Obesity and Subjective Probabilities of Survival

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Introduction

Between 1995 and 2005 obesity measured by body mass index (BMI[1]) showed an increasing prevalence among the US adult population at both national and state levels. The Behavioral Risk Factor Surveillance System (BRFSS) showed that, in the US, 23.9% of the people over 18 years were obese (BMI≥30) in 2005 and that obesity prevalence increased in all states between 1995 and 2005 (CDC, 2006). The National Health and Nutritional Examination Survey (NHANES) showed that in the US, for people over 20 years, the obesity prevalence was of 20.2% for men and of 25.4.% for women for the wave 1988-1994, while the for the wave 1999-2000 it showed a prevalence of 27.5% for men and 33.4% for women. Extreme obesity (BMI≥40) showed a significant increment of 1.4% (from 1.7% to 3.1%) for men and 2.3% (from 4.0% to 6.3%) for women between the same waves (Flegal et al, 2002). The NHANES 2003-2004, for the same age range, showed that among men the prevalence of obesity increased to 31.1%, while for women it remained almost unchanged from its level at 1999-2000. The prevalence of extreme obesity in 2003-2004 was 2.8% in men and 6.9% in women (Ogden et al., 2006). Sturm (2003) pointed out that the prevalence of extreme obesity in the US adult population is increasing much faster than the prevalence of obesity: between 1986 and 2000 the prevalence of severe obesity quadrupled (from about 1 in 200 to 1 in 50, while obesity doubled during the same period (from approximately 1 in 10 to 1 in 5).

Beyond the debates on whether obesity is a disease or not (Heshka and Allison, 2001) or whether the increasing prevalence of obesity (Flegal et al., 2002; Ogden et al., 2006) can be considered an epidemic (Campos et al, 2006; Flegal, 2006), or even what the exact number of deaths can be attributed to obesity (Mark, 2005) it is the acknowledgment that obesity is "strongly associated with a several major health risk factors" (Mokdad et al 2003), and that in the US there is an excess in mortality due to obesity (Allison et al., 1999; Flegal et al., 2005; Fontaine et al, 2003; Mokdad et al., 2004; Olshansky et al, 2005).

Despite the attention that have been being paid by researchers to the increasing trend in obesity prevalence and the concern that its consequences have on mortality, morbidity (Rogers et al., 2003), disability (Sturm et al,, 2004), mental health (Onyike et al., 2003; Wadden et al., 2006) and quality of life (Duval et al., 2006; Jia and Lubetkin, 2005), as well as its economic consequences (Finkelstein et al., 2005), more has to be known on how body weight, particularly excessive body weight, is perceived by the individuals.

Compared to people with normal body weight (18.5≤BMI<25), obesity increases the risk of heart disease, hypertension, and osteoarthritis (in the knees) by two to three times, it increases also the risk of cancer by two times, and increases the risk of type 2 diabetes

[1] BMI= (weight in kilograms / (height in meters)^2)

by three times (WHO, 1999). Obesity is associated with at least as much morbidity as are poverty, smoking, and alcoholism (Sturm and Wells, 2001). But, health risk knowledge not necessarily translates into accordingly behaviors. Studying the relationship between individuals' knowledge of the health risk associated with obesity and the tendency to be obese Kan and Tsai (2004) found, for a sample from Taiwan, that males begin to give careful attention to the health risk of obesity only when they are extremely overweight; for females no relationship was observed between knowledge about the health risks associated with obesity and changes in BMI.

