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# Overweight and obesity in Germany

## Results of the German Health Interview and Examination Survey for Adults (DEGS1)

### Background and purpose

Nutrition, physical activity and genetic disposition determine in close interaction with each other, to a large extent the development of overweight. Life circumstances and individual habits represent a challenge to many people to keep a good balance between energy requirements and energy intake. In the last decades, an increase in the prevalence of overweight and obesity has been observed in many countries, recently also in many threshold and developing countries [1]. Worldwide, the highest prevalence of overweight and obesity for both men and women can be observed in the USA and some islands in the Pacific. Germany belongs to the countries with high overweight and obesity prevalence [1, 2]. In the late 1990s, several European countries, such as the Benelux states, France, Switzerland, Austria and Denmark, had lower obesity prevalence than Germany. Prevalence estimates similar to Germany were reported from the UK, Ireland and Norway and higher estimates from Poland, the Czech Republic, Italy and Spain [3]. More recent data show that there have only been slight changes in prevalence since then [4].

Overweight and obesity are usually defined on the basis of the Body Mass Index (BMI). According to the classification of the WHO, overweight is defined with a BMI of 25 kg/m<sup>2</sup> and higher. This category includes obesity, which specifies a BMI

of 30 kg/m<sup>2</sup> and higher. The BMI range between 25 and 30 kg/m<sup>2</sup> is referred to as pre-obesity [1]. Obesity can have consequences for a person's social life, mobility and quality of life [5, 6, 7], but overweight and obesity are also associated with many complaints and diseases [8]. Persons with obesity have an increased risk of type 2 diabetes mellitus [9, 10], cardiovascular disease [11, 12, 13, 14, 15] and certain types of cancers including cancer of the colon, pancreas, kidneys, breast and cervix [16, 17]. As a result, the life expectancy of obese people is observed to be lower than that of people with normal weight [18, 19]. The health risks of pre-obesity are less well substantiated than those of obesity [18, 19, 20].

Against this background, we present information on the prevalence of overweight and obesity among adults in Germany on the basis of the anthropometrical examinations of the first wave of the German Health Interview and Examination Survey for Adults (DEGS1). To determine time developments and trends, key results from DEGS1 are compared with results from the German National Health Interview and Examination Survey 1998 and the Health Examination Surveys 1990/92.

### Methods

The German Health Interview and Examination Survey for Adults ("Studie zur Gesundheit Erwachsener in Deutschland", DEGS) is part of the health mon-

itoring system at the Robert Koch Institute (RKI). The concept and design of DEGS are described in detail elsewhere [21, 22, 23, 24]. The first wave (DEGS1) was conducted from 2008–2011 and comprised interviews, examinations and tests [21, 24]. The target population comprises residents of Germany aged 18–79 years. DEGS1 has a mixed design which permits both cross-sectional and longitudinal analyses. For this purpose, a random sample from local population registries was drawn to complete participants of the German National Health Interview and Examination Survey 1998 (GNHIES98), who re-participated. A total of 8,152 persons participated, including 4,193 first-time participants (response rate 42%) and 3,959 revisiting participants of GNHIES98 (response rate 62%). In all, 7,238 persons attended one of the 180 examination centres, and 914 were interviewed only. A non-response analysis and a comparison of selected indicators with data from census statistics indicate a high level of representativeness of the net sample for the residential population aged 18–79 years of Germany [22]. The net sample (n=7,988, of these 7,116 participated in examination centres) permits representative cross-sectional and time trend analyses for the age range of 18–79 years in comparison with GNHIES98 [22]. A comparison with the Health Examination Surveys 1990/92 is possible for the age range of 25–69 years [25, 26]. The following analyses consider the 18–

**Tab. 1** Means (95% confidence interval) and medians (5th and 95th percentile) of anthropometric measurements in the adult German population (DEGS1), stratified by sex and age group (n=7,116)

