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Impact of elevated BMI and types of comorbid conditions on health-related quality of life in a nationally representative US sample

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Abstract

Objective: Elevated BMI is associated with multiple chronic conditions including diabetes and CVD. Patients with overweight or obesity may also suffer from comorbidities not directly related to the pathophysiology of elevated BMI. The current study sought to determine the impact of BMI and different types of chronic conditions on health-related quality of life (HRQoL) outcomes.
Design: Six weight categories by BMI were identified: underweight, normal weight, overweight, Class-I obesity, Class-II obesity and Class-III obesity. Twenty chronic conditions were considered and categorised as elevated BMI-related (concordant) or -unrelated (discordant) conditions. HRQoL outcomes were measured using Short Form-6 Dimensions (SF-6D). Multivariable regression models were performed to examine the impact of type, number of comorbid conditions and BMI categories on SF-6D scores.
Setting: Medical Expenditure Panel Survey (2013–2015).
Participants: Nationally representative sample of US population; 18 years or older (*n* 58 960).
Results: Of the sample, 1·7 %, 32·9 %, 34·0 % and 31·4 % were classified as underweight, normal weight, overweight and obese, respectively. The SF-6D scores were significantly decreased across all obesity classes, with the largest reduction in Class-III obesity (0·033; $P < 0·001$). Additionally, individuals with obesity having one or more concordant or discordant comorbidities further reduced SF-6D scores between 0·031 and 0·148 (P-values < 0·001) or between 0·080 and 0·212 (P-values < 0·001), respectively.
Conclusions: Individuals with obesity had a significant reduction in HRQoL outcomes compared to those with normal BMI. Importantly, discordant comorbidity resulted in greater reduction in HRQoL outcomes compared to concordant comorbidity in subjects with elevated BMI.

Keywords
Obesity
Concordant comorbidity
Discordant comorbidity
Quality of life

The obesity epidemic has gained increasing recognition as a major public health concern in the USA. Despite being the focus of numerous public health efforts, prevalence of overweight and obesity has increased steadily[1,2]. Recent estimates indicate that more than two-thirds of the US adult population is overweight[3,4] with up to 40 % classified as obese[5]. The societal burden of obesity in terms of morbidity, mortality and healthcare expenditures is extensive. In the USA, 280 000 to 325 000 deaths per year are attributable to obesity[6], making it the second leading cause of preventable death behind tobacco use[7]. Furthermore, estimates of total US medical costs attributed to obesity range from $147 billion in 2008[8] to $342 billion in 2013[9].

Elevated BMI is an established risk factor for a series of chronic conditions including hyperlipidemia, diabetes mellitus and hypertension[10]. These are concordant conditions[11], meaning they share similar pathophysiologic risk profiles or management processes. On the other hand, patients with elevated BMI may also suffer from discordant comorbidities[11], or conditions not directly related to the pathophysiology of high BMI measures, such as mental-health related illness[12].

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In addition to increasing risk of multiple chronic conditions, elevated BMI is independently associated with reduced health-related quality of life (HRQoL). Measures of HRQoL have become widely used in clinical studies and routine outcome assessment to provide information on the effectiveness of healthcare intervention from the patient's perspective[13]. Improving BMI measure could further improve well-being, reduce bodily pain, depression, or anxiety and increase physical activity and social interaction[14].

The five-item instrument EuroQol-5 Dimensions (EQ-5D) and Short Form-6 Dimensions (SF-6D), which is derived directly from the 12-Item Short Form Health Survey (SF-12), are the most common preference-based HRQoL or health utility measures. They are increasingly used in health economic evaluations to aid resource allocation decisions[15]. The necessity for such health utility measures has been demonstrated as both the US Public Health Service Panel on Cost-Effectiveness in Health and Medicine and the UK National Institute for Health and Clinical Excellence (NICE) prefer health utility measures to be used when assessing cost-effectiveness of new and current health interventions[15]. The SF-6D outcome is an important preference-based health utility measure used to estimate quality-adjusted life years, a universal metric to measure health outcomes for health technology assessment. An increase in BMI is consistently associated with decrements in HRQoL outcomes across multiple measures including the EQ-5D, SF-12 and SF-6D[15,16].

