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BRIEF REPORT

Disproportionate increase of extreme obesity among older adults: an exploratory analysis from the English longitudinal study of ageing

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Abstract
Background The global rise in obesity increasingly includes extreme forms, notably BMI ≥ 50 kg/m², which present disproportionate health risks, especially among older adults. Despite this, most epidemiological research aggregates all obesity (BMI ≥ 30 kg/m²), potentially underestimating the burden of extreme obesity. Understanding trends in this subgroup is critical for targeted public health and clinical responses.
Methods We analyzed data from the English Longitudinal Study of Ageing (ELSA) across four waves (2004–2005 to 2016–2017). Data were analysed on the entire population and also for those aged ≥ 65 years. BMI was calculated from measured or self-reported height and weight and classified using WHO standards. Poisson regression with robust error variance was used to assess trends across BMI categories, adjusting for age and sex.
Results Extreme obesity (BMI 50–59.9 kg/m²) increased by 50% over the 12-year period, and for the first time, individuals with BMI ≥ 60 kg/m² were observed in 2016–2017. Among older adults, mild obesity (BMI 30–39.9 kg/m²) declined slightly, while class II obesity (BMI 40–49.9 kg/m²) rose significantly. However, no individuals aged ≥ 65 years were recorded in the ≥ 60 kg/m² category. Though absolute numbers remain small, the upward trend is clear and clinically significant.
Conclusions Extreme obesity is rising disproportionately, including among older adults, and requires urgent recognition as a distinct public health challenge. Healthcare systems must adapt to the complex needs of this population, including appropriate medical infrastructure, specialized care pathways, and enhanced clinical guidelines. Ongoing surveillance and tailored interventions are essential to address this growing burden.

Keywords Obesity · Body mass index · Older adults · ELSA study

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Introduction

The global obesity epidemic has become one of the most significant public health crises of the 21st century [1]. Beyond increasing rates of overweight and class I obesity (body mass index [BMI] 30–39.9 kg/m²), extreme obesity—defined as BMI ≥ 50 kg/m², and especially the threshold of BMI ≥ 60 kg/m²—has emerged as a disproportionate burden with profound implications for health and healthcare services [2]. Extreme obesity is characterized not only by severe adiposity but also by the substantial co-occurrence of chronic diseases such as cardiovascular disease, type 2 diabetes, and musculoskeletal impairments that greatly limit mobility and independence in affected individuals [2–4]. Further, this level of obesity necessitates more complex clinical management, including specialized diagnostic tools, tailored surgical protocols, and increased social and healthcare support that pose significant logistic and financial challenges to health systems worldwide [5].

Despite this serious public health issue, most epidemiological research and clinical guidelines still focus on the more common BMI categories, often aggregating all individuals with BMI ≥ 30 kg/m² into one group. This practice masks the rapid emergence of the most severely affected population and underestimates its true burden. Recent literature has begun to document a troubling acceleration in extreme obesity in the United States. For example, NHANES data indicate that the proportion of adults with BMI ≥ 60 kg/m² increased more than 200% between 2001 and 2023 [2]. This rapid growth underscores the need for robust data to track these trends across different populations, such as older adults for which the association between high BMI values and negative outcomes is more debated compared to younger populations [6]. In older adults, reductions in mass of individual organs/tissues, as well as in tissue-specific organs, and the corresponding changes in metabolic rate, contributes to a reduction in resting metabolic rate that in turn promotes changes in body composition, favoring increased fat mass and reduced fat-free mass [7]. In this specific population, it should be noted that standard cut-offs for BMI proposed by the World Health Organization have a poor sensitivity [8], potentially leading to the phenomenon known as the obesity paradox [9].

In this paper, we draw upon the ELSA (English Longitudinal Study of Ageing) data, a large epidemiological study in people aged 50 years and over, to describe the prevalence and trends of extreme obesity between 2004 and 2005 and 2016–2017, analyses focus on the entire ELSA population and on those aged≥65 years. Our primary aim is to quantify the extent to which extreme obesity (BMI≥50 kg/m² and BMI≥60 kg/m²) has increased over time, and to characterize the magnitude of these trends in comparison to more commonly reported obesity categories. Together, these findings will inform public health strategies, healthcare resource allocation, and future research needs to address one of the most vulnerable subpopulations facing obesity.