Age group	18–29 years	30–39 years	40–49 years	50–59 years	60–69 years	70–79 years	Total
<b>Women</b>							
<b>Means (95% CI)</b>							
Body height (cm)	165.8 (165.1–166.4)	165.0 (164.1–165.9)	165.9 (165.3–166.6)	163.1 (162.5–163.6)	161.1 (160.5–161.7)	158.5 (157.8–159.1)	163.5 (163.2–163.9)
Body weight (kg)	65.2 (64.0–66.4)	68.7 (66.9–70.4)	70.8 (69.6–72.0)	73.0 (71.6–74.4)	74.0 (72.7–75.4)	73.5 (72.2–74.8)	70.7 (70.1–71.3)
BMI (kg/m <sup>2</sup> )	23.7 (23.3–24.1)	25.2 (24.6–25.8)	25.8 (25.3–26.2)	27.4 (26.9–28.0)	28.5 (28.0–29.0)	29.3 (28.8–29.9)	26.5 (26.3–26.7)
<b>Medians (5–95th percentile)</b>							
Body height (cm)	165.8 (155.5–176.3)	165.1 (153.3–176.0)	166.1 (154.9–175.5)	162.6 (153.3–173.4)	161.1 (151.5–170.9)	158.2 (147.3–169.2)	163.4 (152.3–174.5)
Body weight (kg)	61.8 (49.7–90.5)	64.7 (48.5–98.2)	67.9 (52.2–98.4)	70.0 (53.6–104.9)	71.9 (54.8–102.6)	73.0 (53.6–95.9)	68.0 (51.6–98.2)
BMI (kg/m <sup>2</sup> )	22.4 (18.6–33.2)	23.5 (18.8–35.8)	24.4 (19.5–35.9)	26.3 (20.4–38.8)	27.9 (21.4–37.8)	28.9 (21.8–39.3)	25.4 (19.6–37.0)
<b>Men</b>							
<b>Means (95% CI)</b>							
Body height (cm)	179.8 (179.1–180.6)	179.1 (178.1–180.1)	177.8 (177.0–178.5)	176.7 (176.0–177.3)	174.1 (173.3–174.8)	172.0 (171.2–172.7)	177.0 (176.6–177.3)
Body weight (kg)	79.6 (78.1–81.0)	86.0 (84.1–87.8)	87.0 (85.5–88.5)	87.4 (85.9–88.8)	87.3 (85.9–88.7)	84.3 (83.0–85.7)	85.2 (84.5–85.9)
BMI (kg/m <sup>2</sup> )	24.5 (24.1–24.9)	26.8 (26.3–27.3)	27.6 (27.0–28.1)	27.9 (27.5–28.3)	28.8 (28.4–29.2)	28.5 (28.1–28.9)	27.2 (27.0–27.4)
<b>Medians (5–95th percentile)</b>							
Body height (cm)	179.4 (168.0–192.3)	179.2 (166.5–191.0)	178.0 (166.0–190.1)	176.7 (165.0–187.5)	174.2 (162.1–184.7)	171.6 (160.7–183.3)	176.9 (164.5–189.8)
Body weight (kg)	76.7 (57.9–106.4)	84.9 (63.7–112.8)	85.3 (67.4–115.3)	85.9 (64.3–112.3)	85.1 (66.5–112.6)	83.5 (64.8–105.8)	83.8 (75.1–93.3)
BMI (kg/m <sup>2</sup> )	23.9 (19.0–31.9)	26.1 (20.9–34.9)	27.0 (21.5–35.9)	27.5 (21.6–34.7)	28.1 (22.9–36.2)	27.8 (23.1–35.2)	26.7 (24.1–29.8)

79 year olds who participated in the examination part (n=7,116).

The anthropometric examinations were conducted by trained staff according to standardised procedures. During the measurements the participants were dressed only in underwear without shoes. Body height was measured with a portable stadiometer (Holtain Ltd., UK) with a precision of 0.1 cm, and body weight on a calibrated electronic scale (SECA, column scale 930) with a precision of 0.1 kg. Overweight (BMI $\geq$ 25 kg/m<sup>2</sup>), pre-obesity (BMI $\geq$ 25 to <30 kg/m<sup>2</sup>) and obesity (BMI $\geq$ 30 kg/m<sup>2</sup>) were defined with the Body Mass Index, calculated from body height and weight (BMI = body weight (kg)/body height squared (m<sup>2</sup>)). Further divisions by degree of severity were made in line with the WHO criteria [1].

Socioeconomic status was determined using an index which includes information on school education and vocation-

al training, professional status and net household income (weighted by household needs) and which enables a classification into low, middle and high status groups [27].

The cross-sectional analyses in DEGS1 are conducted with a weighting factor which corrects deviations in the sample from the population structure (of 31 Dec 2010) with regard to age, sex, region and nationality, as well as community type and education [22]. Calculation of the weighting factor also considered, re-participation probability of GNHIES98 participants based on a logistic regression model. A separate weighting factor was prepared for the examination part. For a comparison with the anthropometric results of GNHIES98, the GNHIES98 data were weighted with a new weighting factor. This improves the representativeness for the population on 31 Dec 1997 (with regard to age, sex, fed-

eral state and community size) and additionally considers design aspects in accordance with DEGS1 [22]. Therefore, weighted estimates vary slightly from the results reported in previous publications [25, 28]. The age structure of the population has changed considerably since 1998 and body weight development is strongly associated with age. Accordingly, some results of GNHIES98 are standardised to the age structure of the population at the time of DEGS1 (population at 31 Dec 2010) to illustrate the time development in prevalence of overweight and obesity. To take into account the weighting as well as the correlation of the participants within a community, the confidence intervals are determined with the survey procedures for complex samples of SAS 9.3. Differences are regarded as statistically significant if the respective 95% confidence intervals do not overlap. For evaluation of the

development of overweight and obesity over the three survey periods, tests for linear trend are performed (significant if  $p$  trend  $< 0.05$ ). Results are presented by sex and age groups (18–29, 30–39, 40–49, 50–59, 60–69 and 70–79 years), by socioeconomic status and by region of residence (new federal states including Berlin versus old federal states).

