Implications of obesity in exceptional longevity

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Except for the world's poorest regions, it is estimated that global obesity [body mass index (BMI) >30 kg/m^2] prevalence will reach 18% (men) and >21% (women) by 2025 (1). Recent nationally representative surveys in the US for the 2013–2014 period indicate age-adjusted obesity prevalence of 35.0% and 40.4% among adult men and women, respectively (2) and of 17.0% for children and adolescents aged 2–19 years (3). On the other hand, because healthy life expectancy also shows global improvement, the world is becoming apparently heavier and healthier (4). This finding is paradoxical given the association of obesity, and especially severe/morbid obesity, and/or its metabolic consequences with all-cause mortality as well as with a broad range of diseases and health complaints (5). In fact, recent data suggest that life expectancy will start to decline in the US over this century. Accordingly, we could be approaching a tipping point where technological and medical care advances might no longer compensate for our poor lifestyle habits (6).

Centenarians show exceptional longevity (~20+ years more than the average Westerner) and most have postponed, and some even escaped major diseases despite their advanced age. The latter represents the paradigm of extended healthy life expectancy that any individual would dream of reaching.

We assessed BMI in three independent centenarians' cohorts of both sexes that we have studied extensively (7): n=81 from Northern Italy (Lombardy, Piedmont); n=84 from Spain (central area); and n=467 from Japan [participants in the Tokyo Centenarians and semi-supercentenarians (SS) study] (7). The Italian centenarians were free of major age-related diseases (cancer, CVD, dementia). BMI assessment was done during 2009–2013 (Spain), 2011–2014 (Italy), 2000–2004 (Japanese centenarians) and 2002–2016 (Japanese SS) (7). We compared BMI mean values and categories across cohorts with one-group ANOVA and χ^2 tests, respectively. We obtained approval from the local ethics committees [European University of Madrid (Spain), 2E Science (Italy), and Keio University (Japan)]. The study followed the tenets of the Declaration of Helsinki for Human Research.

Results are shown in *Table 1*. Aside from some geographic-specific differences (Japanese centenarians had the lowest BMI and a high prevalence of underweight–which is concurrent with the typical profile of this country compared with most Western societies), a main result is that the percentage of obese centenarians was well below the estimated current values for adults [age-standardized obesity of 10.8% (95% CI: 9.7–12.0) in men and 14.9% (95% CI: 13.6–16.1) in women] (1). Notably, we found no obese male centenarians in any of the cohorts. Italy has one of the world's highest percentages of obese people [ranked number 9 (men) and 14 (women) in 2014] (1). And yet there were no obese disease-free centenarians in the Italian cohort.

According to our results, obese people do not show healthy life expectancy. Compared to other hominoids, humans show an evolved predisposition to deposit fat.

Table 1 Body mass index (BMI) in three independent cohorts of centenarians

	Italian (disease-free)	Japanese	Spanish
Men and women	n=81	n=467	n=84
Age (y)			
Mean ± SD	101±1	106±3*	102±2*
Median [range]	100 [100, 104]	106 [100, 115]	101 [100, 110]
BMI (kg·m^{-2})			
Mean ± SD	21.9±1.8	19.3±0.4*	24.7±3.8*†
Median (range)	22.5 (18.0, 25.0)	18.9 (11.9, 30.2)	24.6 (17.5, 35.7)
BMI categories			
Underweight	17%	62%*	10%†
Normal	82%	33%*	45%*†
Overweight	1%	5%	38%*†
Obese	0%	<1%	7%*†
Men only	n=40	n=124	n=15
Age (y)			
Mean ± SD	101±1	106±3*	102±3*
Median (range)	100 (100, 103)	107 (100, 112)	101 (100, 111)
BMI (kg·m^{-2})			
Mean ± SD	21.8 ± 1.9	19.7 ± 3.3*	23.9 ± 2.8*†
Median (range)	22.3 (18.0, 24.9)	19.2 (12.7, 29.7)	24.2 (18.7, 28.0)
BMI categories			
Underweight	20%	58% *	7%
Normal	80%	33% *	60% *
Overweight	0%	9%	33% †
Obese	0%	0%	0%
Women only	n=41	n=343	n=69
Age (y)			
Mean ± SD	101±1	106±3*	102±2*
Median [range]	100 [100, 104]	106 [100, 115]	101 [100, 108]
BMI (kg·m^{-2})			
Mean ± SD	22.0±1.7	19.1±3.1*	24.8±4.0*†
Median (range)	22.8 (18.7, 25.0)	18.8 (11.9, 30.2)	24.7 (17.5, 35.7)
BMI categories			
Underweight	15%	64%*	10%†
Normal	83%	32%*	42%*
Overweight	2%	4%	39%*†
Obese	0%	<1%	9%†

Group comparisons performed with a one-group ANOVA and χ^2 tests. Symbols: *, P<0.05 *vs.* Italians; †, P<0.05 *vs.* Japanese. Underweight: BMI <20.0 kg·m^{-2}; Normal: BMI =20.0–24.9 kg·m^{-2}; Overweight: BMI =25.0–29.9 kg·m^{-2}; Obese: BMI ≥30.0 kg·m^{-2}.

Such adaptation maintains energetic homeostasis in times of energy shortfalls and might contribute to explain the energetic paradox that, despite having a higher reproduction output with larger neonates as well as a higher metabolic rate than any other hominoid, humans live longer (8). However, the evolutionary trade-off between the competitive needs of reproduction and growth on the one hand, and maintenance, on the other hand, has been recently disrupted in modern societies living in obesogenic environments. We are becoming progressively inactive (with 1/3 of adults worldwide engaging in <150 min/week of exercise) while eating poor-quality diets at the cost of increasing adiposity to pathogenic levels and making obesity becoming virtually a pandemic.

Obesity prevention is one of the interventions to be kept in mind to promote successful aging. This is even more urgent when considering the potential health- and economic-related effects of the 21th century obesity pandemic. Our data support recent initiatives, e.g., using mobile technology for preventing obesity-related behaviors in at-risk children (9) or pilot research indicating the cost-effectiveness of childhood interventions to combat obesity (10).

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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