Materials and methods

Study population

This study is based on data from the English Longitudinal Study on Ageing (ELSA) between wave 2 (2004–2005) until wave 8 (2016–2017). The ELSA is a prospective and nationally representative cohort of men and women living in England [10]. Wave 2 is commonly used as the baseline wave as this wave contains all data further measured in following waves [10]. In the following waves, new participants were enrolled in order to replace people lost during follow-up [10].

The ELSA was approved by the London Multicenter Research Ethics Committee (MREC/01/2/91). Informed consent was obtained from all participants.

Body mass index categories

In the ELSA study, weight and height were measured by a trained nurse. According to the study protocol [10], these measurements were taken every four year.

Height was measured both standing and sitting. If height or weight could not be measured, then an estimate was obtained from the respondent instead, however, for only 27 participants these data were obtained using this method. If the nurse thought the measurement was likely to be more than 2 cm (3/4 inch) from the true figure for height or more than 1 kg (2 lbs.) from the true figure for weight, it was considered unreliable and they were asked to code it as such.

The maximum weight that would register accurately on the scales was 130 kg (20½ stone). If the nurse thought the respondent exceeded this limit then they were instructed to code "Weight not attempted" and ask the respondent for an estimate instead. All respondents were eligible to have their height and weight measured. Using the height and weight measurements obtained, BMI was calculated by dividing a person's weight in kilograms by the square of their height in meters. BMI values were then grouped according to World Health Organisation definitions of obesity [11], i.e., BMI < 18.5 kg/m^2 (underweight), BMI 18.5–24.9 kg/m^2 (normal weight), BMI 25–29.9 kg/m^2 (overweight), BMI 30–39.9 kg/m^2 (class I obesity), BMI 40–49.9 kg/m^2 (class II obesity), BMI 50–59.9 kg/m^2 (class III obesity) and BMI ≥ 60 kg/m^2 (extremely severe obesity), as also recently reported in other investigations about the same topic [2].

Statistical analysis

Prevalence estimates were calculated for each BMI category by survey years (2004–2005; 2008–2009; 2012–2013; 2016–2017), for the overall study population and for individuals age≥65 years. Poisson regression models with robust error variance were applied to estimate relative risks (RRs) of being in each BMI category across survey years, using 2004–2005 as the reference. Model 1 was unadjusted, while Model 2 adjusted for key demographic confounders (sex and age, as continuous variable expressed in completed years). Model fit was evaluated using Pearson χ^2/degree of freedom (df) and deviance/df to assess dispersion; robust (Pearson-scaled) standard errors were used throughout. All tests were two-sided, with a significance level of $p<0.05$. Analyses were conducted using SAS software (version 9.4).

Results

Of the 9,432 participants of the wave 2 (baseline) of the ELSA study, 8,460 participants had a valid BMI measurement (89.7% of the initial sample size). The mean age of the whole population was 65.2 years with a standard deviation (SD) of 10.1 years, with a slightly higher prevalence of females (54.3%). When restricted to older adults (i.e., ≥65 years), the sample size was constituted of 4,127 people, with a mean of 73.8 years (SD=6.4 years) with a percentage of females of 54.7%.

Table 1; Fig. 1 report the prevalence and 95% confidence interval (CI) of BMI categories, across the years of data collection. Overall, the prevalence of underweight individuals (BMI<18.5 Kg/m^2) showed a non-significant increase in the whole population (from 0.59%, 95%CI: 0.42–0.76 in 2004–2005 to 0.81%, 95%CI: 0.61–1.02 in 2016–2017), indicating a 33% relative increase of this category during the 12-year period of follow-up. Among older adults (≥65 years), this category rose from 0.8% to 1.9%, more than doubling over time.

Mild obesity, i.e., BMI between 30 and 39.9 Kg/m^2, remained practically stable over time in the overall study population (34.6% in 2004–2005 to 34.7% in 2016–2017), but declined among older adults (from 34.5% to 29%). On the contrary, the prevalence of individuals with BMI between 40 and 49.9 Kg/m^2 increased from 3.1% to 4.2%, indicating an increase of approximately 35.5% during the follow-up period, while remaining stable among older adults (2.2% to 2.0%).

