

## Obesity Impacts Access to Kidney Transplantation

Dorry L. Segev,\* Christopher E. Simpkins,\* Richard E. Thompson,<sup>†</sup> Jayme E. Locke,\* Daniel S. Warren,\* and Robert A. Montgomery\*

\*Department of Surgery, Johns Hopkins University School of Medicine, and <sup>†</sup>Department of Biostatistics, Johns Hopkins University School of Public Health, Baltimore, Maryland

### ABSTRACT

Current billing practices and mandates to report surgical outcomes are disincentives to surgical treatment of obese patients, who are at increased risk for longer hospital stays and higher complication rates. The objective of this study was to quantify the independent association between body mass index (BMI) and waiting time for kidney transplantation to identify potential provider bias against surgical treatment of the obese. A secondary data analysis was performed of a prospective cohort of 132,353 patients who were registered for kidney transplantation in the United States between 1995 and 2006. Among all patients awaiting kidney transplantation, the likelihood of receiving a transplant decreased with increasing degree of obesity, categorized by ranges of BMI (adjusted hazard ratios 0.96 for overweight, 0.93 for obese, 0.72 for severely obese, and 0.56 for morbidly obese, compared with a reference group of patients with normal BMI). Similarly, the likelihood of being bypassed when an organ became available increased in a graded manner with category of obesity (adjusted incidence rate ratio 1.02 for overweight, 1.05 for obese, 1.11 for severely obese, and 1.22 for morbidly obese). Although matching an available organ with an appropriate recipient requires clinical judgment, which could not be fully captured in this study, the observed differences are dramatic and warrant further studies to understand this effect better and to design a system that is less susceptible to unintended bias.

*J Am Soc Nephrol* ●●: –, ●●●●. doi: 10.1681/ASN.2007050610

Obesity is increasing significantly in the United States.<sup>1</sup> Performing surgical procedures on obese patients is more difficult, takes longer, and is subject to a higher rate of complications.<sup>2–7</sup> Current billing practices and mandates for reporting of surgeon outcomes are disincentives to operating on patients with predictably longer hospital stays and more complications.<sup>8–15</sup> It has been hypothesized that worse outcomes and financial disincentives might be contributing to a system-wide bias against surgical care for obese patients, even in situations in which surgical therapy might provide for the best outcome. Dindo *et al.*<sup>16</sup> described a “regressive attitude in referring patients who are obese for surgery or denying surgery to such patients.”

Similarly, the prevalence of obesity in patients who have ESRD and register for kidney transplantation (KT) is increasing (Figure 1), and complications and outcomes are worse in obese patients when compared with their nonobese counter-

parts<sup>17–22</sup>; however, even patients who are morbidly obese benefit from KT when compared with their medically treated counterparts.<sup>23–25</sup> Because kidneys are allocated primarily on the basis of initial date of registration,<sup>26</sup> waiting time to KT should be independent of patient body mass index (BMI); however, even in an objective organ allocation sys-

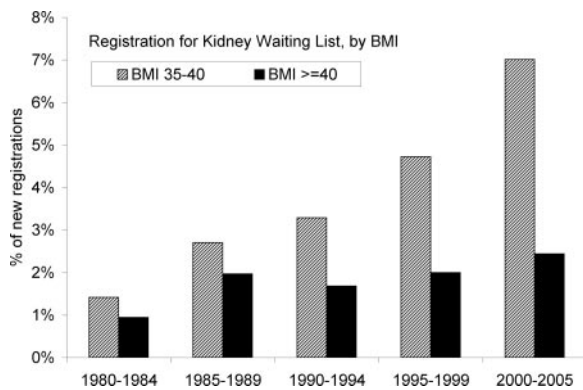
Received May 25, 2007. Accepted August 15, 2007.

Published online ahead of print. Publication date available at [www.jasn.org](http://www.jasn.org).

The content of this article is the responsibility of the authors alone and does not necessarily reflect the views or policies of the Department of Health and Human Services; neither does mention of trade names, commercial products, or organizations imply endorsement by the US government.

