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Does obesity lead to loneliness and perceived social isolation in the second half of life? Findings from a nationally representative study in Germany

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Aim: Little is known about the link between obesity and loneliness as well as perceived social isolation. Therefore, the objective of this longitudinal study is to clarify whether the onset and the end of obesity is associated with changes in perceived social isolation as well as loneliness (stratified by sex) in older age.

Methods: Longitudinal data were used from wave 5 (year 2014) and 6 (year 2017) of the German Ageing Survey – a nationally representative sample of community-dwelling individuals aged ≥40 years in Germany. Established tools were used to quantify loneliness and perceived social isolation. A body mass index ≥30 kg/m^2 was used to classify individuals as being obese. Asymmetric fixed effects regressions were used.

Results: Regressions showed that the end of obesity was associated with decreases in perceived social isolation among women ($\beta = -0.24$, $P = 0.01$), but not in men (with significant sex differences). The onset of obesity was not associated with changes in perceived social isolation. Neither the beginning of obesity nor the end of obesity was associated with changes in loneliness.

Conclusions: Our findings emphasize the importance of overcoming obesity for women in the second half of life. As most of the existing studies were conducted in Germany, studies from other countries are of importance to understand this association better. **Geriatr Gerontol Int 2021; 21: 836–841.**

Keywords: body mass index, excess weight, loneliness, middle age, obesity, old age, overweight, social exclusion, social isolation.

Introduction

It is widely acknowledged that obesity is a key risk factor for both chronic conditions and mortality.[1] Furthermore, it is associated with increased healthcare costs.[2] Moreover, a high prevalence rate of obesity among middle-aged[3] and older adults[4,5] has been shown. In addition, obesity is associated with decreased quality of life[6] or worse mental health.[7] Thus far, only a few studies have investigated the association between obesity and loneliness as well as perceived social isolation, with inconclusive evidence.[4,8–12]

It should be noted that while loneliness refers to the feeling that one's own social network is smaller than desired,[13] perceived social isolation refers to the feeling of not belonging to the society.[14] Therefore, loneliness and perceived social isolation are distinct constructs.[15] In our study, both are correlated (wave 5: Pearson correlation was 0.51, $P < 0.001$ and in wave 6: Pearson correlation was 0.50, $P < 0.001$), but they do not assess the same phenomenon. Thus, an individual can feel lonely without feeling socially isolated or vice versa. Moreover, it has been shown that they differ in their predictors and consequences.[16,17] For further details, please see Hajek and König.[18]

For example, a cross-sectional association between obesity and increased loneliness in the United Kingdom has been found.[11] Based on data from the Survey of Health, Ageing and Retirement in Europe, a longitudinal study[9] conducted in Germany found that the onset of obesity was associated with decreased loneliness scores in men, but with increased loneliness scores in women. In contrast, the end of obesity was not associated with changes in loneliness scores in men and women.

Moreover, only two studies (one cross-sectional study[8] and one longitudinal study among the oldest old[4]) examined the association between obesity and perceived social isolation. While the cross-sectional study[8] found an association between obesity and decreased perceived social isolation among women, the longitudinal study[4] did not find an association between these factors among the oldest old. It should be noted that the existing studies differ somewhat in the study populations, the tools used to quantify perceived social isolation as well as loneliness and the analytical approach.

In light of the limited and inconclusive evidence, our aim was to clarify whether the onset and the end of obesity is associated with changes in perceived social isolation as well as loneliness (stratified by sex) in middle-aged and older adults. Knowledge

about an association between obesity and loneliness as well as perceived social isolation is of importance, as both loneliness and perceived social isolation are associated with morbidity and mortality in late life.[19,20]

Regarding the possible consequences of obesity, one may argue that the onset of obesity is associated with increased loneliness and perceived social isolation scores (particularly in women) because factors such as social norms, pressure from media or perceived stigmatization might be present.[21] Thus, they may feel that they do not belong to the society or certain groups.[22] Conversely, one may argue, that the onset of obesity is associated with decreased loneliness or perceived social isolation scores as this increase in weight may reflect an increase in sociability.[8] This appears to be plausible because a previous cross-sectional study found an association between obesity and decreased perceived social isolation scores among older women. In line with these findings, more positive views about obesity have been shown among older participants,[23] whereas young adults[24] or children with obesity[25] feel stigmatized.