For those with a BMI between 50 and 59.9 Kg/m^2, the prevalence increased from 0.15% to 0.27% in the general population (+50%), and from 0.05% to 0.07% among older adults. Finally, considering extreme grades of obesity (i.e., BMI≥60 Kg/m^2), we observed that nobody was ranked in this category in 2004–2005, while the prevalence reached 0.04% after 12 years of follow-up, meaning that four subjects reported this condition in 2016–2017. On the contrary, no older person was ranked into this category during the different waves considered.

Table 2 (overall study population) and Table 3 (older adults) report the trends of the different BMI categories over time. Across outcomes, Pearson χ^2/df ranged from 0.57 to 1.10 and deviance/df was <1, indicating no relevant

Table 1 BMI categories (prevalence, 95% CI), by year of data collection

	2004–2005	2008–2009	2012–2013	2016–2017
(a) Overall study population	*n=7,970*	*n=9,113*	*n=8,858*	*n=7,487*
BMI<18.5 kg/m^2	0.6 (0.4–0.8) (*n*=47)	0.6 (0.4–0.7) (*n*=51)	0.6 (0.4–0.8) (*n*=53)	0.8 (0.6-1.0) (*n*=61)
BMI 18.5–24.9 kg/m^2	18.4 (17.6–19.3) (*n*=1468)	17.6 (16.8–18.4) (*n*=1601)	19.4 (18.5–20.2) (*n*=1715)	20.5 (19.5–21.4) (*n*=1531)
BMI 25–29.9 kg/m^2	43.1 (42.0-44.2) (*n*=3437)	41.4 (40.4–42.5) (*n*=3776)	40.5 (39.5–41.6) (*n*=3590)	39.6 (38.4–40.7) (*n*=2961)
BMI 30–39.9 kg/m^2	34.6 (33.6–35.7) (*n*=2761)	35.8 (34.8–36.8) (*n*=3264)	35.0 (34.0–36.0) (*n*=3098)	34.7 (33.6–35.7) (*n*=2594)
BMI 40–49.9 kg/m^2	3.1 (2.7–3.5) (*n*=245)	4.3 (3.9–4.7) (*n*=389)	4.2 (3.8–4.6) (*n*=374)	4.2 (3.8–4.7) (*n*=317)
BMI 50–59.9 kg/m^2	0.2 (0.1–0.2) (*n*=12)	0.3 (0.2–0.4) (*n*=28)	0.3 (0.2–0.4) (*n*=28)	0.3 (0.2–0.4) (*n*=20)
BMI≥60 kg/m^2	0 (*n*=0)	0.04 (0.0-0.1) (*n*=4)	0 (*n*=0)	0.04 (0.0-0.1) (*n*=3)
(b) Population 65+years	*n=4,174*	*n=3,485*	*n=2,734*	*n=2,149*
BMI<18.5 kg/m^2	0.8 (0.5–1.1) (*n*=31)	0.9 (0.6–1.3) (*n*=24)	0.6 (0.3-1.0) (*n*=12)	1.9 (1.2–2.6) (*n*=27)
BMI 18.5–24.9 kg/m^2	19.3 (18.1–20.5) (*n*=755)	19.0 (17.5–20.5) (*n*=484)	21.2 (19.3–23.0) (*n*=398)	24.0 (21.7–26.2) (*n*=338)
BMI 25–29.9 kg/m^2	43.1 (41.6–44.7) (*n*=1688)	44.5 (42.6–46.4) (*n*=1135)	42.9 (40.6–45.1) (*n*=806)	43.0 (40.4–45.6) (*n*=606)
BMI 30–39.9 kg/m^2	34.5 (33.0–36.0) (*n*=1351)	32.2 (30.4–34.0) (*n*=822)	32.9 (30.8–35.1) (*n*=619)	29.0 (26.6–31.4) (*n*=409)
BMI 40–49.9 kg/m^2	2.2 (1.8–2.7) (*n*=87)	3.1 (2.4. 3.8) (*n*=79)	2.3 (1.6-3.0) (*n*=43)	2.0 (1.3–2.7) (*n*=28)
BMI 50–59.9 kg/m^2	0.05 (0-0.1) (*n*=2)	0.2 (0-0.4) (*n*=5)	0.1 (0-0.3) (*n*=2)	0.07 (0-0.2) (*n*=1)