**Correspondence:** Dr. Dorry Segev, Department of Clinical Research, Transplant Surgery, Johns Hopkins Medical Institutions, 600 N. Wolfe Street, Harvey 611, Baltimore, MD 21287. Phone: 410-502-6115; Fax: 410-614-2079; E-mail: [dorry@jhmi.edu](mailto:dorry@jhmi.edu)

Copyright © 0 by the American Society of Nephrology



**Figure 1.** Registration for the kidney transplant waiting list, by year and BMI category.

tem, potential for provider bias exists. Providers can bypass a given patient, and multiple bypasses can significantly delay surgical treatment for patients awaiting KT. As a result, providers can strongly influence a patient's time to transplantation. The goal of our study was to quantify the independent association between BMI and waiting time for KT as a marker for provider bias against surgical treatment in these patients.

## RESULTS

### Patient Characteristics

Of 132,353 candidates analyzed, 45,411 (34.3%) were overweight (BMI 25 to 30), 25,509 (19.3%) were obese (BMI 30 to 35), 9479 (7.2%) were severely obese (BMI 35 to 40), and 3605 (2.7%) were morbidly obese (BMI 40 to 60). Obese patients were more likely to be female (48.1% severely obese and 57.5% morbidly obese compared with 41.5% reference group) and black (38.7% severely obese and 40.5% morbidly obese compared with 27.9% reference group). There were almost no differences between BMI subgroups in terms of blood type, education, insurance, or panel-reactive antibody (PRA) level. Whereas the reference group of patients were listed at equal proportions throughout the study period, a higher proportion of obese patients were listed in the more recent years of the study (Table 1).

### Time to Transplantation

Median time to transplantation for patients awaiting KT increased as BMI category increased (39 mo for reference group, 40 mo for overweight, 42 mo for obese, 51 mo for severely obese, and 59 mo for morbidly obese;  $P < 0.001$ ; Figure 2). Among the various regression models investigated, overweight patients had 2 to 4% lower likelihood, obese patients had 2 to 7% lower likelihood, severely obese patients had 24 to 28% lower likelihood, and morbidly obese patients had 42 to 44% lower likelihood of receiving a transplant (Table 2). In the allocation-adjusted model, likelihood (hazard ratio [HR]) of receiving a transplant was 0.96 for overweight patients (95% confidence interval [CI] 0.94 to 0.99;  $P = 0.01$ ), 0.93 for obese

patients (95% CI 0.90 to 0.97;  $P < 0.001$ ), 0.72 for severely obese patients (95% CI 0.68 to 0.77;  $P < 0.001$ ), and 0.56 for morbidly obese patients (95% CI 0.50 to 0.62;  $P < 0.001$ ; Table 3). Addition of the full-model covariates related to disease progression and outcomes did not change any of the point estimates from the allocation model by  $>5\%$ . Of the full-model covariates, diabetes (HR 0.82; 95% CI 0.76 to 0.88), FSGS (HR 1.07; 95% CI 1.01 to 1.15), polycystic kidney disease (HR 1.07; 95% CI 1.01 to 1.12), systemic lupus erythematosus (SLE; HR 0.83, 95% CI 0.76 to 0.90), hemodialysis (HR 1.34; 95% CI 1.26 to 1.42), peritoneal dialysis (HR 1.38; 95% CI 1.28 to 1.48), and peripheral vascular disease (HR 0.89; 95% CI 0.80 to 0.98) were statistically significant.

### Bypasses

Likelihood of being bypassed for an organ offer by a provider other than the patient was also higher as BMI category increased. Among the regression models investigated, overweight patients had 0 to 3% higher likelihood, obese patients had 0 to 5% higher likelihood, severely obese patients had 4 to 13% higher likelihood, and morbidly obese patients had 22 to 23% higher likelihood of being bypassed (Table 2). In the allocation-adjusted model, likelihood of being bypassed (incidence rate ratio [IRR]) was 1.02 for overweight patients (95% CI 1.00 to 1.04;  $P = 0.02$ ), 1.05 for obese patients (95% CI 1.02 to 1.08;  $P < 0.001$ ), 1.11 for severely obese patients (95% CI 1.07 to 1.14;  $P < 0.001$ ), and 1.22 for morbidly obese patients (95% CI 1.13 to 1.32;  $P < 0.001$ ; Table 4). Addition of the full-model covariates did not change any of the point estimates from the allocation model by  $>5\%$ . Of the full-model covariates, only diabetes (IRR 0.94; 95% CI 0.90 to 0.98), SLE (IRR 1.08; 95% CI 1.01 to 1.15), and peritoneal dialysis (IRR 0.94; 95% CI 0.90 to 0.99) were statistically significant.