Similarly, in both women and men, the end of obesity may reflect the (difficult) overcoming of long-lasting obesity and may be perceived as a turning point of life. Individuals overcoming obesity may finally feel accepted from society and may take courage to make new friendships or engage in certain (social) activities. Conversely, the end of obesity (or unintentional weight loss) may also reflect decreases in mental health or could be caused by severe diseases such as cancer. Moreover, this weight loss in later life may reflect increased frailty levels. In light of the mixed evidence and the possible counterbalancing effects, we do not have any directed hypotheses. Furthermore, the directionality of the associations (e.g., from loneliness to obesity through changes in eating and lifestyle habits) have also been addressed in the Discussion section.

Methods

Sample

Longitudinal data from the fifth (year 2014) and sixth wave (year 2017) were used from the German Ageing Survey (DEAS study, "Deutscher Alterssurvey"). It is funded by the Federal Ministry for Family Affairs, Senior Citizens, Women and Youth (BMFSFJ) and organized by the German Centre of Gerontology (DZA, "Deutsches Zentrum für Altersfragen").

The DEAS study is a representative cross-sectional and longitudinal survey of individuals ≥40 years residing in private households in Germany. Beginning in the year 1996 (first wave), the DEAS study includes several age-related topics such as retirement, meaning of aging, private care, grandchild care and health-related factors.

The main inclusion criterion for first time participants is that individuals had to be at least 40 years. Another inclusion criterion is living in a private household. For panel participants, inclusion criteria were having at least one valid interview in former waves, willingness to participate in the panel (i.e., written consent) and not living abroad.

The DEAS study has a cohort-sequential design. In the first, second (year 2002), third (year 2008) and fifth wave (year 2014), nationally representative baseline samples were drawn and followed up subsequently. In contrast, the fourth (year 2011) and sixth waves (year 2017) were panel surveys. This means that solely individuals who already participated in previous waves were re-interviewed. About 6000 individuals were first time participants in wave 5, and over 4000 individuals had already taken part before.

In wave 6, 6626 individuals were interviewed. The overall response rate was 33% (25% for the cross-sectional sample and 61% for the panel sample) in wave 5. In wave 6, the response rate was 63%. This difference can be explained by the fact that wave 6 only includes individuals who were willing to participate in the panel. Actually, the response rate for the panel samples are comparable for wave 5 (61%) and wave 6 (63%). Further details regarding the DEAS study are given elsewhere.[26]

As perceived social isolation was only quantified from wave 5 onwards, we used data from wave 5 and 6 in our current study. Furthermore, because we used linear fixed effects (FE) regressions (see Statistical analysis section), we focused on intraindividual changes in both the independent variables and the dependent variable from wave 5 and wave 6. Therefore, our analytical sample solely includes individuals taking part both in wave 5 and wave 6 with such intraindividual changes from wave 5 to wave 6. Therefore, our analytical sample comprised 9110 observations.

All individuals gave their written informed consent before the interview. The study was conducted according to the principles expressed in the Declaration of Helsinki. An ethical statement for the DEAS study was not necessary as the criteria for requiring an ethical statement were not achieved (risk for the respondents, lack of information about the aims of the study, examination of patients). This is in accordance with the German Research Foundation guidelines (Deutsche Forschungsgemeinschaft, DFG) available at: https://www.dfg.de/en/research_funding/faq/faq_humanities_social_science/index.html). The German Centre of Gerontology, which is responsible for the DEAS study, did not apply for ethics approval, based on the recommendation of a standing council of the DEAS that decided no ethics approval was necessary.

Dependent variable

Perceived social isolation was quantified using a tool created by Bude and Lantermann[14] consisting of four items: "I am worried to be left behind," "I feel like I do not really belong to society," "I feel that I am left out" and "I feel excluded from society" (each item ranges from 1 = strongly agree to 4 = strongly disagree). All items were recoded. By averaging the items, a score was computed. Higher values correspond to higher perceived social isolation. In the current study, Cronbach's alpha was 0.88 (wave 5) and 0.87 (wave 6).