Previous studies have adjusted for comorbidities when evaluating the association between overweight and HRQoL[17,18]. Alternatively, the effect of elevated BMI on HRQoL has been investigated, independently of comorbidities by including only otherwise healthy patients[19]. Additional studies have investigated association of HRQoL in patients with obesity and select conditions, for example, type 2 diabetes, and inflammatory conditions[20]. Studies of multimorbidity often focused on the number of conditions, rather than interactions between different types of conditions[18]. In the current study, we examined the impact of elevated BMI on HRQoL outcome considering both the summative impact of multimorbidity, while separately assessing the type of chronic comorbid conditions (concordant *v.* discordant) in a nationally representative US sample.

Methods

Data source

The current study analysed pooled data from the Medical Expenditure Panel Survey (MEPS) Full Year Consolidated Data and Medical Condition Files from 2013 to 2015[21]. The MEPS, conducted by the Agency for Healthcare Research and Quality (AHRQ), is a nationally representative survey of the US civilian non-institutionalised population[21]. The MEPS collects individual-level data regarding healthcare expenditure, medical conditions, use of medical care services, health status, quality of life and demographic characteristics. Medical conditions were recorded verbatim by interviewers and subsequently converted to International Classification of Diseases, Ninth Revision (ICD-9) and Clinical Classification System (CCS) codes by professional coders[21]. MEPS data files are publicly available and de-identified; thus, this study was exempt from Institutional Review Board review.

Table 1 Concordant and discordant conditions

Concordant conditions	Discordant conditions
Hypertension	Autism
Hyperlipidemia	Cancer
Diabetes	Dementia
Congestive heart failure	Depression
Coronary artery disease	Hepatitis
Cardiac arrhythmia	HIV
Stroke	Schizophrenia
Chronic kidney disease	Substance abuse disorder
Arthritis	
Osteoporosis	
Asthma	
Chronic obstructive pulmonary disease	

Weight category

BMI in MEPS data files is calculated using height and weight as reported by household respondents. The study population was classified into six weight categories as defined by the WHO: underweight (BMI < 18·5 kg/m^2), normal weight (BMI between 18·5 and 24·9 kg/m^2), overweight (BMI between 25 and 29·9 kg/m^2), Class-I obesity (BMI between 30·0 and 34·9 kg/m^2), Class-II obesity (BMI between 35·0 and 39·9 kg/m^2) and Class-III obesity (BMI ≥ 40 kg/m^2)[22].

Chronic conditions

Chronic conditions of interest were categorised as concordant (elevated BMI-related) or discordant (elevated BMI-unrelated) using the US Department of Health and Human Services (HHS) conceptual model for defining and identifying chronic conditions[23]. Concordant conditions included the following: hypertension, hyperlipidemia, diabetes, congestive heart failure, coronary artery disease, cardiac arrhythmia, stroke, chronic kidney disease, arthritis, osteoporosis, asthma and chronic obstructive pulmonary disease. Conversely, discordant conditions of obesity included autism, cancer, dementia, depression, hepatitis, HIV, schizophrenia and substance abuse disorder. The full list of concordant and discordant comorbid conditions related to obesity is reported in Table 1.

Health-related quality of life measures

The HRQoL SF-12 instrument consists of twelve survey questions (items) measuring eight health dimensions

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(general health, physical functioning, role limitations – physical, and bodily pain measure physical health component and vitality, social functioning, role limitations – emotional, and mental health measure mental health component)[24]. Responses are summarised using two aggregate scores: the physical component summary and mental component summary[24]. HRQoL SF-6D measures were directly derived from responses of the twelve items of the SF-12 used in the MEPS datasets. The SF-6D condenses the eight health dimensions in the SF-12 into six: (1) physical functioning; (2) role limitations; (3) social functioning; (4) pain; (5) mental health and (6) vitality[14], hence called SF-6D. The SF-6D instrument has proven to be sensitive to the expected loss of HRQoL associated with obesity[15]. SF-6D scores range from 0·30 to 1·00, with 0·30 indicating worst possible health condition and 1·00 for perfect health[24,25]. To determine the clinical relevance of reduced HRQoL in terms of SF-6D measures, we compared the observed decline in SF-6D scores in our study to published estimates of minimal clinically important difference (MCID) for SF-6D scores. Prior studies reported mean estimates for SF-6D MCID ranging from 0·027 to 0·041[26–28].

