models presume symmetric effects of variables. In our study, this means that the impact of the onset of obesity on loneliness is the same as the impact of the end of obesity (in absolute values). However, as stated by Allison 'this is implausible for many social phenomena' (Allison, 2019). We also assume that it may be more realistic to presume asymmetric effects in our association of interest (obesity and loneliness). Since the purpose of our study was to examine the link between the beginning and the end of obesity and changes in levels of loneliness, we therefore also used asymmetric FE regressions (Allison, 2019). These asymmetric FE regressions solely examine whether intraindividual changes over time from non-obesity to obesity (and vice versa) are associated with intraindividual changes over time in loneliness levels. Consequently, only time-varying variables can be included in FE regressions as main effects. Time-constant factors like sex or country of origin however could be integrated as moderating factors. Further details with regard to FE regressions are provided elsewhere (Cameron & Trivedi, 2005; Gangl, 2010). Please see also (Gunasekara, Richardson, Carter, & Blakely, 2014).

Cluster-robust standard errors were computed. The significance level was set at  $p < 0.05$ . Stata 16.0 (StataCorp, College Station, Texas, USA) was used.

## Results

### Sample characteristics

Sample characteristics for individuals included in regression analysis are depicted in Table 1. In total, average age was 66.0 years (SD: 9.7; ranging from 50 to 101 years), 52.1% of the individuals were female and most of the individuals (57.1%) had a medium education. Average loneliness score was 3.7 (SD: 1.2 years). While the highest age was 101 years in wave 5, it was 100 years in wave 6 and 94 years in wave 7.

It is worth noting that in total 272 individuals had changes from non-obesity to obesity in the observation period (wave 5 to wave 7). Moreover, 243 individuals had changes from obesity to non-obesity in the observation period. We also checked the within-variation using the Stata commands 'xttab' and 'xttrans'. For example, in the variable 'loneliness', the total within of 73.8% is the normalized between weighted average of the within percents and is therefore a measure of the overall stability of this variable (in contrast, a time-constant variable will have a tabulation with within percents of 100). We checked all variables using the aforementioned commands. In sum, we concluded that there is enough within-variation over time.

### Regression analysis

Results of FE regression analysis are displayed in Table 2. While the results of conventional linear FE regression

analysis are presented in column 2 (men) and 3 (women), the results of asymmetric linear FE regression analysis are presented in column 4 (men) and 5 (women).

Conventional FE regressions revealed that changes in obesity status were associated with changes in loneliness (men:  $\beta = -.19$ ,  $p < .05$ ; women:  $\beta = .19$ ,  $p < .05$ ). Asymmetric FE regressions showed that in men, the onset of obesity was associated with a decrease in loneliness ( $\beta = -.31$ ,  $p < .05$ ), whereas the end of obesity was not associated with loneliness ( $\beta = .09$ ,  $p = .41$ ). Asymmetric FE regressions showed that in women, the onset of obesity was associated with an increase in loneliness ( $\beta = .33$ ,  $p < .01$ ), whereas the end of obesity was not associated with loneliness ( $\beta = -.06$ ,  $p = .65$ ).

## Discussion and conclusion

Based on data from the general adult population 50+ in Germany, the aim of this study was to examine whether the onset and the end of obesity was associated with loneliness. First, conventional FE regression analysis revealed that changes in obesity status were associated with changes in loneliness. Second, and the particular benefit of our study, asymmetric FE regressions showed that in men the onset of obesity was associated with a decrease in loneliness, whereas the end of obesity was not associated with loneliness. Asymmetric FE regressions showed that in women, the onset of obesity was associated with an increase in loneliness, whereas the end of obesity was not associated with loneliness.

To date, only very few studies exist that analyze the link between obesity and loneliness. Beyond the two German studies described in the introduction, one small sample cross-sectional study (64 individuals without obesity; 68 individuals with obesity; individuals aged 19 to 71 years) showed that individuals with obesity had higher levels of loneliness compared to individuals without obesity (Schumaker et al., 1985). They also found that men with obesity did not differ in terms of loneliness from men without obesity. In contrast, women with obesity had higher levels of loneliness compared to women without obesity. Based on longitudinal data from Sweden (Swedish Level of Living Surveys, taking place in 1991 and 2000;  $n = 3,586$ ; individuals aged 18 to 75 years), a further study (Oliveira, Rostila, Leon, & Lopes, 2013) analyzed the link between social relations and obesity. They revealed that a lower level of emotional support was associated with an increased incidence of obesity among men, whereas this association was not associated among women.

Due to the rather large differences in the statistical method used, it is challenging to compare our study to the studies mentioned above. We assume that the link between the onset of obesity and increased loneliness in women may be explained by social norms, stigmatization and media pressure (Lennon et al., 1999). However, it was quite surprising that the onset of obesity was associated with *decreased* loneliness in men. A possible explanation may be that older men experiencing obesity may feel a high acceptance in society, which is at least partially in accordance with previous research (Hebl & Turchin, 2005; Himmelstein, Puhl, & Quinn, 2018). Moreover, positive views about obesity are associated with higher age among the Swedish population (Hansson & Rasmussen, 2014). Stigmatization is particularly present in

**Table 1.** Characteristics of observations included in fixed effects regression analysis ( $n = 10,446$  observations; wave 5 to wave 7).