The six-item version of the De Jong Gierveld Loneliness scale[27] was used to quantify loneliness; for example: "I miss having people around." Favorable psychometric characteristics have been demonstrated.[28] Higher values correspond to higher levels of loneliness. The mean rating across all items was computed, with higher values corresponding to higher loneliness scores. In our study, Cronbach's alpha was 0.83 (wave 5) and wave 0.84 (wave 6). This tool has favorable psychometric properties.[27,28]

Independent variables

The key independent variable was obesity. The self-reported body mass index (BMI; weight in kg divided by height-squared in meters) was used to classify obesity (obesity if BMI ≥30 kg/m²; non-obesity otherwise). Furthermore, it was adjusted for several time-varying sociodemographic and health-related factors. More precisely, with regard to time-varying sociodemographic factors, it was adjusted for age, marital status (distinguishing between married, living together with spouse; others (including: married, living separated from spouse; widowed single; divorced), employment status (employed; retired; other: not employed). With regard to

time-varying health-related factors, it was adjusted for self-rated health (from 1 = very good to 5 = very bad), physical functioning (subscale "Physical functioning" of the SF-36,[29] ranging from 0 [worst] to 100 [best]), and the number of chronic conditions (ranging from 0 to 11 chronic conditions: cardiac and circulatory disorders; bad circulation; joint, bone, spinal or back problems; respiratory problems, asthma, shortness of breath; stomach and intestinal problems; cancer; diabetes; gall bladder, liver or kidney problems; bladder problems; eye problems, vision impairment; and ear problems, hearing problems).

The time-constant variable education was exclusively used for reasons of sample description (ISCED-97,[30] distinguishing between low [0–2], medium [3, 4] and high [5, 6] education).

As we were interested in intentional weight losses when it comes to the end of obesity, individuals experiencing an unintentional weight loss of >5 kg (11 pounds) in weight in the past 12 months (wave 6) were excluded in sensitivity analyses (answer options: no or yes). Individuals experiencing such an unintentional weight loss often suffer from various chronic diseases such as cancer or frailty, which could bias our estimates.

In another sensitivity analysis, general self-esteem (10-item Rosenberg scale,[31] final score ranges from 1 to 4, with higher values corresponding to higher levels of general self-esteem) was added to our main model. Cronbach's alpha was 0.84.

In further sensitivity analysis, the frequency of sports activities (daily; several times a week; once a week; one to three times a month; less often; never) was added to our main model. Moreover, in another sensitivity analysis, regressions were stratified by age group (first group: individuals aged 40–64 years; second group: individuals aged ≥65 years). In a last sensitivity analysis, transitions into and out of at least class II obesity (BMI ≥35 kg/m^2) were examined.

Statistical analysis

Characteristics of the analytical sample were computed in a first step. After that, (asymmetric) linear FE regressions were used to estimate the association between obesity and perceived social isolation stratified by sex. For example, this is in line with recommendations proposed by Ferrer-i-Carbonell and Frijters.[32]

FE regressions offer the advantage of reducing the problem of unobserved heterogeneity (e.g., genetic factors). More precisely, FE regressions yield consistent estimates even when time-constant factors (unobserved and observed) exist, which are systematically associated with the explanatory variables.[33] This is a main advantage compared with other panel regression models (such as random effects regressions).[33] Our statistical choice was underlined by a Hausman test with cluster-robust standard errors (e.g., the Sargan–Hansen statistic was 111.49, $P < 0.001$ with perceived social isolation as outcome measure among the total sample).

A key characteristic of FE regressions is that they solely rely on intraindividual changes over time from wave 5 to wave 6 (e.g., a change from non-obesity to obesity within an individual from wave 5 to wave 6). Thus, main effects of time-constant factors (e.g., sex) cannot be estimated. However, FE regressions can be stratified by sex, which was done in our study, as the longitudinal association between obesity and loneliness/isolation may vary by sex. It should be repeated that individuals are only included in our analytical sample if they took part in both wave 5 and wave 6 (and had intraindividual changes, e.g., in loneliness).