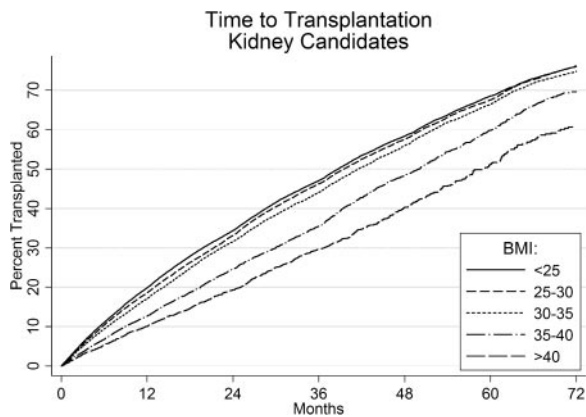
## DISCUSSION

In this study, we identified an independent association between obesity and waiting time for KT. Likelihood of receiving a transplant decreased and likelihood of being bypassed increased significantly for higher BMI categories, even after adjustment for all factors relevant to the allocation system, factors possibly influencing access to health care, and factors that could influence provider risk-benefit decisions.

Two disincentives within the health care system are consistent with our findings. First, even in risk-adjustment systems, payment often does not adequately reflect patient difficulty or time investment. This puts providers at risk for "cream-skimming" or "selection by providers of those consumers expected to be profitable."<sup>8,9</sup> Second, mandated and publicly available outcomes reporting (which occurs in organ transplantation as well as other surgical fields) puts providers at risk for "profiling" or avoiding patients who are perceived to be high risk.<sup>10-14</sup> In coronary artery bypass grafting, racial disparities resulting from "racial profiling" have even occurred.<sup>15</sup> Given

**Table 1.** Characteristics of candidates registered for kidney transplantation, by BMI

Characteristic	BMI				
	18.5 to 25	25 to 30	30 to 35	35 to 40	40 to 60
n	48,349	45,411	25,509	9479	3605
%	36.5	34.3	19.3	7.2	2.7
Blood type (%)					
A	33.0	33.3	33.3	33.0	33.1
B	14.5	14.2	14.4	14.7	15.2
AB	4.1	3.9	3.9	4.0	4.4
O	48.5	48.7	48.4	48.3	47.2
Gender (%)					
male	58.5	65.8	57.9	51.9	42.5
female	41.5	34.2	42.1	48.1	57.5
Ethnicity (%)					
white	47.5	46.7	46.5	44.7	44.4
black	27.9	30.7	34.9	38.7	40.5
Hispanic	14.1	15.8	13.6	12.1	11.3
other	10.6	6.8	5.0	4.4	3.8
Education (%)					
pre-college	59.3	60.1	60.2	58.2	58.8
college	40.7	39.9	39.8	41.8	41.2
Insurance (%)					
private	37.6	41.3	43.1	44.5	42.3
Medicare	49.1	48.3	47.0	44.6	46.2
Medicaid	10.1	7.3	7.4	8.3	8.7
other	3.2	3.1	2.5	2.6	2.8
PRA (%)					
<20	80.4	81.9	80.3	78.3	77.9
20 to 80	12.1	11.5	12.3	14.0	13.2
>80	7.5	6.7	7.3	7.7	8.9
Year listed (%)					
1995 to 1996	16.6	13.0	10.1	8.7	9.3
1997 to 1998	16.7	14.5	12.4	10.9	12.5
1999 to 2000	16.2	15.9	15.2	14.1	15.4
2001 to 2002	16.1	17.1	17.5	17.7	18.5
2003 to 2004	18.0	20.0	22.0	23.7	22.5
2005 to 2006	16.4	19.5	22.9	25.0	21.9

**Figure 2.** Time to transplantation, by BMI, for candidates who were registered for KT.

that obese patients are typically higher risk and less profitable because of longer hospital stays and increased postoperative complications, the risk for a “regressive attitude” by providers

toward obese patients seems high,<sup>16</sup> although any generalizations of our findings to patients outside of KT are limited and speculative.