	N/Mean	%(SD)
Female: N (%)	5,441	52.1%
Education (ISCED-97): N (%)		
Low education	1,236	11.9%
Medium education	5,928	57.1%
High education	3,221	31.0%
Age in years: Mean (SD)	66.0	(9.7)
Marital status: married and living together with spouse; registered partnership: N (%)	7,659	73.3%
Household net income (per year) in Euro: Mean (SD)	37,018.9	(42,424.4)
Self-rated health (from 1 to 5, with higher values reflecting worse self-rated health): Mean (SD)	3.2	(1.0)
Functional decline (ranging from 0 to 3, with higher values reflecting functional impairment): Mean (SD)	0.1	(0.3)
Depressive symptoms (from 0 to 12, with higher values reflecting more depressive symptoms): Mean (SD)	2.3	(2.0)
Number of chronic diseases (from 0 to 10, with higher values reflecting more chronic diseases): Mean (SD)	1.2	(1.3)
Loneliness (Loneliness Scale): Mean (SD)	3.7	(1.2)
Presence of obesity ( $\text{BMI} \geq 30 \text{ kg/m}^2$ ): N (%)	2,380	22.8%

Please note that time-invariant factors (education and sex) were only displayed for descriptive purposes.

**Table 2.** Determinants of loneliness score (SHARE; wave 5 to wave 7).

	(1) Loneliness score – Men	(2) Loneliness score – Women	(3) Loneliness score – Men	(4) Loneliness score – Women
Potential confounders <sup>a</sup>	✓	✓	✓	✓
Change in obesity (Ref.: absence of obesity)	–0.19* (0.08)	0.19 (0.08)		
Onset of obesity			–0.31* (0.12)	0.33** (0.11)
End of obesity			0.09 (0.11)	–0.06 (0.12)
Observations	5,005	5,441	5,014	5,516
Individuals	2,683	2,931	2,684	2,950
R <sup>2</sup>	0.05	0.03	0.05	0.04

Comments: Cluster-robust standard errors in parentheses. \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $p < 0.10$ .

<sup>a</sup>Potential confounders include age, marital status, income, self-rated health, functional impairment, depressive symptoms and chronic diseases.

children with obesity (Sikorski et al., 2012). A speculative explanation may be that older men who experience obesity feel accepted by family and friends. However, there is a lack of studies fully supporting this statement and therefore future research is required to confirm our findings.

It is quite puzzling why the end of obesity was not associated with loneliness in women and in men. A possible explanation may be that the end of obesity is caused by unintentional weight loss among very old individuals – as a sign of frailty (Alibhai, Greenwood, & Payette, 2005). In this particular age group, the end of obesity may lead to loneliness (due to functional losses (Hajek & König, 2020)). Among middle-aged individuals (50 to 64 years), the end of obesity may be associated with decreased loneliness levels because these individuals may regain self-worth (Byrne, Cooper, & Fairburn, 2003). After the end of obesity, they may feel self-confident and therefore make new social contacts (Hu, Jin, Hu, & He, 2013). However, empirically, we could not find these associations in middle-aged and very old individuals (please see [Supplementary Table 1](#)).

Some strengths and limitations are worth noting. Our longitudinal study adds to the limited knowledge regarding the link between obesity and loneliness. Loneliness was quantified using an established instrument. Asymmetric FE models were used to clarify the link between the beginning and the end of obesity and changes in levels of loneliness. The use of FE regressions also assists in reducing the challenge of unobserved heterogeneity (a huge challenge in observational studies). It should be noted that height and weight are based on self-reports. Most commonly, individuals underestimate weight and overestimate height (Gorber, Tremblay, Moher, & Gorber, 2007). Therefore, the true BMI values are expected to be higher. Nevertheless,

when this bias is constant within individuals over time, then FE estimates are not biased. Furthermore, a rather small sample selection and attrition bias have been identified in the SHARE study (Palgi, Shrira, & Zaslavsky, 2015).

In conclusion, findings showed that the onset of obesity has different consequences in terms of loneliness for older women and men in Germany, whereas the end of obesity was not associated with changes in loneliness scores. We recommend that future studies should distinguish between the onset and the end of obesity (and between women and men) – which comes along with important practical implications. When older women report transitions to obesity, efforts to prevent the loss of loneliness may be important.

Moreover, we think that future studies are required to delve into the moderating role of personality-related variables such as the big five or locus of control in the link between obesity and loneliness. Furthermore, the potential moderating role of coping strategies such as flexible goal adjustment or general self-efficacy should be clarified. Additionally, potential cultural differences should be examined in upcoming studies.

## Disclosure statement

The authors declare no conflict of interest.

## Data availability statement

Data were obtained from a third party and cannot be made publicly available. More specifically, data for the study came from the SHARE project and are available to all researchers for purely scientific purposes upon request on their website (<http://www.share-project.org/>).



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