It may be worth noting that conventional FE models presume symmetric effects of variables. For example, this means that the influence of the onset of obesity on perceived social isolation is the same as the influence of the end of obesity (in absolute terms). However, asymmetric effects may be more plausible.[9] Therefore, asymmetric FE regressions were used in our study.

Cluster-robust standard errors were calculated. The statistical significance was determined with $P < 0.05$. Stata 16.0 (StataCorp, College Station, TX, USA) was used to conduct the analyses.

Results

Sample characteristics

Sample characteristics for the analytical sample ($n = 9110$ observations; pooled across waves) are shown in Table 1. In total, average age was 65.6 years (SD: 10.7 years; 40–97 years), 50.5% of the individuals were female, and 49.1% of the individuals had a medium education. The average perceived social isolation score was 1.6 (SD: 0.6) and the average loneliness score was 1.8 (SD: 0.5). The average perceived isolation score was 1.6 (SD: 0.6) for individuals without obesity and it was 1.7 (SD: 0.6) for individuals with obesity. Furthermore, the average loneliness score was 1.7 (SD: 0.5) for individuals without obesity and it was 1.8 (SD: 0.6) for individuals with obesity.

Table 1 Characteristics of observations ($N = 9110$) included in fixed effects regressions (waves 5 and wave 6, pooled)

Variables	n (%)/Mean ± SD
Age (in years)	65.6 ± 10.7
Sex	
Male	4506 (49.5)
Female	4604 (50.5)
Education (ISCED-97)	
Low education	410 (4.5)
Medium education	4476 (49.1)
High education	4224 (46.4)
Employment status	
Working	3203 (35.2)
Retired	5237 (57.5)
Other (not employed)	670 (7.4)
Marital status	
Married, living together with spouse	6470 (71.0)
Other (including: married, living separated from spouse, divorced, widowed)	2640 (29.0)
Self-rated health (from 1 = very good to 5 = very bad)	2.5 ± 0.8
Number of physical illnesses (from 0 to 11)	2.6 ± 1.9
Physical functioning (from 0 [worst] to 100 [best])	83.0 ± 21.6
Perceived social isolation (from 1 to 4, with higher values corresponding to higher perceived social isolation)	1.6 ± 0.6
Loneliness (from 1 to 4, with higher values corresponding to higher loneliness)	1.8 ± 0.5
Body mass index (kg/m^2)	26.9 ± 4.6

Variables sex and education were not included in fixed effects regressions as explanatory variables because they are time-invariant. This means that they do not vary within individuals over time. Physical functioning was quantified using the subscale "Physical functioning" from the SF-36.[29] Perceived social isolation was assessed using a scale developed by Bude and Lantermann.[14] Loneliness was quantified using the De Jong Gierveld tool.[27]

Further details are given in Table 1. In sum, the average BMI (in kg/m^2) was 26.9 (SD: 4.6; 15.6–60.6; 21.6% being obese).

While 243 individuals (121 men; 122 women) changed from non-obesity (wave 5) to obesity (wave 6), 188 (103 men; 85 women) individuals changed from obesity (wave 5) to non-obesity (wave 6). The average change in BMI (in kg/m^2) for those changing from non-obesity to obesity was 2.5 (SD: 2.6; in men: 2.1, SD: 1.7; in women: 2.9, SD: 3.2). The average change in BMI (in kg/m^2) for those changing from obesity to non-obesity was −3.2 (SD: 3.9; in men: −2.9, SD: 3.4; in women: −3.6, SD: 4.5).

The coefficients for "onset of obesity" and "end of obesity" of the asymmetric FE regressions presented in the next section solely rely on these intraindividual changes over time.

Regression analysis

The results of linear asymmetric FE regressions are displayed in Table 2. With regard to perceived social isolation, regressions showed that this outcome measure was not associated with the beginning of obesity (i.e., intraindividual changes from non-obesity in wave 5 to obesity in wave 6) in the total sample and in both sexes. However, decreases in perceived social isolation were associated with the end of obesity (i.e., intraindividual changes from obesity in wave 5 to non-obesity in wave 6) in women ($\beta = -0.21$, $P < 0.01$), but not in the total sample and in men. The interaction term (sex × end of obesity) achieved statistical significance ($\beta = -0.24$, $P = 0.01$).