Objective

Survival expectations were proved to be consistent with individual's observed survival patterns (Kerry Smith et al., 2001). Although Mirowsky (1999) found that men in the US expect to live about 3 years longer than the actuarial estimates (and black males about 6 years longer). Popham and Michell (2007) found that self-rated life expectancy was associated with lifecourse SES after adjusting for self-rated health and smoking status (those experiencing childhood disadvantages and poor educational attainment had the highest odds of being pessimistic regarding their own survival probabilities) which made them state that "self-rated life expectancy appears to reflect something over and above current health status and smoking behavior". Even though smokers appear to realize that they have lower higher mortality risks than never smokers heavy smokers seem to be overoptimistic regarding their survival probabilities (Schoembaum, 1997). Similarly Wardle and Steptoe (2003) found that lower lifespan expectations were more probable among people in the lower social class and that it was associated with smoking and unhealthy dietary choices. Following the same line of reasoning Falba and Busch (2005) found that individuals appear to underestimate the mortality risk due to excessive body weight, even though obesity has been consistently associated with an increased risk of mortality (Salomon and Mason, 1997). Instead Hamermesh and Hamermesh (1983) found that those males that were more than 15% overweight expected to live around four years less than actuarial estimates.

The aim of the present study is investigate whether individuals are aware of the mortality risks associated with excessive body weight as reflected by their estimations of their own survival probabilities.

Data and Methods

The data used for the present study is from the Health and Retirement Study (HRS). The HRS is a longitudinal survey that was designed to gather information on persons from pre-retirement into retirement in the US. The first's wave (1992) target population includes individuals aged 51-61 living in households. A total of 15497 individuals, including spouses or partners regardless of their age, were eligible for interviews in 1992 from whom 12654 respondents (7704 households) were finally interviewed. The survey consists of a total of eight waves with interviews conducted every two years. The

subsample for this study comprises all the individuals, targets and spouses, aged 50 to 65, which were followed-up for 14 years: a total of 10292 individuals at baseline. Not proxies were considered for this subsample. Up until 2006 (the last wave) there were 1889 deaths.

The HRS provides self-reported data regarding height and weight. This information was used to calculate the BMI of the participants. According to the data it was observed that 29.18% of the males and 38.35% of the females had normal body weight ($18.5 \leq BMI < 25$), 49.08% of the males and 33.86% of the females were overweight ($25 \leq BMI < 30$), and that 21.24% of the males and 25.69% were obese ($BMI \geq 30$) at baseline. HRS provides information on self estimates of the probability of surviving to age 75: respondents were asked about the chances (ranging from 0 to 10) that they have of reaching their 75 birthday, being 0 "absolutely no chance" and 10 "absolutely certain". These self-reported probabilities were found to behave like probabilities and that they do aggregate to population probabilities (Hurd and McGarry, 1995). The average answer to that question was compared to the conditional probability of surviving to age 75 given that a person survived to the median age of the sample used, which is 56 years. The conditional probabilities were calculated from the Kaplan-Meier estimates of the survivor function. The HRS provides information about the status (dead, still alive, or lost) of every one of the respondents in each wave. For the cases in which the respondent is dead or lost it was assumed that the event happened in the middle of the period between waves. In the cases in which the respondent is still alive or was lost for the study a variable indicating that the case was censored was used for the corresponding life table. The analysis was done stratifying by sex, smoking behavior (never smoker and current or past smoker) and weight status. We not use the cut points of BMI as suggested by the WHO for determining weight status because they are fixed and the same for males and females. Instead we used the cut points of the quintiles of BMI for the male and female populations respectively in order to have a relative measure of BMI. The 3rd quintile of BMI was taken as reference. Cox proportional models were run in order to investigate whether obesity has an effect on mortality that was not captured by the respondent's self-rated health status or by the respondent's self-predicted probability of surviving.

Preliminary Results

Table 1 shows the results obtained from the life table compared to the self-predicted probabilities of surviving to age 75. First of all we can observe that the conditional probabilities of surviving at age 75 consistently decline from the 2nd quintile of BMI to the upper ones, for males and females, ever-smokers and non-smokers. The pattern is not so consistent in the case of the self-predicted probabilities of surviving although in every case ever-smokers report a lower mean probability of surviving than never-smokers do. We notice that non-smoker males, as well as females, were less optimistic regarding their probabilities of surviving for each weight category than the actual probabilities may suggest. On the contrary, ever-smoker males in all categories of BMI, and ever-smoker females at the 1st and 5th quintiles, were more optimistic than the actual probabilities of surviving to age 75 may suggest. Considering relative probabilities comparing in each