Several constraints of this study potentially limit a causal inference. Because United Network for Organ Sharing (UNOS) data are reported by transplant centers, inferences made from our findings must be based on the assumption that there was no systematic bias in reporting. This bias is less likely given the prospective nature of the UNOS cohort, the strict requirement for reporting factors that are relevant to the allocation scheme, the supplementation of patient death reports with record linkage to the Social Security Master Death File, and the results of our sensitivity analysis for missing data. Furthermore, despite that dozens of covariates are collected for each transplant candidate, unmeasured and residual confounding cannot be excluded. This limitation includes that BMI occasionally misclassifies obesity, especially in heavy, lean, muscular patients with ESRD. In addition, the selection bias inherent in an analysis of patients

**Table 2.** Likelihood of receiving a kidney transplant and of being bypassed for an offer

Parameter	BMI 25 to 30 <sup>a</sup>	BMI 30 to 35 <sup>a</sup>	BMI 35 to 40 <sup>a</sup>	BMI >40 <sup>a</sup>
Transplantation (HR)				
univariate	0.97 (0.94 to 0.99), P = 0.01	0.92 (0.88 to 0.95), P < 0.001	0.72 (0.67 to 0.76), P < 0.001	0.56 (0.51 to 0.62), P < 0.001
allocation model <sup>b</sup>	0.96 (0.94 to 0.99), P = 0.01	0.93 (0.90 to 0.97), P < 0.001	0.72 (0.68 to 0.77), P < 0.001	0.56 (0.50 to 0.62), P < 0.001
full model <sup>c</sup>	0.98 (0.96 to 1.01), P = 0.2	0.98 (0.94 to 1.02), P = 0.3	0.76 (0.72 to 0.81), P < 0.001	0.58 (0.53 to 0.65), P < 0.001
Bypasses (IRR)				
univariate	0.99 (0.95 to 1.01), P = 0.3	0.98 (0.94 to 1.03), P = 0.5	1.04 (0.99 to 1.09), P = 0.1	1.22 (1.13 to 1.31), P < 0.001
allocation model <sup>b</sup>	1.02 (1.00 to 1.04), P = 0.02	1.05 (1.02 to 1.08), P < 0.001	1.11 (1.07 to 1.14), P < 0.001	1.22 (1.13 to 1.32), P < 0.001
full model <sup>c</sup>	1.03 (1.01 to 1.05), P < 0.001	1.05 (1.02 to 1.09), P < 0.001	1.13 (1.08 to 1.17), P < 0.001	1.23 (1.14 to 1.32), P < 0.001

<sup>a</sup>As compared with reference group BMI 18.5 to 25.

<sup>b</sup>Adjusted for factors relevant to the allocation system, factors possibly influencing access to health care, and center-specific clustering.

<sup>c</sup>Adjusted for factors relevant to the allocation system, factors possibly influencing access to health care, factors biologically related to disease progression and outcomes that could influence provider risk–benefit decisions, and center-specific clustering.

actually listed for transplantation possibly causes the true problem to be underestimated; in fact, 21% of transplant centers did not list a single morbidly obese patient and 15% of centers did not list a single severely obese patient during the study period.

Most important, the process of matching an organ offer with an appropriate recipient requires the kind of experience and clinical judgment that cannot be fully captured or accounted for in an observational study. Although in general the risks of dialysis far exceed those of transplantation, even for obese patients,<sup>23–25</sup> the risk–benefit decision may vary between individuals, may vary across time, and is not fully elucidated. It is certainly possible that rather than being influenced by mandatory outcomes reporting and billing practices, providers are bypassing obese patients who are stable on dialysis in the hopes that they lose weight and avoid the obesity-related postoperative complications of transplantation. Given that few lose significant weight before transplantation and that weight loss before transplantation was not associated with improved outcomes,<sup>27</sup> it remains unclear whether such a practice is worthwhile.