## Results

Mean values and selected percentiles (P50, P5, and P95) of body height and body weight determined in DEGS1 as well as the calculated BMI stratified by age group and sex are shown in **Tab. 1**. The mean body height among women aged 70–79 years is roughly 7 cm less than among those aged 18–29 years and the corresponding group difference among men is almost 8 cm. The observed cross-sectional decrease in body height with advancing age is partly attributable to the acceleration of growth between the observed birth cohorts, but also attributable to the loss of bone mass resulting in a shortening of the spine with advanced age. With increasing age groups, the body weight becomes higher among women up to the age of 60–69 years. On average, men aged 30–39 years have a significantly higher body weight than those aged 18–29 years but the difference is smaller in the higher age groups. Whereas body weight of women is not essentially different between the two highest age groups, body weight is lower among men aged 70–79 years compared to men aged 60–69 years, by an average of 3 kg. The mean BMI also increases steadily with increasing age among both sexes. The medians of body height are almost identical with the corresponding mean values for both sexes and all age groups; this indicates a virtually normal distribution. For body height and BMI, the median values are lower than the means, which implies a distribution slightly skewed to the right.

Age and sex-specific means for body height, weight and BMI from GNHIES98 are shown in **Tab. 2**. Since the weighting factor was adapted, these results may differ slightly from those previously published. Among women, mean body height and body weight have hardly changed

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**Overweight and obesity in Germany. Results of the German Health Interview and Examination Survey for Adults (DEGS1)**

### Abstract

The increase in overweight and obesity is a worldwide health problem. The first wave of the German Health Interview and Examination Survey for Adults (DEGS1), conducted from 2008 through 2011, provides current data about overweight and obesity among adults in Germany. Within DEGS1, a representative sample of the 18- to 79-year-old population was interviewed with regard to health relevant issues and physically examined ( $n=7,116$ ). From measurements of body height and weight, the body mass index (BMI) was calculated, which was used to define overweight ( $BMI \geq 25 \text{ kg/m}^2$ ) and obesity ( $BMI \geq 30 \text{ kg/m}^2$ ). Results are stratified for gender, age group, socioeconomic status and region and compared with results from the

German National Health Interview and Examination Survey 1998 (GNHIES98) and the National Examination Surveys 1990/92. According to DEGS1, 67.1% of men and 53.0% of women are overweight. The prevalence of overweight has not changed compared to GNHIES98. The prevalence of obesity, however, has risen substantially, especially among men: in GNHIES98, 18.9% of men and 22.5% of women were obese, in DEGS1, these figures were 23.3% and 23.9%, respectively. The increase in obesity occurred especially among young adults.

### Keywords

Health survey · Adults · Obesity · Overweight · Anthropometrics · Epidemiology

## Übergewicht und Adipositas in Deutschland. Ergebnisse der Studie zur Gesundheit Erwachsener in Deutschland (DEGS1)

### Zusammenfassung

Die Zunahme von Übergewicht und Adipositas ist ein weltweites Gesundheitsproblem. Die von 2008 bis 2011 durchgeführte erste Welle der „Studie zur Gesundheit Erwachsener in Deutschland“ (DEGS1) liefert aktuelle Daten zu Übergewicht und Adipositas bei Erwachsenen in Deutschland. In DEGS1 wurde eine repräsentative Stichprobe der 18- bis 79-Jährigen zu gesundheitsrelevanten Themen befragt und medizinisch untersucht ( $n=7116$ ). Aus Messwerten zu Körperhöhe und -gewicht wurde der Body-Mass-Index (BMI) berechnet und damit Übergewicht ( $BMI \geq 25 \text{ kg/m}^2$ ) und Adipositas ( $BMI \geq 30 \text{ kg/m}^2$ ) definiert. Die Ergebnisse werden nach Geschlecht, Altersgruppen, Sozialstatus und Region dargestellt und mit denen des Bundes-Gesundheitssurveys 1998 (BGS98)

und des Nationalen Untersuchungssurveys 1990/92 verglichen. Nach Daten des DEGS1 sind 67,1% der Männer und 53,0% der Frauen übergewichtig. Diese Zahlen haben sich im Vergleich zum BGS98 nicht verändert. Die Adipositasprävalenz ist jedoch bedeutend gestiegen, und zwar insbesondere bei Männern: Nach Daten des BGS waren 18,9% der Männer und 22,5% der Frauen adipös, in DEGS1 sind es 23,3% der Männer und 23,9% der Frauen. Die deutliche Zunahme der Adipositas zeigt sich besonders bei jungen Erwachsenen.

### Schlüsselwörter

Gesundheitssurvey · Adipositas · Übergewicht · Anthropometrie · Epidemiologie

between GNHIES98 and DEGS1. Only in the 70–79 year age group has the mean body weight increased significantly. In DEGS1, on average, men are slightly heavier and taller than in GNHIES98. A significant increase in body height in DEGS1 compared to GNHIES98 is observed among men in the 50–59 year and the 60–69 year age groups, whereas body weight increased significantly only among men in the 60–69 year and the 70–79 year age groups. The mean BMI did not change

significantly in both men and women in comparison to GNHIES98.