Abbreviations BMI (Body Mass Index); CI (Confidence Interval)

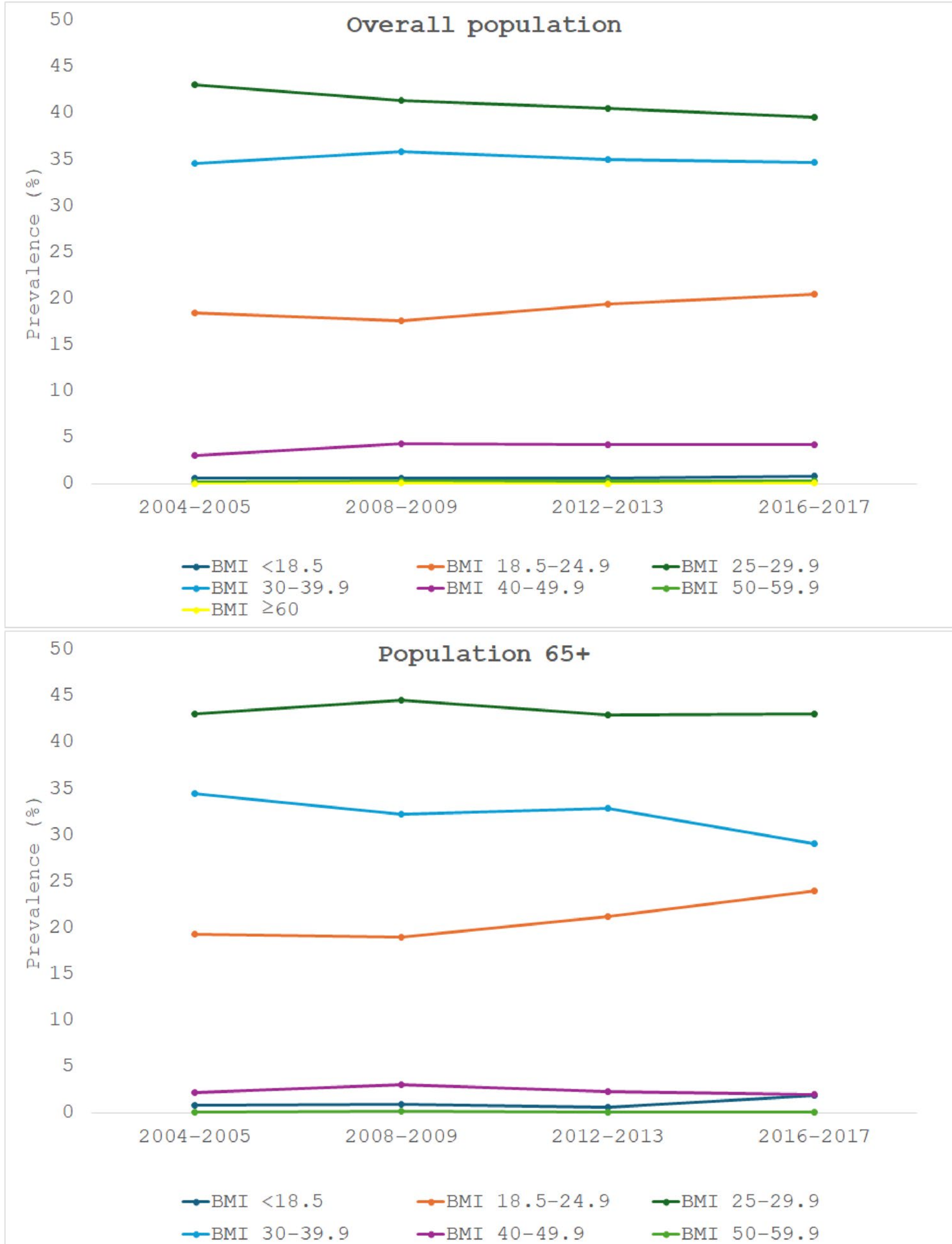

Fig. 1 BMI categories (prevalence), by year of data collection

overdispersion and an adequate fit of the Poisson specification. The underweight model showed mild overdispersion (Pearson χ^2/df = 1.10), while the extreme-obesity model had very small deviance/df consistent with under-dispersion due to sparse counts. In the sample as a whole, using a Poisson model and adjusting for age and sex, we observed that the RR of being underweight in 2016–2017 compared to 2004–2005 was 1.15 (95%CI: 0.79–1.65, $p = 0.466$) in the general population, indicating a non- significant increase. A similar figure was observed among older adults (RR = 1.15, 95%CI: 0.68–1.90, $p = 0.614$). When considering obesity in the whole population, the RR of having a BMI between 30 and 39.9 Kg/m^2 in 2016–2017 compared to 2004–2005 was 1.02 (95%CI: 0.98–1.06, $p = 0.362$), for a BMI between 40 and 49.9 Kg/m^2 was 1.56 (95%CI: 1.33–1.82, $p < 0.001$), and for a BMI between 50 and 59.9 Kg/m^2 was 2.48 (95%CI: 1.26–4.88, $p = 0.008$). Among older adults, mild obesity remained practically stable (RR = 1.08, 95%CI: 0.98–1.18, $p = 0.107$). The prevalence of BMI between 40 and 49.9 Kg/m^2 significantly increased (RR = 1.82, 95%CI: 1.24–2.66, $p = 0.002$); however, these results should be interpreted with caution considering that they were based on small numbers.