Statistical analysis

Generalised linear models with Gaussian distribution and identity link were used to compare SF-6D scores across BMI categories, type (concordant *v.* discordant) of comorbidities and numbers of each type of comorbid conditions. All analyses controlled for baseline characteristics including age, race, gender, education, income, insurance coverage, marital status and tobacco use. The impact of concordant and discordant comorbid conditions and the incremental burden of each type of comorbidities on SF-6D scores was examined in the population with elevated BMI (BMI $\geq$ 25 kg/m^2). Separate generalised linear models were used to evaluate the impact of different elevated BMI categories, type (concordant *v.* discordant) of comorbidities and the incremental burden of each type of comorbidities on the SF-6D HRQoL outcome. *P*-value < 0·05 were considered statistically significant for a single hypothesis testing. When combining hypotheses for multiple tests, *P*-values were adjusted using the conservative Bonferroni adjustment[29]. All analyses were performed using the R *survey* package version 3.36[30], accounting for sampling strata and survey weights used in the MEPS survey design to control for survey non-response and adjustment to population control totals.

Results

Baseline characteristics

A sample of 58 960 subjects aged 18 years or older were identified from the pooled cross-sectional MEPS data between 2013 and 2015. Of which, 1·7 %, 32·9 %, 34·0 % and 31·4 % were classified as underweight, normal weight, overweight and obese, respectively. Among subjects with obesity, most had Class-I obesity (58·5 %), followed by those with Class-II and Class-III obesity (25·2 % and 16·3 %, respectively). Males were more likely to be overweight or Class-I obese (56·1 % and 51·2 %, respectively). Females were more likely to be Class-II or Class-III obese (53·8 % and 65 %, respectively), while also having a higher proportion of underweight subjects (74·8 %). In the youngest age group (18 to 24 years of age), the proportion of underweight respondents was disproportionately high (26·2 %), while the proportion of subjects with overweight and obesity was disproportionately low (8·1 % and 6·3 %, respectively). The highest rate of elevated BMI was seen in those 45 to 64 years of age. Overweight and all classes of obesity were more prevalent in black and Hispanic populations as well as in those with lower income. Hypertension, hyperlipidemia, diabetes mellitus and arthritis were the most common conditions observed in respondents with obesity, followed by respiratory conditions. Prevalence of all concordant conditions was higher in the overweight category compared to the normal weight category apart from osteoporosis. A similar prevalence trend was observed with discordant conditions, except for those with dementia or HIV (Table 2).

Health-related quality of life outcomes

Compared to subjects with normal weight, SF-6D scores were significantly decreased across all obesity classes, with the largest reduction in Class-III obesity (0·033; $P < 0·001$) (Table 3). Overweight subjects had reduced SF-6D scores compared to those with normal BMI; however, the reduction was not found statistically significant ($P = 1·000$). Similarly, there was no-significant reduction in SF-6D scores observed in underweight subjects compared to those with normal BMI ($P = 0·830$).

Chronic conditions

Having chronic conditions resulted in further significant reduction in SF-6D scores, apart from hyperlipidemia, chronic kidney disease, osteoporosis, autism, cancer and HIV. The largest reductions in SF-6D scores were observed in subjects with depression (0·110; $P < 0·001$), dementia (0·090; $P < 0·001$) and arthritis (0·064; $P < 0·001$) (Table 4). Having one or more concordant or discordant conditions further reduced SF-6D scores from 0·031 to 0·148 or from 0·080 to 0·212, respectively. In addition, when comparing incremental burden of having discordant conditions *v.* concordant conditions, the SF-6D scores were significantly lower: one discordant comorbidity *v.* one concordant comorbidity (0·080 *v.* 0·031, $P < 0·001$), two discordant comorbidity *v.* two concordant comorbidity (0·125 *v.* 0·057, $P < 0·001$), three discordant comorbidity *v.* three concordant comorbidity (0·157 *v.* 0·077,

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Table 2 Baseline characteristics

