

Income of Living Kidney Donors and the Income Difference Between Living Kidney Donors and Their Recipients in the United States

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Disincentives for living kidney donation are common but are poorly understood. We studied 54 483 living donor kidney transplants in the United States between 2000 and 2009, limiting to those with valid zip code data to allow determination of median household income by linkage to the 2000 U.S. Census. We then determined the income and income difference of donors and recipients. The median household income in donors and recipients was \$46 334 ± \$17 350 and \$46 439 ± \$17 743, respectively. Donation-related expenses consume ≥ 1 month's income in 76% of donors. The mean ± standard deviation income difference between recipients and donors in transplants involving a wealthier recipient was \$22 760 ± 14 792 and in 90% of transplants the difference was <\$40 000 dollars. The findings suggest that the capacity for donors to absorb the financial consequences of donation, or of recipients to reimburse allowable expenses, is limited. There were few transplants with a large difference in recipient and donor income, suggesting that the scope and value of any payment between donors and recipients is likely to be small. We conclude that most donors and recipients have similar modest incomes, suggesting that the costs of donation are a significant burden in the majority of living donor transplants.

Key words: Disincentives, economics, living kidney donation

Abbreviations: ESRD, end stage renal disease; LRD, living related donor; LURD, living unrelated donor; PRA,

panel reactive antibody; RUCA, rural urban commuting area.

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Introduction

Living kidney donation is the optimal treatment for end-stage renal disease as it is associated with improved survival and quality-of-life, and leads to lower net healthcare costs (1,2–4). Given the gap between demand and availability of kidneys available for transplantation, increased emphasis has been placed on removing barriers and disincentives for living donors. Living kidney donors incur expenses including lost wages and the costs of travel, meals, day care, parking and lodging that are related to the transplant process (5–7). However, the ability of living donors to bear such costs is not well described. Describing the income of living donors would provide an indication of the potential financial impact of donation, and inform the need for strategies to reimburse donation-related expenses.

Similarly, knowledge of differences between donor and recipient income would provide an indication of the recipients' ability to compensate donors for out-of-pocket expenses related to donation. The National Organ Transplant Act (NOTA) made it unlawful for any person to receive "valuable consideration" for a human organ. NOTA does not define valuable consideration but makes it clear that "expenses of travel, housing and lost wages incurred by the donor of a human organ in connection with donation of the organ" are excluded and therefore permissible (8). Finally, determination of the income difference between donors and recipients would provide indirect information about the potential scope of illegal financial transactions between the recipient and donor. While significant concern over this practice exists, there is virtually no information to determine the extent to which individuals may receive "valuable consideration" for donating an organ.

Our objective was to determine the economic impact of donation on live kidney donors, and the capacity of recipients to provide allowable expense reimbursements or an

illegal cash or material good incentive to donors. Given the absence of direct data, we assessed median household income of donors and recipients, and large differences in donor and recipient income using data from the United States Renal Data System (USRDS).

Methods

Study population

All adult (recipient age ≥ 18 years at time of transplantation) living kidney donor transplants captured in the United States Renal Data System between 2000 and 2009 in which the donor and recipient zip code were available were included in this analysis. Donor and recipient characteristics were described using the mean and standard deviation, or proportions and group differences were compared by the *t*-test in the case of continuous variables or the chi-square test in the case of categorical variables.

Income determination and classification of living donor transplants as “income-concordant” or “income-discordant”

Median household income for each donor and recipient was determined by linking the zip code of residence at the time of transplantation for each donor and recipient to median household income data recorded at the zip code level from the 2000 U.S. Census. Quintiles of donor and recipient median household income were determined.

Income-concordant transplants included those in which the recipient and donor resided in the same zip code. In addition, among transplants in which the donor and recipient resided in different zip codes, the subset in which the donor and recipient were in the same quintile of median household income were also classified as income concordant. Income-discordant transplants were only identified when the donor and recipient resided in different zip codes, and included those in which the recipient had a higher income quintile than the donor (recipient wealthier), as well as those in which the donor income quintile was higher than the recipient (donor wealthier). The proportion of income-concordant and -discordant transplants was determined overall, among subgroups of living-related donor (LRD) and living-unrelated donor (LURD) transplants, and among subgroups in which the recipient resided in rural, micropolitan or metropolitan areas.