Table 2 Poisson regression (with robust errors variance) for changes in BMI category prevalence

Overall study population	Model 1			Model 2		
	RR	95% CI	p-value	RR	95% CI	p-value
Underweight						
2008-09 vs. 2004-05	0.95	0.66–1.36	0.774	0.98	0.69–1.40	0.917
2012-13 vs. 2004-05	1.01	0.70–1.47	0.938	1.05	0.72–1.53	0.797
2016-17 vs. 2004-05	1.38	0.96–1.98	0.08	1.15	0.79–1.65	0.466
Normal weight						
2008-09 vs. 2004-05	0.95	0.91–1.00	0.064	0.96	0.91–1.01	0.094
2012-13 vs. 2004-05	1.05	0.99–1.11	0.063	1.02	0.96–1.08	0.421
2016-17 vs. 2004-05	1.11	1.05–1.17	<0.001	1.08	1.02–1.14	0.013
Overweight						
2008-09 vs. 2004-05	0.96	0.93–0.99	0.006	0.96	0.93–0.99	0.006
2012-13 vs. 2004-05	0.94	0.91–0.97	<0.001	0.95	0.92–0.98	0.002
2016-17 vs. 2004-05	0.92	0.89–0.95	<0.001	0.91	0.88–0.94	<0.001
Obesity 30–39.9 kg/m^2						
2008-09 vs. 2004-05	1.03	1.00–1.07	0.038	1.03	1.00-1.06	0.05
2012-13 vs. 2004-05	1.01	0.98–1.04	0.584	1.01	0.98–1.06	0.415
2016-17 vs. 2004-05	1.00	0.96–1.04	0.995	1.02	0.98–1.06	0.362
Obesity 40–49.9 kg/m^2						
2008-09 vs. 2004-05	1.39	1.23–1.57	<0.001	1.38	1.22–1.56	<0.001
2012-13 vs. 2004-05	1.37	1.20–1.58	<0.001	1.36	1.18–1.56	<0.001
2016-17 vs. 2004-05	1.38	1.19–1.59	<0.001	1.56	1.33–1.82	<0.001
Obesity 50–59.9 kg/m^2						
2008-09 vs. 2004-05	2.04	1.06–3.94	0.034	2.02	1.04–3.90	0.037
2012-13 vs. 2004-05	2.1	1.09–4.06	0.027	2.26	1.15–4.43	0.018
2016-17 vs. 2004-05	1.77	0.91–3.46	0.093	2.48	1.26–4.88	0.008