The current prevalence of underweight, normal weight, overweight and obesity with further division of the two last groups by degree of severity are shown in **Tab. 3**. The prevalence of underweight is low in DEGS1, among women it is slightly higher (4.5%) in the younger age groups. Among men, in all age groups, except the 18–29 year olds, the prevalence is less than half a per cent.

**Tab. 2** Means (95% confidence interval) of anthropometric measurements in the adult German population (GNHIES98<sup>a</sup>), stratified by sex and age group (n=7,124)

Age group	18–29 years	30–39 years	40–49 years	50–59 years	60–69 years	70–79 years	Total
<b>Women</b>							
Body height (cm)	166.0 (165.3–166.6)	165.8 (165.2–166.4)	163.5 (163.0–164.0)	162.1 (161.5–162.6)	159.9 (159.2–160.6)	158.0 (157.1–158.8)	163.1 (162.7–163.4)
Body weight (kg)	64.9 (63.9–65.9)	68.9 (67.7–70.1)	70.5 (69.0–72.1)	73.1 (71.7–74.5)	74.1 (72.5–75.6)	70.7 (69.3–72.2)	70.1 (69.4–70.8)
BMI (kg/m <sup>2</sup> )	23.5 (23.2–23.9)	25.1 (24.6–25.5)	26.4 (25.8–27.0)	27.8 (27.3–28.3)	29.0 (28.4–29.6)	28.3 (27.8–28.9)	26.4 (26.1–26.7)
<b>Men</b>							
Body height (cm)	179.0 (178.2–179.8)	178.1 (177.5–178.8)	176.7 (176.2–177.3)	174.2 (173.6–174.8)	171.8 (171.1–172.5)	170.2 (169.1–171.2)	176.0 (175.6–176.3)
Body weight (kg)	79.1 (77.7–80.5)	84.0 (83.1–84.9)	86.1 (84.8–87.3)	85.4 (84.3–86.7)	83.2 (81.9–84.4)	80.6 (78.6–82.5)	83.3 (82.8–83.9)
BMI (kg/m <sup>2</sup> )	24.7 (24.3–25.1)	26.5 (26.2–26.7)	27.5 (27.2–27.9)	28.1 (27.8–28.5)	28.1 (27.8–28.5)	27.8 (27.3–28.3)	26.9 (26.7–27.1)

<sup>a</sup>The GNHIES98 analyses were conducted with a weighting factor which improves the representativeness for the population on 31 Dec 1997 and also takes into account design aspects in accordance with DEGS1. Due to the latter, this weighting factor deviates slightly from the one used in previous publications.

**Tab. 3** Prevalence (95% CI) of underweight, normal weight, overweight and obesity in the adult German population (DEGS1), stratified by sex and age group (n=7,116)