With regard to loneliness, neither the beginning of obesity nor the end of obesity was associated with changes in loneliness. This also applies to the total sample for both sexes.

In sensitivity analyses, individuals were excluded when they had an unintentional weight loss in wave 6 (please see the Methods section for further details; results not shown, but available upon request). However, the association between the end of obesity and decreases in perceived social isolation among women remained almost the same ($\beta = -0.21$, $P < 0.01$).

Moreover, in another sensitivity analysis (see Table S1), general self-esteem was added to our main model. However, the key findings remained very similar (end of obesity and decreases in perceived social isolation among women: $\beta = -0.17$, $P < 0.05$).

In further sensitivity analysis (see Table S2), the frequency of sports activities was added to our main model. Again, the key findings remained nearly identical (end of obesity and decreases in perceived social isolation among women: $\beta = -0.21$, $P < 0.01$).

In another sensitivity analysis (see Tables S3 and S4), regressions were stratified by age group (40–64 years, ≥65 years). Our main findings remained remarkably similar. However, while there was an association between end of obesity and decreases in perceived social isolation among women aged ≥65 years ($\beta = 0.34$, $P < 0.001$), this association vanished among women aged 40–64 years.

In a last sensitivity analysis (see Table S5), transitions into and out of at least class II obesity (BMI ≥35 kg/m^2) were examined. In this regression model, the association between the end of at least class II obesity and decreases in perceived social isolation among women did not achieve statistical significance.

Discussion

Using longitudinal data from a nationally representative sample of older adults, the aim of this study was to clarify whether the onset and the end of obesity is associated with changes in perceived social isolation as well as loneliness (stratified by sex). Regressions showed that the end of obesity was associated with decreases in perceived social isolation among women (particularly driven by women aged ≥65 years), but not in men (with significant sex differences). The onset of obesity was not associated with changes in perceived social isolation. Neither the beginning of obesity nor the end of obesity was associated with changes in loneliness.

Our findings will be discussed in light of the inconclusive and mixed evidence. Our study showed that the end of obesity can assist in mitigating feelings of social isolation among women. This is in contrast to a recent cross-sectional study (wave 5) also based on the DEAS study, which showed that obesity was associated with decreased perceived social isolation levels in women. However, as the authors of the former cross-sectional study[8] note, it

Table 2 Determinants of perceived social isolation and loneliness. Results of linear asymmetric fixed effects regressions

	Perceived social isolation, total sample	Perceived social isolation, men	Perceived social isolation, women	Loneliness, total sample	Loneliness, men	Loneliness, women
Potential confounders[†]	✓	✓	✓	✓	✓	✓
Beginning of obesity (BMI ≥30 kg/m^2)	0.03 (0.05)	0.01 (0.06)	0.05 (0.07)	−0.01 (0.04)	−0.07 (0.05)	0.06 (0.05)
End of obesity (BMI ≥30 kg/m^2)	−0.07 (0.05)	0.05 (0.06)	−0.21** (0.08)	−0.04 (0.04)	0.01 (0.05)	−0.09 (0.06)
Observations	9110	4506	4604	9100	4498	4602
Individuals	4555	2253	2302	4550	2249	2301
(Pseudo) R^2	0.01	0.01	0.01	0.01	0.01	0.01

Beta coefficients are displayed. Cluster-robust standard errors in parentheses.

[*]$P < 0.05$.

[**]$P < 0.01$.

[***]$P < 0.001$.

[+]$P < 0.10$.

[†]Potential confounders include age, family status, employment status, physical functioning, self-rated health and chronic diseases. Perceived social isolation was assessed using a scale developed by Bude and Lantermann.[14] Loneliness was quantified using the De Jong Gierveld tool.[27]

may be the case that self-selection may play a role in this former study: Women with low levels of perceived social isolation may be more prone to become obese (e.g., due to unobserved factors such as extraversion).[8]

Our current findings may be interpreted as follows: the end of obesity may reflect a turning point in life in (older) women and may increase, for example, self-confidence. This may assist in making new contacts.[34] Ultimately, this may lead to increased feelings of belonging to society. Furthermore, (older) women may feel more accepted from society after the end of obesity as they meet social norms of attractiveness. However, future research is required to clarify the mechanisms.