Abbreviations: CI (Confidence Interval); RR (Relative Risk)

Model 1: not adjusted; Model 2: sex and age adjusted

Table 3 Poisson regression (with robust errors variance) for changes in BMI category prevalence

Population 65+years	Model 1			Model 2		
	RR	95% CI	p-value	RR	95% CI	p-value
Underweight						
2008-09 vs. 2004-05	1.19	0.74–1.90	0.472	0.99	0.63–1.55	0.949
2012-13 vs. 2004-05	0.81	0.43–1.52	0.504	0.82	0.48–1.42	0.486
2016-17 vs. 2004-05	2.42	1.46-4.00	<0.001	1.15	0.68–1.90	0.614
Normal weight						
2008-09 vs. 2004-05	0.98	0.91–1.06	0.674	0.88	0.82–0.95	<0.001
2012-13 vs. 2004-05	1.10	1.00-1.20	0.04	0.92	0.85-1.00	0.055
2016-17 vs. 2004-05	1.24	1.13–1.37	<0.001	0.87	0.78–0.97	0.012
Overweight						
2008-09 vs. 2004-05	1.03	0.99–1.08	0.153	1.02	0.98–1.06	0.341
2012-13 vs. 2004-05	0.99	0.94–1.05	0.827	1.01	0.96–1.06	0.746
2016-17 vs. 2004-05	0.99	0.94–1.06	0.915	0.99	0.93–1.07	0.902
Obesity 30–39.9 kg/m^2						
2008-09 vs. 2004-05	0.93	0.89–0.98	0.008	1.02	0.97–1.07	0.357
2012-13 vs. 2004-05	0.95	0.9–1.02	0.138	1.04	0.98–1.10	0.219
2016-17 vs. 2004-05	0.84	0.78–0.91	<0.001	1.08	0.98–1.18	0.107
Obesity 40–49.9 kg/m^2						
2008-09 vs. 2004-05	1.39	1.12–1.74	0.003	1.56	1.27–1.93	<0.001
2012-13 vs. 2004-05	1.03	0.77–1.38	0.85	1.48	1.13–1.94	0.004
2016-17 vs. 2004-05	0.89	0.62–1.30	0.553	1.82	1.24–2.66	0.002

Abbreviations: CI (Confidence Interval); RR (Relative Risk)

Model 1: not adjusted

Model 2: sex and age adjusted

Discussion

The ELSA findings highlight that while rates of mild obesity (BMI 30–39.9 kg/m²) in older adults remained stable or even declined, extreme obesity (BMI ≥ 50 kg/m²) increased disproportionately between 2004 and 2017. Specifically, the prevalence of individuals with a BMI ≥ 50 kg/m² increased by approximately 40% over the 12-year period, even though the absolute numbers are still limited and in the ELSA study people weighing more than 130 Kg were not included. However, the emergence of people with BMI ≥ 60 kg/m² was documented for the first time in this cohort, although there was no documentation for those aged ≥ 65 years.

Despite methodological and demographic differences between the ELSA and NHANES cohorts [2], the broad pattern of increasing extreme obesity is evident across both studies. However, there are some noteworthy differences. First, in ELSA, extreme obesity rates rose most markedly among those ≥ 65 years old, a pattern less distinctive in the NHANES age-stratified analyses, where trends span in the broad adult population. Second, extreme obesity remains less prevalent in the United Kingdom (U.K.) cohort (e.g., only 0.04% had BMI ≥ 60 kg/m²) compared to the United States (U.S.) cohort, where extreme obesity reached approximately 0.37% by 2021–2023. Finally, the U.S. data show more sustained and accelerated relative increases over two decades, while the U.K. cohort reveals a more gradual rise, especially among those already aged ≥ 65 years. The comparison with US data highlights the global rise of extreme obesity but must be interpreted within the UK's distinct healthcare and sociodemographic context. The UK's publicly funded NHS provides broad access to preventive care yet limited specialized obesity and bariatric services may influence management outcomes. Additionally, obesity in the UK is more strongly linked to socioeconomic deprivation and regional disparities, whereas US trends are shaped by greater ethnic and income heterogeneity. Differences in healthcare infrastructure, lifestyle, and cultural attitudes toward weight likely explain the slower but still concerning increase in extreme obesity observed in the ELSA cohort compared with US data.