Age group	18–29 years	30–39 years	40–49 years	50–59 years	60–69 years	70–79 years	Total
<b>Women</b>							
Underweight ( $<18.5$ kg/m <sup>2</sup> )	4.5 (2.9–7.1)	4.4 (2.5–7.8)	1.9 (1.1–3.4)	1.0 (0.5–2.4)	0.2 (0.0–0.7)	1.9 (0.5–6.4)	2.3 (1.8–3.1)
Normal weight ( $18.5$ – $<25.0$ kg/m <sup>2</sup> )	65.5 (60.8–69.8)	57.6 (51.8–63.1)	51.7 (47.4–56.0)	38.1 (33.7–42.7)	29.2 (25.2–33.4)	17.8 (14.3–21.8)	44.7 (42.6–46.8)
Overweight ( $\geq 25.0$ kg/m <sup>2</sup> )	30.0 (25.9–34.5)	38.0 (32.8–43.5)	46.4 (42.1–50.8)	60.9 (56.1–65.4)	70.7 (66.4–74.6)	80.3 (75.9–84.1)	53.0 (50.8–55.1)
Pre-obesity ( $25.0$ – $<30.0$ kg/m <sup>2</sup> )	20.4 (16.7–24.6)	20.1 (16.3–24.5)	27.8 (23.8–32.2)	33.5 (29.5–37.8)	35.9 (31.4–40.5)	38.8 (33.9–43.9)	29.0 (27.3–30.8)
Obesity ( $\geq 30.0$ kg/m <sup>2</sup> )	9.6 (7.2–12.7)	17.9 (14.0–22.7)	18.6 (15.6–22.2)	27.3 (23.3–31.8)	34.8 (30.3–39.6)	41.6 (36.9–46.4)	23.9 (22.0–25.9)
Grade I obesity ( $30.0$ – $<35.0$ kg/m <sup>2</sup> )	6.9 (4.9–9.7)	11.6 (8.2–16.2)	12.7 (10.1–15.8)	17.5 (14.1–21.4)	22.5 (18.2–27.5)	28.1 (23.8–33.0)	15.9 (14.4–17.5)
Grade II obesity ( $35.0$ – $<40.0$ kg/m <sup>2</sup> )	1.8 (0.7–4.2)	4.0 (2.5–6.1)	3.9 (2.3–6.4)	5.3 (3.7–7.5)	8.8 (6.2–12.2)	9.6 (6.8–13.6)	5.2 (4.3–6.3)
Grade III obesity ( $\geq 40.0$ kg/m <sup>2</sup> )	0.9 (0.3–2.7)	2.3 (1.1–4.6)	2.1 (1.2–3.6)	4.6 (3.1–6.9)	3.5 (2.2–5.5)	3.8 (2.1–6.7)	2.8 (2.2–3.5)
<b>Men</b>							
Underweight ( $<18.5$ kg/m <sup>2</sup> )	2.7 (1.5–4.7)	0.4 (0.1–2.0)	0.3 (0.1–1.1)	0.2 (0.1–0.7)	0.2 (0.0–1.4)	0.1 (0.0–0.6)	0.7 (0.5–1.1)
Normal weight ( $18.5$ – $<25.0$ kg/m <sup>2</sup> )	62.0 (57.0–66.8)	37.2 (31.5–43.2)	29.8 (25.3–34.6)	21.5 (18.2–25.3)	15.9 (12.8–19.6)	17.4 (14.0–21.4)	32.2 (30.1–34.3)
Overweight ( $\geq 25.0$ kg/m <sup>2</sup> )	35.3 (30.6–40.3)	62.4 (56.4–68.1)	69.9 (65.0–74.4)	78.3 (74.5–81.7)	83.9 (80.2–87.0)	82.5 (78.5–86.0)	67.1 (65.0–69.2)
Pre-obesity ( $25.0$ – $<30.0$ kg/m <sup>2</sup> )	26.7 (22.6–31.2)	40.4 (34.9–46.2)	47.1 (42.0–52.1)	50.8 (46.2–55.3)	50.8 (45.5–56.1)	51.3 (45.7–56.8)	43.8 (41.8–45.9)
Obesity ( $\geq 30.0$ kg/m <sup>2</sup> )	8.6 (6.3–11.8)	22.0 (17.6–27.2)	22.9 (18.2–28.2)	27.5 (23.5–32.0)	33.1 (27.9–38.7)	31.3 (25.9–37.3)	23.3 (21.2–25.4)
Grade I obesity ( $30.0$ – $<35.0$ kg/m <sup>2</sup> )	6.6 (4.5–9.6)	16.8 (12.7–21.7)	16.5 (12.8–21.0)	23.0 (19.2–27.3)	25.3 (20.7–30.4)	25.7 (20.7–31.5)	18.1 (16.3–20.1)
Grade II obesity ( $35.0$ – $<40.0$ kg/m <sup>2</sup> )	1.6 (0.8–3.4)	4.0 (2.1–7.4)	4.2 (2.6–6.7)	3.8 (2.3–6.0)	5.8 (4.0–8.3)	5.0 (3.3–7.7)	3.9 (3.2–4.7)
Grade III obesity ( $\geq 40.0$ kg/m <sup>2</sup> )	0.4 (0.1–1.3)	1.3 (0.4–4.0)	2.1 (1.0–4.5)	0.8 (0.3–1.9)	2.0 (1.1–3.7)	0.5 (0.1–2.1)	1.2 (0.8–1.8)

**Tab. 4** Prevalence (95% CI) of overweight and obesity in the adult German population (DEGS1), stratified by sex, socioeconomic status and age group (n=6,998)

Age group	18–29 years		30–44 years		45–64 years		65–79 years	
	Overweight BMI ≥25.0 kg/m <sup>2</sup>	Obesity BMI ≥30.0 kg/m <sup>2</sup>	Overweight BMI ≥25.0 kg/m <sup>2</sup>	Obesity BMI ≥30.0 kg/m <sup>2</sup>	Overweight BMI ≥25.0 kg/m <sup>2</sup>	Obesity BMI ≥30.0 kg/m <sup>2</sup>	Overweight BMI ≥25.0 kg/m <sup>2</sup>	Obesity BMI ≥30.0 kg/m <sup>2</sup>
<b>Women</b>								
<b>Socioeconomic status</b>								
Low	36.9 (27.3–47.8)	16.4 (9.9–26.0)	49.2 (37.3–61.1)	32.6 (21.8–45.6)	70.0 (62.6–76.4)	41.8 (34.1–49.9)	80.8 (72.4–87.1)	47.1 (39.6–54.7)
Middle	30.3 (25.0–36.2)	8.3 (5.7–12.1)	44.2 (39.1–49.5)	17.1 (13.5–21.4)	61.3 (57.4–65.0)	27.3 (23.8–31.2)	77.9 (73.9–81.4)	38.7 (33.8–43.8)
High	18.7 (11.0–30.0)	4.4 (1.8–10.5)	23.4 (17.2–30.9)	7.2 (4.3–11.8)	45.5 (38.7–52.5)	13.8 (9.8–19.0)	55.7 (44.4–66.4)	15.8 (9.3–25.5)
<b>Men</b>								
<b>Socioeconomic status</b>								
Low	35.2 (25.2–46.7)	10.6 (5.5–19.2)	72.6 (60.5–82.1)	41.4 (30.3–53.5)	75.3 (67.4–81.8)	28.5 (22.1–35.9)	82.8 (73.4–89.4)	34.3 (23.5–47.1)
Middle	36.0 (30.0–42.4)	8.7 (5.8–12.9)	65.4 (59.1–71.3)	21.7 (17.0–27.3)	81.4 (77.6–84.7)	30.1 (26.2–34.4)	84.7 (80.5–88.1)	34.0 (28.1–40.5)
High	33.6 (22.0–47.6)	5.3 (1.6–16.2)	58.5 (49.7–66.7)	10.8 (6.3–18.0)	70.6 (63.9–76.4)	19.2 (14.2–25.5)	78.5 (70.0–85.0)	22.7 (16.2–30.8)