	Total sample	Underweight	Normal weight	Overweight	Class I obesity	Class II obesity	Class III obesity
	%	%	%	%	%	%	%
Total	58 960	949	18 284	20 107	11 394	4973	3253
Age groups							
18–24	10·9	26·2	17·3	8·1	6·3	6·6	5·8
25–44	34·9	33·0	36·1	33·6	33·7	35·0	40·7
45–64	34·9	17·5	28·4	37·1	39·9	41·4	41·1
≥ 65	19·3	23·3	18·2	21·2	20·1	17·0	12·4
Gender							
Male	47·9	25·2	41·3	56·1	51·2	46·2	35·0
Female	52·1	74·8	58·7	43·9	48·8	53·8	65·0
Race							
Hispanic	14·4	10·5	12·0	15·9	16·6	15·2	13·0
White	66·2	65·8	67·8	66·0	65·3	63·4	64·7
Black	11·3	8·6	8·2	10·9	13·4	16·4	18·8
Asian	5·4	12·5	9·4	4·7	1·9	1·0	0·2
Other/multiple	2·7	2·6	2·6	2·5	2·7	4·0	3·3
Income							
< 100 % poverty	11·8	16·3	11·5	10·8	11·5	14·1	16·5
100–124 % poverty	4·1	5·9	4·1	3·7	4·4	4·3	5·4
125–199 % poverty	13·0	16·1	12·4	12·8	13·6	13·8	14·6
200–399 % poverty	28·9	27·9	27·7	28·6	30·0	30·4	32·2
≥ 400 % poverty	42·1	33·8	44·2	44·1	40·5	37·4	31·3
Education							
Less than high school	12·0	15·6	11·5	11·9	12·6	12·9	11·3
High school	27·1	26·3	23·7	27·2	30·0	30·5	32·1
Some college or more	60·9	58·1	64·8	60·9	57·4	56·6	56·6
Insurance							
Any private	69·6	60·9	71·3	70·5	68·6	66·4	63·0
Public only	19·0	28·8	17·1	18·2	19·6	21·3	26·7
Uninsured	11·4	10·3	11·6	11·3	11·8	12·3	10·3
Current smoker							
Yes	15·7	22·1	16·5	15·2	15·0	14·5	15·6
No	84·3	77·9	83·5	84·8	85·0	85·5	84·4
Marital status							
Married	53·5	37·0	51·0	57·0	57·8	53·4	47·7
Other	46·5	63·0	49·0	43·0	42·2	46·6	52·3
Concordant conditions							
Hypertension	29·1	14·6	17·1	29·3	38·5	46·3	49·4
Hyperlipidemia	24·2	10·7	16·0	25·9	31·1	34·0	30·8
Diabetes	11·3	3·0	4·7	10·5	16·4	22·3	26·5
Congestive heart failure	0·95	0·38	0·54	0·7	1·5	1·7	2·5
Coronary artery disease	6·2	4·4	4·3	6·4	7·3	8·9	8·5
Cardiac arrhythmia	4·1	3·4	3·1	4·1	4·9	5·1	6·1
Stroke	2·0	2·3	1·7	2·1	2·1	2·0	2·0
Chronic kidney disease	0·13	0·0	0·13	0·25	0·31	0·34	0·35
Arthritis	10·2	8·9	7·4	9·1	12·7	15·6	18·1
Osteoporosis	1·2	3·2	1·8	0·94	0·94	0·68	0·55
Asthma	7·4	6·8	5·8	6·3	8·5	12·0	13·9
COPD	7·3	11·2	5·6	6·5	8·4	10·5	12·4
Discordant conditions							
Autism	0·14	0·17	0·14	0·16	0·04	0·19	0·28
Cancer	7·8	7·4	7·3	8·6	7·8	7·5	6·4
Dementia	0·89	1·8	1·1	0·88	0·63	0·74	0·58
Depression	13·6	14·5	10·9	12·3	16·0	18·2	23·6
Hepatitis	0·38	0·37	0·32	0·44	0·50	0·23	0·11
HIV	0·19	0·48	0·26	0·16	0·10	0·23	0·04
Schizophrenia	0·41	0·41	0·30	0·37	0·56	0·49	0·71
Substance abuse disorder	0·86	1·1	0·88	0·89	0·78	0·72	0·92

COPD, chronic obstructive pulmonary disease.
Weight categories (kg/m^2): underweight (BMI < 18 5), normal weight (18 5 ≤ BMI < 25), overweight (25 ≤ BMI < 30), Class-I obesity (30 0 ≤ BMI < 35), Class-II obesity (35 0 ≤ BMI < 40) and Class-III obesity (BMI ≥ 40).

$P < 0·001$) and four discordant comorbidity *v.* four concordant comorbidity (0·212 *v.* 0·108, $P < 0·001$) (Table 5). Associations between SF-6D scores and incremental burden of type of chronic conditions are reported in Table 5.