However, we believe that also our data underscore the urgent need for dedicated public health strategies tailored to extreme obesity, which is associated with marked higher rates of comorbidity and health-care utilization [5]. Current clinical guidelines and public health campaigns often focus on reducing obesity at the population level, but they overlook the most severely affected individuals who face unique challenges related to mobility, treatment access, and responsiveness to standard weight-loss interventions [12]. In our opinion, given the growing proportion of people with BMI ≥ 50 kg/m², healthcare systems will need to increase public and professional awareness of this rapidly expanding subgroup and not consider obese people only as one category. Second, our epidemiological study suggests that public health authorities should develop policies for ensuring appropriate medical equipment and care pathways for people with extreme obesity: these patients usually require personalized tools and equipment, often not available [13], particularly considering that bariatric surgery is generally not an option after 70 years old and that new medications for obesity are rapidly coming [14]. Finally, our study indicates that a better integration of public health interventions, medications leading to weight loss and specialized bariatric services are necessary to better face this important epidemiological increase [15]. Again, from a clinical point of view, bariatric surgery in older adults, particularly those over 70 years of age, presents significant limitations due to increased surgical risks, frailty, comorbidities, and reduced physiological resilience. While surgery can offer meaningful weight reduction and metabolic improvements, its benefits may be attenuated by age-related declines in muscle mass, slower recovery, and higher complication rates, leading most guidelines to discourage such interventions beyond 70 years. In parallel, pharmacological treatments for obesity—such as GLP-1 receptor agonists and dual agonists—are emerging as promising options for elderly patients who are not surgical candidates. However, challenges remain, including limited evidence in frail older adults, polypharmacy concerns, potential gastrointestinal side effects, and the need to balance efficacy with preservation of muscle and bone mass. Beyond individual treatment, healthcare infrastructure must adapt to the growing prevalence of extreme obesity in aging populations. Nursing homes and hospitals increasingly require specialized equipment such as reinforced beds, bariatric wheelchairs, lifting devices, and widened doorways to ensure safe care and dignity for patients. These adaptations are essential components of a comprehensive, multidisciplinary approach to managing extreme obesity among older adults.

Despite its strengths, this study has several limitations. First, while ELSA is a nationally representative, longitudinal cohort, findings may not be fully generalizable to all older adults outside of England or to younger populations. Second, measurement constraints in epidemiological studies—such as the upper limit of 130 kg in the ELSA dataset and the reliance on self-reported weights for some individuals—may lead to an underestimation of the true prevalence of extreme obesity in this population, underscoring the need for improved data collection protocols and equipment capacity in future research. Third, the small number of participants in the highest BMI categories substantially reduced the statistical power of the analyses, limiting the precision of trend estimates and subgroup comparisons. Fourth, we were not able to fully account for all potential confounders that may contribute to obesity trends, including dietary habits, physical activity, and healthcare access. Finally, as an observational study, we cannot infer causal relationships between measured factors and changes in extreme obesity rates over time. Furthermore, our models were adjusted only for age and sex. Other potential confounders, such as socioeconomic status, lifestyle behaviours, and comorbidities, were not included and may influence obesity trends. Therefore, caution is warranted when interpreting the adjusted estimates, and future studies with more comprehensive covariate data are needed.

In conclusion, this study highlights a substantial and concerning rise in extreme obesity among older adults in England over a 12-year period, mirroring trends observed internationally. Given the projected aging of populations and persistent global obesity epidemic, ongoing surveillance and tailored interventions will be vital to reduce the health burden and improve quality of life for those most severely affected.

Author contributions All authors have contributed to the writing or the editing of the paper submitted, approved before the submssion by everyone.

Data availability The data are available upon reasonable request to the corresponding author.

Declarations

Competing interests The authors declare no competing interests. Nicola Veronese is the Editor in Chief of Aging Clinical Experimental Research.

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