**Tab. 5** Prevalence (95% CI) of obesity in the adult German population (DEGS1), stratified by sex and region (n=7,116)

Age group	18–29 years	30–39 years	40–49 years	50–59 years	60–69 years	70–79 years	Total
<b>Women</b>							
New Federal States	6.9 (3.7–12.6)	24.0 (14.6–36.8)	19.9 (14.1–27.4)	25.3 (19.5–32.0)	39.4 (30.6–49.0)	46.0 (37.2–55.1)	26.1 (22.4–30.1)
Old Federal States	10.3 (7.5–14.0)	16.5 (12.4–21.7)	18.3 (14.9–22.4)	27.9 (23.1–33.3)	33.5 (28.3–39.0)	40.2 (34.9–45.9)	23.4 (21.2–25.7)
<b>Men</b>							
New Federal States	8.0 (4.3–14.3)	21.5 (13.9–31.8)	15.1 (9.4–23.5)	34.4 (26.7–42.9)	32.2 (25.7–39.6)	31.8 (24.7–39.8)	22.9 (19.6–26.5)
Old Federal States	8.8 (6.1–12.5)	22.2 (17.1–28.2)	24.8 (19.3–31.2)	25.6 (21.1–30.7)	33.3 (27.0–40.3)	31.1 (24.6–38.6)	23.4 (20.9–26.0)

More than 60% of young adults have normal weight. This percentage decreases consistently with advancing age among women. Among men, the percentage with normal weight is significantly higher in the 18–29 year age group than in the 30–39 year age group. Among the 70–79 year olds, only about a sixth (17.8% of women, 17.4% of men) have normal weight. Accordingly, the prevalence of overweight and obesity increases with advancing age. In total, 67.1% of men and 53.0% of women aged 18–79 years are overweight. Among women, a continuous increase of overweight prevalence can be observed up to old age. The prevalence is, however lower than among men, in all age groups. For men a large increase in overweight can be observed among young adults. Among the 18–29 year olds, 35.3% are overweight, but it is already 62.4% among the 30–39 year olds. Also for obesity, a considerable increase for both sexes with increasing age is seen. The overall

obesity prevalence in DEGS1 is 23.3% for men and 23.9% for women.

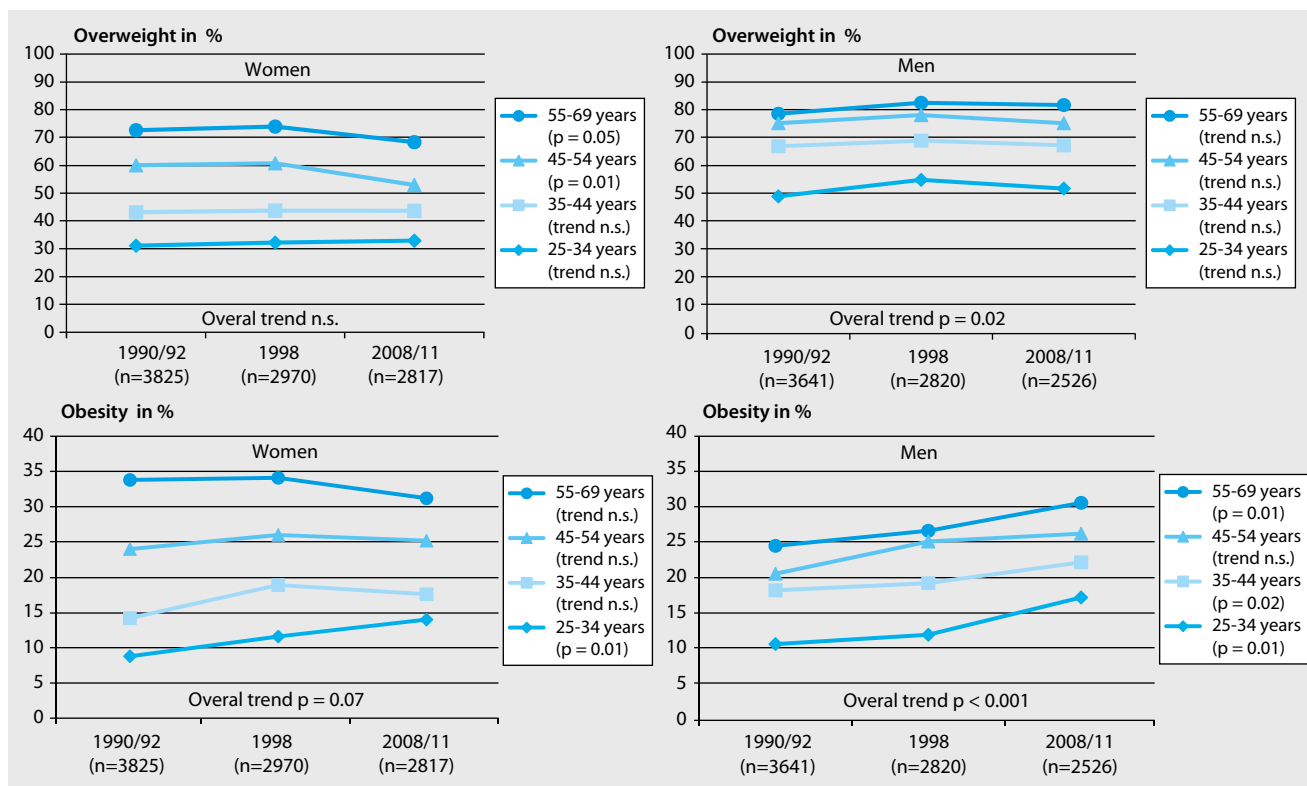
■ **Tab. 4** presents the prevalence of overweight and obesity stratified by sex, age group and socioeconomic status. Overweight prevalence in all age groups declines with increasing socioeconomic status among women. This trend is not observed among men. A decrease in the percentage of obesity with increasing socioeconomic status can be seen, however, for both men and women.