Discussion

Consistent with previous literature[15–17,19,20], our results indicated that individuals with obesity have a significant

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Table 3 SF-6D disutility by BMI category (*n* 58 960)

BMI category	SF-6D disutility	SE	Unadjusted *P*-value	Adjusted *P*-value*	Clinical significance†
Normal weight	Reference				
Underweight	0·0084	0·0061	0·166	0·830	No
Overweight	0·00028	0·0017	0·874	1·000	No
Class-I obesity	0·011	0·0021	<0·001	<0·001	No
Class-II obesity	0·016	0·0028	<0·001	<0·001	No
Class-III obesity	0·033	0·0038	<0·001	<0·001	Yes

SF-6D, Short Form-6 Dimensions.
**P*-values were adjusted for multiple tests in combining hypotheses using the conservative Bonferroni adjustment.
†Based on the minimal clinically important difference for SF-6D ranging from 0·027 to 0·041.
Multivariate linear regression model for SF-6D disutility adjusted for all comorbid conditions and baseline characteristics including age, race, gender, education, income, insurance coverage, marital status and tobacco use in the overall sample.
Further comparing to the preceding weight category, that is, overweight *v.* Class-I obesity, Class-I *v.* Class-II obesity and Class-I *v.* Class-II obesity, the SF-6D disutilities were all significant (*P*-values < 0 05).

Table 4 SF-6D disutility by chronic comorbid conditions in elevated-BMI sample (*n* 39 727)

Comorbidity type	SF-6D disutility	SE	Unadjusted *P*-value	Adjusted *P*-value*	Clinical significance†
Concordant comorbidity					
Hypertension	0·021	0·0024	<0·001	<0·001	Yes
Hyperlipidemia	0·009	0·0031	0·004	0·074	No
Diabetes	0·028	0·0031	<0·001	<0·001	Yes
Congestive heart failure	0·053	0·0102	<0·001	<0·001	Yes
Coronary artery disease	0·022	0·0048	<0·001	<0·001	No
Cardiac arrhythmia	0·023	0·0047	<0·001	<0·001	No
Stroke	0·032	0·0067	<0·001	<0·001	Yes
Chronic kidney disease	0·024	0·0192	0·22	1·000	No
Arthritis	0·064	0·0033	<0·001	<0·001	Yes
Osteoporosis	0·005	0·0093	0·61	1·000	No
Asthma	0·028	0·0037	<0·001	<0·001	Yes
COPD	0·028	0·0040	<0·001	<0·001	Yes
Discordant comorbidity					
Autism	0·044	0·0243	0·069	1·000	No
Cancer	0·013	0·0048	0·006	0·120	No
Dementia	0·093	0·0113	<0·001	<0·001	Yes
Depression	0·110	0·0029	<0·001	<0·001	Yes
Hepatitis	0·044	0·0139	0·001	0·032	Yes
HIV	0·016	0·0229	0·49	1·000	No
Schizophrenia	0·064	0·0139	<0·001	0·002	Yes
Substance abuse disorder	0·040	0·0109	<0·001	0·008	Yes

SF-6D, Short Form-6 Dimensions; COPD, chronic obstructive pulmonary disease.
**P*-values were adjusted for multiple tests in combining hypotheses using the conservative Bonferroni adjustment.
†Based on the minimal clinically important difference for SF-6D ranging from 0·027 to 0·041.
Multivariate linear regression model for SF-6D disutility adjusted for all comorbid conditions and baseline characteristics including age, race, gender, education, income, insurance coverage, marital status and tobacco use in the elevated-BMI sample.

reduction in HRQoL outcomes in terms of SF-6D measures compared to individuals with a normal BMI. Furthermore, the observed reductions in quality of life were significant in comparisons of consecutive weight categories, from overweight to Class-III obesity. However, when compared to those with normal BMI, overweight individuals (BMI between 25 and 29·9 kg/m^2) did not experience significant reductions in HRQOL outcomes. Comorbid conditions (concordant and discordant) were more prevalent in elevated-BMI individuals compared to those with normal BMI, except for osteoporosis, HIV and dementia. When using Bonferroni adjustment for multiple tests, significant reductions in quality of life were observed with all conditions apart from hyperlipidemia, chronic kidney disease, osteoporosis, autism, cancer and HIV. Except for hyperlipidemia and cancer, it is possible that the low prevalence of these comorbid conditions (all less than 1 % in the elevated-BMI population) might contribute to the non-significant reduction in quality of life. Our study used the nationally representative sample of the US civilian non-institutionalised population, thus hyperlipidemia, mainly an asymptomatic condition, and cancer survival respondents might not experience in significantly reduced SF-6D scores. Importantly, when comparing incremental burden between discordant and concordant comorbidities, that is, one/two/three discordant comorbidity *v.* one/two/three concordant comorbidity, significant greater reduction in HRQoL outcomes were observed in discordant rather than concordant comorbidities in individuals with elevated BMI. Our findings on discordant comorbidities were consistent with a similar study investigated comorbid conditions in the diabetic population[31]. A possible explanation is that similar