stratum the 3rd quintile of BMI against the others the results suggest that ever-smoker females in the upper body weight category are under-predicting their mortality risk. Both, the self-predicted probability and the life table probability of surviving among females in the 5th quintile compared to those in the 3rd quintile are statistically significant and show a greater mortality risk among females in the highest category of BMI. It is important to notice that the actual relative risk is lower than the self-predicted one suggesting that although females in this category may be aware of their comparative lower survival probabilities they do not fully measure their risk.

From the previous results we can see that some health-related behaviors, namely smoking, or health conditions like obesity may be underestimated with respect to their effect on mortality. Self-rated health is a strong mortality predictor and it has been shown that longevity expectations are also good mortality predictors (Kerry Smith et al., 2001). Siegel and associates suggest that in spite of the fact that "self-rated life expectancy and self-rated health may be conceptually related, they have independent effects on mortality" (Siegel et al., 2003). Following this reasoning we would like to investigate whether self-rated health and self-predicted probability of surviving can entirely take account of the effect of obesity on mortality.

In Table 2 we can see the result of running two Cox proportional models. Both of them adjust for age at baseline, smoker status, and education. Model 1 shows that for males and females being in the upper category of BMI increases the mortality risk significantly compared to those in the 3rd quintile of BMI (24% for males and 76% for females). In Model 2 we add the two mentioned variables (self-rated health and self-predicted survival probability). We observe that, as expected, self-rated health significantly predicts mortality risk for both males and females, and that, for females it is also true for the self-rated probability of surviving to age 75. In the case of males the coefficient for the 5th quintile of BMI no longer shows an effect on mortality. But, for females, being in the upper category of body weight, that is to say in the 5th quintile of BMI (BMI≥31.35), still increases the mortality risk in 36% among those females compared with females in the 3rd quintile of BMI even though self-rated health and self-rated probability of surviving both have coefficients in the expected direction and both are statistically significant. That is to say that a higher level of BMI has an effect on mortality that was not explained by self-related health or by self-related probability of survival. This result may suggest that females in this category of BMI may still not be fully aware of the increased mortality risk to which they are exposed. On the other hand for males from the two mentioned variables only self-rated health remains statistically significant. This last result is consistent with Siegel et al (2003) who found that self-predicted survival is not significantly associated with mortality when self-rated health is in the model. In general the results are in accordance with those obtained by Falba and Busch (2005).

Overall the results suggest that individuals may not to be fully aware of the increased mortality risk of excessive body weight.