The prevalence of obesity in the new and old federal states of Germany is shown in ■ **Tab. 5**. Overall, it can be observed that the prevalence in the two regions is getting more similar compared to older surveys [25, 28]. Among women, the prevalence is higher in the new federal states than in the old federal states, but the difference is not significant. Within age groups, the differences between the two regions are also not significant.

For the 18–79 year age range, the prevalence of overweight determined in DEGS1 is not different from that in GNHIES98 (men 67.1%, women 53.0%). After age standardisation, the comparison of the results of both surveys shows a small decline in overweight prevalence of 1.5 percentage points respectively for men and women, although not statistically significant. For the prevalence of obesity, a statistically significant increase in comparison to GNHIES98 can be observed among men as well as a small, but not significant, increase among women. In GNHIES98, 18.9% of men and 22.5% of women were obese. After adjustment of the GNHIES98 data to the changed age structure (men 19.5%, women 23.1%), there is still a significant increase in obesity prevalence among men.

■ **Fig. 1** presents the prevalence of overweight and obesity in the last three national health examination surveys (Health Examination Surveys 1990/92, GNHIES98





**Fig. 1** ▲ Prevalence of overweight and obesity during the last 20 years by age group for women and men. Age: 55–69 years Line with circles, 45–54 years Line with triangles, 35–44 years Line with squares, 25–34 years Line with diamonds. n.s. not significant

and DEGS1), by sex and age group for the 25–69 year age range. Among women, the prevalence of overweight did not change between the three surveys (trend not significant). Among men, a small increase in the prevalence of overweight over time can be observed. In this case, the overall trend is significant ( $p_{\text{trend}} = 0.02$ ), but not in the respective age groups. In total, a significant increase in obesity can be observed among women ( $p_{\text{trend}} = 0.07$ ) and men ( $p_{\text{trend}} < 0.001$ ). In particular among the youngest age groups, a substantial increase can be observed for both sexes (men and women:  $p_{\text{trend}} = 0.01$ ). Whereas among women the prevalence in the older age groups increased up to 1998 and thereafter no further increase and even a slight decrease was observed (trend not significant), among men there was a significant increase over time in the age groups 35–44 years ( $p_{\text{trend}} = 0.02$ ) and 55–69 years ( $p_{\text{trend}} = 0.01$ ).

## Discussion

The proportion of overweight adults in Germany has not increased further during the last decade, but it remained stable on a high level. In contrast, the prevalence of obesity continued to rise, especially among young adults. This is alarming because a growing number of people are suffering from severe overweight at an early age and often for the rest of their life [29, 30], resulting in an increased risk for several diseases. The socioeconomic gradient in the prevalence of obesity also did not change, in tendency, in recent years: men and women with a low socioeconomic status are still more often affected by obesity.

In our analyses, overweight and obesity were evaluated on the basis of BMI. This index is not grounded on physical or physiological considerations but rather on the empirical observation of Quetelet in the early 19th century that during the growth phase, i.e. during childhood and adolescence, body weight on average increases in proportion to body height

squared [31]. He used this index mainly to evaluate normal growth. Not until a century later, when overweight prevalence increased and this was recognised as a health problem, the Quetelet Index was renamed to Body Mass Index and used to identify overweight and obesity. BMI correlates well with body fat mass, but is not identical with it and does not take into account, for example, body fat distribution, [32]. Within the scope of a large nationwide survey, however, the use of BMI is of advantage since it can be measured relatively quickly, easy and highly standardised compared to other indicators of overweight like body circumferences or subscapular measurements.