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Table 5 SF-6D disutility by incremental burden of concordant and discordant conditions (*n* 39 727)

	SF-6D disutility	SE	Unadjusted *P*-value	Adjusted *P*-value*	Clinical significance†
Number of concordant conditions					
One condition	0·031	0·0026	<0·001	<0·001	Yes
Two conditions	0·057	0·0033	<0·001	<0·001	Yes
Three conditions	0·077	0·0038	<0·001	<0·001	Yes
Four conditions	0·108	0·0049	<0·001	<0·001	Yes
≥ 5 conditions	0·148	0·0066	<0·001	<0·001	Yes
Number of discordant conditions					
One condition	0·080	0·0028	<0·001	<0·001	Yes
Two conditions	0·125	0·0064	<0·001	<0·001	Yes
Three conditions	0·157	0·0020	<0·001	<0·001	Yes
Four conditions	0·212	0·0018	<0·001	<0·001	Yes

SF-6D, Short Form-6 Dimensions.
**P*-values were adjusted for multiple tests in combining hypotheses using the conservative Bonferroni adjustment.
†Based on the minimal clinically important difference for SF-6D ranging from 0·027 to 0·041.
Multivariate linear regression model for SF-6D disutility adjusted for baseline characteristics including age, race, gender, education, income, insurance coverage, marital status and tobacco use in the elevated-BMI sample.

care plans were implemented to manage concordant comorbidities effectively as they share similar pathophysiologic risk profiles, thus resulting in less increase in SF-6D disutility compared to separate care plans used to manage discordant comorbid conditions[28]. Overall, our study findings on SF-6D disutility in comorbid conditions were consistent with previous studies[32,33]. However, the magnitudes of SF-6D disutility among the studies were slightly different due to different study samples.

Evaluation of statistical significance alone is inappropriate when interpreting changes in health utility scores. Our analyses demonstrated a clinically significant reduction in SF-6D scores in most discordant conditions except for cancer and HIV. On the other hand, only half of concordant conditions resulted in a clinically significant reduction. This important finding indicating that the impact of discordant conditions on HRQoL outcomes was more substantial compared to the impact of concordant conditions in subjects with elevated BMI.

Strengths and limitations

Our study had several strengths, the most significant being inclusion of discordant conditions rarely considered in studies of obesity and HRQoL. These conditions are often more prevalent in overweight and obesity[12,34], and as demonstrated in our study, can be more detrimental to quality of life. Another strength was the large sample size included in our analysis. Using survey weights and sampling strata, we were able to compile multiple years of generalisable data from a large nationally representative sample. Furthermore, using the SF-6D preference-based single-index measure is favourable for estimation of quality-adjusted life years used in health economic evaluation.

Inevitably, analysis of observational data has certain limitations. MEPS data is limited to non-institutionalised individuals; thus, the results of this study may not be generalisable to this often severely ill population. With the guidance of the US Department of HHS, our analysis measured twenty chronic conditions; however, decrements in HRQoL may be due to unmeasured conditions more prevalent in individuals with obesity such as gout or gallbladder disease[15,35]. However, several studies have established a reduced quality of life in subjects with obesity independent of comorbidity, either by controlling for various chronic conditions[15,17] or including only otherwise healthy patients[19]. Self-reporting of key variables may have caused imprecise estimates of BMI and underestimation of chronic disease prevalence. Studies of self-reported anthropometric data consistently observe an underestimation of weight and overestimation of height[36,37]. Respondents with elevated BMI have demonstrated a larger disparity between objective and self-reported measurements[36,37] compared to those with normal BMI. Additionally, BMI can be an unreliable measure of adiposity. BMI does not consider body composition leading to an overestimation of body fat in individuals with increased muscled mass and underestimation of body fat in the elderly[38,39]. Moreover, differences in body composition between genders may lead to an inflated prevalence of men classified as overweight[38]. Finally, our study reported overall SF-6D disutililies for concordant and discordant comorbid conditions in overweight and obese individuals independent of their obesity severity.

Conclusions

Our study showed that obesity was an independent predictor of reduced HRQoL. Several chronic conditions produced a clinically significant reduction in SF-6D scores in overweight and obese subjects, with the most pronounced reductions observed in subjects with depression, dementia and arthritis. Importantly, the impact of chronic conditions on quality of life in subjects with elevated BMI was more pronounced with discordant comorbidities than

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concordant comorbidities. Furthermore, as the number of comorbidities increased, we observed a corresponding linear reduction in HRQoL outcomes.

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