If indeed a bias exists that causes providers to delay or forego KT for obese patients awaiting transplantation, then the question of how to address this bias remains challenging. More stringent BMI requirements before approval for transplantation would limit the disparities in waiting time but would certainly not expand access to transplantation for obese patients. Preoperative bariatric surgery would expand transplant opportunities for obese patients, but the risks of the various weight-loss procedures in patients with ESRD have not been well studied. If the transplant community decides that organs should not be allocated to patients with excessive postoperative risk, then an objective change to the allocation policy would need to take place. Regardless of the

solution, it is reasonable to think that patients consider placement on the transplant waiting list to be an implicit promise of fair, unbiased treatment under a transparent allocation scheme and that current practice may not be living up to that promise.

## CONCISE METHODS

### Study Design and Population

This was a secondary data analysis of a prospective cohort of adult candidates who were registered for deceased-donor KT. This study evaluated the association between BMI and two candidate outcome measures: Time to transplantation and number of times bypassed. BMI was calculated on the basis of weight and height at registration, as weight (kg) divided by squared height (cm), and categorized as reference (18.5 to 25), overweight (25 to 30), obese (30 to 35), severely obese (35 to 40), and morbidly obese (40 to 60). Because it is rare for updated weight information to be reported to the transplant center after registration for the waiting list and because allocation decisions are usually made on the basis of the information recorded on the waiting list, we analyzed outcomes on the basis of BMI at initial listing. The study population included 168,827 adults who were available for analysis in the UNOS Kidney–Pancreas Standard Transplant Analysis and Research (STAR) Files and who registered for a first deceased-donor kidney transplant between January 1, 1995, and June 6, 2006. Excluded were live-donor transplant recipients ( $n = 23,933$ ), multi-organ transplant recipients ( $n = 1822$ ), urgent or emergent registrations ( $n = 463$ ), patients with incomplete waiting list histories ( $n = 743$ ), patients who were missing information about BMI ( $n = 5414$ ), and patients with BMI out of range ( $<18.5$  or  $>60$ ;  $n = 4099$ ).

### Regression Modeling

For each regression model, an unadjusted analysis was performed of the following variables from the STAR file: (1) Factors relevant

**Table 3.** Factors affecting the likelihood of receiving a kidney transplant (multivariate Cox proportional hazards model)

Parameter	HR (95% CI)	P
BMI		
18.5 to 25	Reference	
25 to 30	0.96 (0.94 to 0.99)	0.01
30 to 35	0.93 (0.90 to 0.97)	<0.001
35 to 40	0.72 (0.68 to 0.77)	<0.001
40 to 60	0.56 (0.50 to 0.62)	<0.001
Blood type		
A	Reference	
B	0.49 (0.46 to 0.52)	<0.001
AB	1.74 (1.60 to 1.90)	<0.001
O	0.55 (0.53 to 0.58)	<0.001
Gender		
male	Reference	
female	1.06 (1.03 to 1.09)	<0.001
Ethnicity		
white	Reference	
black	0.65 (0.59 to 0.72)	<0.001
Hispanic	0.67 (0.58 to 0.76)	<0.001
other	0.58 (0.51 to 0.67)	<0.001
Education		
pre-college	Reference	
college	1.01 (0.97 to 1.05)	0.7
Insurance		
private	Reference	
Medicare	0.99 (0.92 to 1.06)	0.8
Medicaid	0.71 (0.63 to 0.80)	<0.001
other	0.87 (0.75 to 1.00)	0.1
PRA		
<20	Reference	
20 to 80	0.59 (0.55 to 0.64)	<0.001
>80	0.42 (0.37 to 0.48)	<0.001
Year listed		
1995 to 1996	Reference	
1997 to 1998	0.88 (0.83 to 0.93)	<0.001
1999 to 2000	0.78 (0.72 to 0.84)	<0.001
2001 to 2002	0.76 (0.67 to 0.86)	<0.001
2003 to 2004	0.70 (0.60 to 0.81)	<0.001
2005 to 2006	0.53 (0.43 to 0.67)	<0.001