Table 1
Probability of Surviving to Age 75 (HRS 1992-2006) by BMI Quintiles

	Self-Predicted (SD)	Life Table Estimates [a]	Self-Predicted Relative Risk (95%CI)	Relative Risk Estimates
Males[1]				
Never Smoker				
Quintile 1 (N=560)	0.667 (0.279)	0.768	1.03 (0.97-1.10)	0.99 (0.85-1.17)
Quintile 2 (N=694)	0.661 (0.276)	0.797	1.02 (0.96-1.09)	1.03 (0.87-1.22)
Quintile 3 (N=735)	0.649 (0.285)	0.772	1.00	1.00
Quintile 4 (N=747)	0.654 (0.283)	0.696	1.01 (0.95-1.07)	0.90 (0.78-1.05)
Quintile 5 (N=754)	0.618 (0.352)	0.666	0.95 (0.89-1.02)	0.86 (0.75-1.00)
Ever Smoker				
Quintile 1 (N=423)	0.580 (0.330)	0.449	1.00 (0.93-1.08)	0.91 (0.84-0.99)
Quintile 2 (N=292)	0.599 (0.331)	0.569	1.04 (0.96-1.12)	1.15 (1.05-1.26)
Quintile 3 (N=252)	0.578 (0.322)	0.495	1.00	1.00
Quintile 4 (N=217)	0.535 (0.324)	0.495	0.93 (0.86-1.00)	1.00 (0.92-1.09)
Quintile 5 (N=226)	0.528 (0.336)	0.504	0.91 (0.84-0.99)	1.02 (0.93-1.11)
Females[2]				
Never Smoker				
Quintile 1 (N=733)	0.710 (0.262)	0.868	1.07 (1.01-1.13)	1.06 (0.86-1.30)
Quintile 2 (N=770)	0.715 (0.264)	0.867	1.08 (1.01-1.14)	1.05 (0.86-1.30)
Quintile 3 (N=808)	0.665 (0.283)	0.822	1.00	1.00
Quintile 4 (N=843)	0.654 (0.289)	0.806	0.98 (0.92-1.05)	0.98 (0.82-1.18)
Quintile 5 (N=860)	0.623 (0.308)	0.757	0.94 (0.88-1.00)	0.92 (0.78-1.09)
Ever Smoker				
Quintile 1 (N=372)	0.625 (0.317)	0.597	1.02 (0.95-1.09)	0.83 (0.74-0.94)
Quintile 2 (N=302)	0.643 (0.292)	0.733	1.05 (0.98-1.12)	1.02 (0.89-1.18)
Quintile 3 (N=262)	0.614 (0.305)	0.716	1.00	1.00
Quintile 4 (N=245)	0.616 (0.309)	0.698	1.00 (0.94-1.08)	0.98 (0.85-1.12)
Quintile 5 (N=197)	0.567 (0.323)	0.547	0.92 (0.86-0.99)	0.76 (0.68-0.86)

[a] Probability of surviving to age 75 given the person survived to age 56

[1] Quintile 1: BMI<23.83; Quintile 2: 23.83≤BMI<25.85; Quintile 3: 25.85≤BMI<27.73 ; Quintile 4 : 27.73≤BMI<30.18 ; Quintile 5 : BMI≥30.18

[2] Quintile 1: BMI<22.48; Quintile 2: 22.48≤BMI<24.98; Quintile 3: 24.98≤BMI<27.48 ; Quintile 4 : 27.48≤BMI<31.35 ; Quintile 5 : BMI≥31.35

Table 2
Cox Proportional Regressions (HRS 1992-2006)

	Males				Females			
	Model 1		Model 2		Model 1		Model 2	
	RR	P	RR	P	RR	P	RR	P
Age	0.96	0.000	0.94	0.000	0.97	0.006	0.96	0.000
Never Smoker (vs. Ever Smoker)	2.35	0.000	2.10	0.000	2.26	0.000	1.98	0.000
Years of Education	0.96	0.000	1.01	0.555	0.93	0.000	0.99	0.331
Quintile 1 [1]	1.09	0.358	1.02	0.832	1.37	0.008	1.47	0.001
Quintile 2 [2]	0.93	0.457	0.92	0.408	1.03	0.789	1.12	0.388
Quintile 4 [3]	1.07	0.490	0.99	0.923	1.26	0.055	1.17	0.195
Quintile 5 [4]	1.24	0.023	1.04	0.682	1.76	0.000	1.36	0.008
Self-Rated Health [5]			1.62	0.000			1.61	0.000
Probability of Surviving to 75[6]			1.00	0.921			0.97	0.012

[1] Quintile 1 Males: BMI<23.83; Quintile 1 Females: BMI<22.48
[2] Quintile 2 Males: 23.83≤BMI<25.85; Quintile 2 Females: 22.48≤BMI<24.98
[3] Quintile 4 Males: 27.73≤BMI<30.18 ; Quintile 4 Females : 27.48≤BMI<31.35
[4] Quintile 5 Males: BMI≥30.18 ; Quintile 5 Females: BMI≥31.35
Omitted category Quintile 3
[5] 1: Excellent; 2: Very Good; 3: Good; 4: Fair; 5: Poor. Omitted category Excellent
[6] From 1 to 10 vs 0

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