It may be worth noting that our findings regarding the missing association between the end of obesity and loneliness are in line with a recent longitudinal study using (German) data from SHARE (which, in contrast to our current study, used the UCLA-3 to quantify loneliness).[4] However, it is puzzling why the end of obesity is associated with reduced perceived social isolation among women in our study, but not with loneliness. A possible explanation is that the De Jong Gierveld tool mainly focuses on cognitive loneliness,[35] whereas the Bude and Lantermann scale focuses more on affective dimensions. Thus, it may be possible that the end of obesity in women may particularly have consequences for affective factors. Nevertheless, future research including both tools is required to confirm these differences.

With regard to the onset of obesity, while the aforementioned study based on SHARE data[4] found an association between the onset of obesity and decreases in loneliness in men as well as increases in loneliness among women, our current study did not find an association between the onset of obesity and our outcome measures. Given that similar datasets and analytical approaches were used, these discrepancies appear puzzling. It may be the case that factors such as sociability or feelings of acceptance by society may counterbalance factors such as feeling stigmatized or not meeting social norms of attractiveness in our study. Moreover, while the study based on SHARE had short time intervals between the three waves, whereas our study used data with 3 years between both waves. Thus, potential short-term effects may not be identified due to adaptation processes. However, future studies are required to clarify these associations.

Our study adds to the limited knowledge[36] on the longitudinal association between obesity and loneliness and perceived social isolation. Longitudinal data were used from a nationally representative sample. The outcome measures were quantified using established tools. The problem of unobserved heterogeneity was reduced using asymmetric FE regressions. It was adjusted for several sociodemographic and health-related factors.

It is likely that BMI is underestimated in the DEAS study as it is based on self-assessments. However, if this underestimation is constant within individuals over time, it does not bias FE estimates.[33] In contrast, if such a misperception varies within individuals over time, it would bias the estimates.[33] Moreover, some interesting factors were not assessed in the DEAS study (such as caloric intake or certain personality factors such as extraversion). It should also be noted that a small sample selection bias and panel attrition is present in the DEAS study.[26] More precisely, participation rates were lower; for example, among individuals living in large cities, individuals aged 70–85 years or women.[26] However, the distribution of several socio-demographic characteristics (e.g., family status, income or occupational status) is very similar compared with the distribution within the older German population.[26] In addition, key reasons for drop off were time constraints and a general refusal. In contrast to individuals who drop out after their first participation, panel participants are slightly younger,

better educated, more affluent (in terms of income) and slightly healthier.[26] Please see Schiel et al.[37] for additional details.

Moreover, only two waves over a short time frame (3 years) were used in this study. Future studies based on more waves and over a longer time frame are therefore required. It should be noted that the possibility of reverse causality cannot be dismissed in our study (e.g., from perceived social isolation to the onset of obesity). Future research, e.g., based on panel instrumental variable approaches (when valid instruments are present) or based on dynamic panel-data estimations using maximum likelihood and structural equation modeling[38,39] (when the requirements are met such as the presence of at least three waves). In addition, our current study investigated the longitudinal association between obesity and perceived social isolation. Thus, future research is needed to examine the association between obesity and objective social isolation (e.g., measured by using infrequent contacts or low levels of social activity[40,41]).

Our findings emphasize the importance of overcoming obesity for women in the second half of life. As most of the existing studies were conducted in Germany, studies from other countries are of importance to understand this association better.

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Disclosure statement

The authors declare no conflict of interest.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Table S1 Determinants of perceived social isolation and loneliness. Results of linear asymmetric FE regressions (with general self-esteem as additional time-varying covariate)

Table S2. Determinants of perceived social isolation and loneliness. Results of linear asymmetric FE regressions (with frequency of sports activities as additional time-varying covariate)

Table S3. Determinants of perceived social isolation and loneliness. Results of linear asymmetric FE regressions (among individuals aged 40–64 years)

Table S4. Determinants of perceived social isolation and loneliness. Results of linear asymmetric FE regressions (among individuals aged ≥65 years)

Table S5. Determinants of perceived social isolation and loneliness. Results of linear asymmetric FE regressions (investigating the beginning and end of at least class II obesity).