to the allocation system (blood type, PRA level, and year of listing [to account for significant changes in waiting time during the study period]); (2) factors possibly influencing access to health care (gender, ethnicity, insurance, education); and (3) factors biologically related to disease progression and outcomes that could influence provider risk–benefit decisions (age at registration, cause of renal failure [categorized as glomerulonephritis, IgA nephropathy, FSGS, reflux, polycystic kidney disease, diabetes, SLE, hypertension, or other], functional status, hospitalized, diabetes, hypertension, previous malignancy, cerebrovascular disease, type of dialysis [hemodialysis, peritoneal dialysis, or predialysis], peptic ulcer disease, and peripheral vascular disease). The appropriate functional form of model covariates was determined by exploratory data analysis in unadjusted models. Because all factors that were investigated were biologically plausible confounders, two

**Table 4.** Factors affecting the likelihood of being bypassed for a kidney offer (multivariate negative binomial regression model)

Parameter	IRR (95% CI)	P
BMI		
18.5 to 25	Reference	
25 to 30	1.02 (1.00 to 1.04)	0.02
30 to 35	1.05 (1.02 to 1.08)	<0.001
35 to 40	1.11 (1.07 to 1.14)	<0.001
40 to 60	1.22 (1.13 to 1.32)	<0.001
Blood type		
A	Reference	
B	0.37 (0.35 to 0.39)	<0.001
AB	0.84 (0.79 to 0.90)	<0.001
O	1.21 (1.17 to 1.25)	<0.001
Gender		
male	Reference	
female	0.96 (0.94 to 0.98)	<0.001
Ethnicity		
white	Reference	
black	1.27 (1.18 to 1.37)	<0.001
Hispanic	1.21 (1.11 to 1.33)	<0.001
other	1.19 (1.05 to 1.35)	0.01
Education		
pre-college	Reference	
college	1.00 (0.97 to 1.03)	0.9
Insurance		
private	Reference	
Medicare	0.96 (0.91 to 1.01)	0.1
Medicaid	1.05 (0.95 to 1.16)	0.3
other	1.15 (0.96 to 1.38)	0.1
PRA		
<20	Reference	
20 to 80	1.06 (0.99 to 1.15)	0.1
>80	1.25 (1.10 to 1.43)	<0.001
Year listed		
1995 to 1996	Reference	
1997 to 1998	0.88 (0.79 to 0.98)	0.02
1999 to 2000	0.81 (0.64 to 1.02)	0.1
2001 to 2002	0.68 (0.52 to 0.88)	<0.001
2003 to 2004	0.38 (0.29 to 0.51)	<0.001
2005 to 2006	0.09 (0.07 to 0.13)	<0.001

forced multivariate models were used: An allocation model (1 and 2) and a full model (1, 2, and 3).

### Provider Bypasses

To understand better the mechanism by which patients with higher BMI had longer waiting times, we investigated the association of BMI with provider bypasses. Each organ offer is made to patients on the waiting list in decreasing order of allocation priority until a physician and then a patient accept an offer. The physician has first right of refusal for any potential offer to a particular patient. Through this system, a provider can bypass a patient before the organ is ever offered to the patient, or the patient can refuse the offer. The UNOS kidney offer history data set was analyzed to determine the relative likelihoods of being bypassed. The UNOS data set records information only on organs that were even-

tually transplanted. Number of total bypasses (excluding offers that the patient refused) was grouped as follows: Bypasses likely made by anyone other than the patient, bypasses likely made at the level of the center or provider, and bypasses likely made at the level of the provider. Results for bypasses likely made by anyone other than the patient are reported. Sensitivity to our categorization judgment and assumptions was tested by comparing our models for each of the different bypass category groupings. A bypass category grouping that included all bypasses was also tested to account for possible errors in the somewhat subjective coding system. The ratios for BMI categories did not vary by >5% in any of the sensitivity analyses.