The presented results are based on standardised examinations conducted in a nationwide health survey. Such body measurements, which generally provide a higher overweight prevalence than self-reported assessments, are conducted regularly in only few countries [3]. In self-reported information, in particular women often underestimate their real body weight by some kilograms, and men and

women overestimate their body height, both resulting in an underestimation of BMI [33]. An important aspect of a nationwide survey is its representativeness for the residential population. Some selection bias cannot be completely excluded, however, because seriously ill or bedridden persons tend not to participate in health surveys. Also, revisiting participants of GNHIES98 may, in tendency, be healthier or may be more interested in health topics. For DEGS, a multistage sample was drawn which was essentially random, although it was stratified for certain characteristics. In addition, analyses were weighted with regard to age, sex, region, nationality, type of municipality and education. A potential bias by re-participation was minimised using an adapted weighting factor. Many additional measures were undertaken to enhance the response rate [23]. Finally, a comparison with census statistics indicates a high level of representativeness [22].

An advantage of the survey design is the possibility to perform cross-sectional analyses and—in conjunction with the previous survey—life course and trend analyses with the available data set. A wide spectrum of health-relevant variables is available for this purpose. Within the abundance of health topics, however, specific aspects cannot always be assessed comprehensively or in much detail. For instance, a direct measurement of body fat mass would be informative, but the necessary time and financial efforts would be too extensive for current realisation within the scope of a health survey.

In addition to the national health surveys, the German National Nutrition Survey II (NVS II) obtained anthropometric measurements in 2006 [34]. In the NVS II, the sampling and anthropometric measurements were performed similarly as in DEGS1. Although some selection effects cannot be completely excluded, like in DEGS1 due to re-participation, or in the NVS II due to a possible higher tendency to participate because of a special interest in nutrition topics, it is still reasonable to compare the results of the two surveys. In the NVS II, 66.0% of men aged 18–80 years and 50.6% of women in the same age range were overweight and 20.5% of men and 21.2% of women were

obese. The prevalence of overweight is fairly similar and the prevalence of obesity is slightly lower than in DEGS1, but they correspond with the time trend because the NVS II survey was conducted some years earlier. The published results from the NVS II on the distribution of mean body height, body weight and BMI are in total and for age groups, for both women and men, very similar to the results of DEGS1.

Among adults in Germany, a stabilisation of overweight prevalence can be seen in recent years, but also a further increase in the proportion of obese persons. The relatively large increase in obesity in the younger age groups corresponds with the high prevalence of obesity observed in the children and adolescent health survey (KiGGS) [35]. Although in KiGGS obesity for children and adolescents was defined differently than for adults in DEGS1—namely on the basis of percentiles—the obesity prevalence among 14–17 year olds was, with 8.2% for boys and 8.9% for girls, already almost as high as among 18–29 year olds in DEGS1. Therefore, obesity prevention should target the younger age groups in particular.

For an international comparison of overweight and obesity prevalence, it has to be considered that representative data based on body measurements are currently only available in a few countries. According to the current OECD report [4], Germany has a middle position in Europe considering overweight and obesity prevalence. However, for this OECD report self-reported information was used, for Germany as well as for most other European countries. In comparison to the few EU countries which have recent measurement data, the obesity prevalence determined in DEGS1 (2008–2011) is fairly similar to that in the United Kingdom (2009/10: 26.1%), Ireland (2007: 23.0%) and Luxembourg (2008: 22.5%), but is lower than in Hungary (2009: 28.5%) and higher than in the Czech Republic (2010:21.0%) and Slovakia (2008: 16.9%). A considerably higher prevalence is reported for the USA, where 35.5% of men aged 20 years and above and 35.8% of women of the same age were obese in the years 2009/2010. The prevalence of overweight was 73.9% for men and 63.7% for women [36].

## Conclusion and outlook

**The prevalence of overweight and obesity in the adult population of Germany remains at a high level. Whereas the overweight prevalence did not increase further in recent years, the obesity prevalence continued to grow. The large increase in obesity prevalence in the younger age groups is particularly remarkable. Furthermore, clear differences in disadvantage of persons with a low socioeconomic status can be observed. These first results of DEGS1 will be succeeded by differentiated analyses of, for instance, waist and hip circumference measurements. The inclusion of GNHIES98 participants in DEGS1 and the renewed inclusion of DEGS1 participants in subsequent survey waves enables the calculation of individual changes in BMI and other health-relevant characteristics over time. In addition, determinants of these changes and associated behaviour patterns can be examined to get more insight in the development of obesity in Germany. Such an analysis can include persons who used to have normal weight and now are overweight, as well as persons who used to be overweight and meanwhile have normal weight. The findings from this may be important for the conception of prevention approaches. Overweight and obesity continue to be of high public health relevance both in the context of prevention and health promotion as well as within the scope of medical care.**

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