### Time to Transplantation

Patients entered the study at the time of registration for organ transplantation. Time-to-event analyses were performed for the event of transplantation, censoring at (1) death while waiting, (2) removal from the waiting list for reasons other than transplantation, or (3) end of study (administrative censoring). The hazards of being censored were minimally higher for obese patients compared with the reference group (BMI <18 to 25): HR 1.03 (95% CI 1.01 to 1.05) for overweight candidates, HR 1.08 (95% CI 1.06 to 1.11) for obese candidates, HR 1.11 (95% CI 1.06 to 1.15) for severely obese candidates, and HR 1.03 (95% CI 0.98 to 1.09) for morbidly obese candidates. Sensitivity analyses were performed to demonstrate that potential differences in censoring for severely or morbidly obese patients did not affect the conclusions of this study. For each type of censoring (death, removal for other reasons, administrative, or any of these) and for each model (univariate, allocation, and full), the trends in the sensitivity analyses were similar to those in the analyses reported here.

### Inactive Status

A patient can switch from active to inactive status when certain conditions that the provider deems would preclude transplantation arise. For example, many centers will list obese patients but make them inactive until the patient loses an appropriate amount of weight. Also, obese patients might have a higher risk for infectious comorbidities (e.g., cellulitis, pneumonia, slowly healing wounds) that are contraindications for transplantation during the times of ongoing infection. As a result, we considered only active time on the waiting list as time awaiting transplantation; however, for the purposes of sensitivity analysis, we confirmed that similar trends were still demonstrated even when inactive time was included.

### Regression Model Analysis

Bypasses were modeled as count data and found to follow a Poisson distribution with overdispersion, so negative binomial models were used to analyze the IRR of being bypassed. Time to transplantation was estimated using the Kaplan-Meier method, and comparisons of HR for transplantation were performed using Cox regression models. To account for differences in practice protocols between transplant centers, as well as geographic differences in disease severity and organ availability, we adjusted all models for center-specific clustering effects. Unless otherwise specified, all tests were two-sided with statis-

tical significance set at  $\alpha = 0.05$ . All analyses were performed using Stata 9.1 for Linux (StataCorp, College Station, TX).

### Sensitivity Analysis

Models were repeated with serial omissions of covariates that were not statistically significant on univariate analysis, to confirm that inclusion of these covariates in a forced model did not affect the conclusions. Also, for each covariate with missing data (education 19%, functional status 9%, hypertension 4%, previous malignancy 6%, PRA 6%, cerebrovascular disease 5%, peptic ulcer disease 5%, and peripheral vascular disease 6%), models were repeated with missing values of each covariate recoded as (1) “missing” categories and (2) the most extreme cases. Results did not vary by >5% in any of the sensitivity analyses.

### ACKNOWLEDGMENTS

As a study of the United Network for Organ Sharing database, this work was supported in part by Health Resources and Services Administration contract 234-2005-370011C.

D.L.S. had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

### DISCLOSURES

None.

### REFERENCES

1. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM: Prevalence of overweight and obesity in the United States, 1999–2004. *JAMA* 295: 1549–1555, 2006
2. Falagas ME, Kompoti M: Obesity and infection. *Lancet Infect Dis* 6: 438–446, 2006
3. Pasulka PS, Bistran BR, Benotti PN, Blackburn GL: The risks of surgery in obese patients. *Ann Intern Med* 104: 540–546, 1986
4. Choban PS, Heckler R, Burge JC, Flancbaum L: Increased incidence of nosocomial infections in obese surgical patients. *Am Surg* 61: 1001–1005, 1995
5. Canturk Z, Canturk NZ, Cetinarlan B, Utkan NZ, Tarkun I: Nosocomial infections and obesity in surgical patients. *Obes Res* 11: 769–775, 2003
6. Hawn MT, Bian J, Leeth RR, Ritchie G, Allen N, Bland KI, Vickers SM: Impact of obesity on resource utilization for general surgical procedures. *Ann Surg* 241: 821–826, discussion 826–828, 2005
7. Romero-Corral A, Montori VM, Somers VK, Korinek J, Thomas RJ, Allison TG, Mookadam F, Lopez-Jimenez F: Association of body-weight with total mortality and with cardiovascular events in coronary artery disease: A systematic review of cohort studies. *Lancet* 368: 666–678, 2006
8. Barros PP: Cream-skimming, incentives for efficiency and payment system. *J Health Econ* 22: 419–443, 2003
9. Ellis RP: Creaming, skimping and dumping: Provider competition on the intensive and extensive margins. *J Health Econ* 17: 537–555, 1998
10. Epstein AM: Rolling down the runway: The challenges ahead for quality report cards. *JAMA* 279: 1691–1696, 1998

11. Omoigui NA, Miller DP, Brown KJ, Annan K, Cosgrove D 3rd, Lytle B, Loop F, Topol EJ: Outmigration for coronary bypass surgery in an era of public dissemination of clinical outcomes. *Circulation* 93: 27–33, 1996
12. Schneider EC, Epstein AM: Influence of cardiac-surgery performance reports on referral practices and access to care: A survey of cardiovascular specialists. *N Engl J Med* 335: 251–256, 1996
13. Burack JH, Impellizzeri P, Homel P, Cunningham, JN Jr: Public reporting of surgical mortality: A survey of New York State cardiothoracic surgeons. *Ann Thorac Surg* 68: 1195–1200, discussion 1201–1202, 1999
14. Werner RM, Asch DA: The unintended consequences of publicly reporting quality information. *JAMA* 293: 1239–1244, 2005
15. Werner RM, Asch DA, Polsky D: Racial profiling: The unintended consequences of coronary artery bypass graft report cards. *Circulation* 111: 1257–1263, 2005
16. Dindo D, Muller MK, Weber M, Clavien PA: Obesity in general elective surgery. *Lancet* 361: 2032–2035, 2003
17. Aalten J, Christiaans MH, de Fijter H, Hene R, van der Heijde JH, Roodnat J, Surachno J, Hoitsma A: The influence of obesity on short- and long-term graft and patient survival after renal transplantation. *Transpl Int* 19: 901–907, 2006
18. Chow KM, Szeto CC, Leung CB, Lui SF, Tong YF, Li PK: Body mass index as a predictive factor for long-term renal transplant outcomes in Asians. *Clin Transplant* 20: 582–589, 2006
19. Gore JL, Pham PT, Danovitch GM, Wilkinson AH, Rosenthal JT, Lipshutz GS, Singer JS: Obesity and outcome following renal transplantation. *Am J Transplant* 6: 357–363, 2006
20. Shah T, Kasravi A, Huang E, Hayashi R, Young B, Cho YW, Bunnapradist S: Risk factors for development of new-onset diabetes mellitus after kidney transplantation. *Transplantation* 82: 1673–1676, 2006
21. Rodrigo E, Fernandez-Fresnedo G, Valero R, Ruiz JC, Pinera C, Palomar R, Gonzalez-Cotorruelo J, Gomez-Alamillo C, Arias M: New-onset diabetes after kidney transplantation: Risk factors. *J Am Soc Nephrol* 17[Suppl]: S291–S295, 2006
22. Massarweh NN, Clayton JL, Mangum CA, Florman SS, Slakey DP: High body mass index and short- and long-term renal allograft survival in adults. *Transplantation* 80: 1430–1434, 2005
23. Pelletier SJ, Maraschio MA, Schaubel DE, Dykstra DM, Punch JD, Wolfe RA, Port FK, Merion, RM: Survival benefit of kidney and liver transplantation for obese patients on the waiting list. *Clin Transpl* 77–88, 2003
24. Marks WH, Florence LS, Chapman PH, Precht AF, Perkinson DT: Morbid obesity is not a contraindication to kidney transplantation. *Am J Surg* 187: 635–638, 2004
25. Glanton CW, Kao TC, Cruess D, Agodoa LY, Abbott KC: Impact of renal transplantation on survival in end-stage renal disease patients with elevated body mass index. *Kidney Int* 63: 647–653, 2003
26. UNOS: Policy 3.5: Organ Distribution: Allocation of Deceased Kidneys, 2006. Available at: [http://www.unos.org/PoliciesandBylaws2/policies/pdfs/policy\\_7.pdf](http://www.unos.org/PoliciesandBylaws2/policies/pdfs/policy_7.pdf). Accessed December 1, 2006
27. Schold JD, Srinivas TR, Guerra G, Reed AI, Johnson RJ, Weiner ID, Oberbauer R, Harman JS, Hemming AW, Meier-Kriesche HU: A “weight-listing” paradox for candidates of renal transplantation? *Am J Transplant* 7: 550–559, 2007

---

See related editorial, “●●●,” on pages 000–000.