Determination of rural and urban commuting area groupings

There may be significant heterogeneity in median household income among individuals residing within the same zip code, particularly in urban areas. We therefore determined the extent to which the residence location of each donor and recipient was rural or urban using the rural–urban commuting area (RUCA) code (9,10). RUCA codes are assigned to each US zip code based on markers of population density, with values ranging from 1.0 (most urban) to 10.6 (most rural). Information on population density is supplemented by data on employment commuting to ensure that suburban areas with low population density in which many residents work in nearby large urban areas are classified as urban. As in previous work (9,10), we classified each patient in the current analysis as belonging to 1 of 3 mutually exclusive RUCA groups: metropolitan (RUCA 1.0–3.9; cities with population of $>50\,000$ and their associated suburban areas); micropolitan (RUCA 4.0–6.0; towns or cities with population of $10\,000$ – $50\,000$); and rural (RUCA >6.0 ; towns with population of $<10\,000$).

Quantification of income difference between recipients and donors

We quantified the income difference between recipient and donors in two subgroups with the largest potential income difference: transplants in which the annual recipient income was in the top 50% of all recipients and the

annual donor income was in the bottom 50% of all donors and vice versa. Within these two groups, we quantified the difference in median annual household income in $\$10\,000$ increments, and determined the number and proportion of transplants with an income difference from $< \$10\,000$ to $\geq \$100\,000$.

Factors associated with a living donor transplant with a large recipient donor income difference ($\geq \$40\,000$)

We determined factors associated with transplants in which the annual income difference between recipients and donors was in the top 10% of all transplants ($\geq \$40\,000$) in a multivariate regression model that included adjustment for donor characteristics (age, gender, race, education level, relationship to recipient and whether donor and recipient resided in a same or different RUCA group), and recipient characteristics (age, gender, race, education, cause of end stage renal disease (ESRD), PRA, transplant number, duration of dialysis exposure prior to transplantation). Patients with missing data were retained in the model by creating a missing category for each variable with missing data. The study was conducted with the approval of our local hospital research ethics board. All analyses were performed using StataMP 11 (StataCorp, College Station, TX, USA).

Results

There were 61 843 living donor transplants available for analysis during the study period. $N = 7360$ transplants were excluded because of an invalid or missing zip code for the donor or recipient. The donor and recipient characteristics of the 54 483 transplants included in this study are shown in Table 1, along with a comparison of the 21 992 transplants where the donor and recipient resided in the same zip code, and the 32 491 transplants where the donor and recipient resided in different zip codes.

Income in donors and recipients

The mean \pm standard deviation of the median household income in donors and recipients was $\$46\,334 \pm 17\,350$ and $\$46\,439 \pm 17\,743$, respectively. The distribution of recipient and donor income was very similar (Figure 1 Top), and this was consistent when analysis was restricted to transplants involving recipients and donors living in different zip codes (Figure 1 Bottom). Overall 31 739 (58%) of transplants were income concordant including 21 992 transplants where the donor and recipient resided in the same zip code, and 9747 transplants in which the donor and recipient resided in different zip codes but were in the same income quintile. Among transplants where the donor and recipient resided in different zip codes, 30% had the same income, 35% involved a wealthier recipient and 35% had a wealthier donor. There was no evidence that the proportion of transplants in which the recipient income exceeded the donor income was increasing over time.

Income concordance and discordance in living-related and living-unrelated transplants

When considering all transplants in which the donor and recipient resided in different zip codes (Table 2), the proportion of income-concordant transplants was higher in

Income of Living Kidney Donors and Recipients

Table 1: Characteristics of living donor transplants and comparison of transplants where recipients and donors resided in same versus different zip codes

	All transplants (N = 54 483)	Transplants where recipient and donor resided in same zip code (N = 21 992)	Transplants where recipient and donor resided in different zip code (N = 32 491)	p-Value
Donor characteristics				
Age (mean ± standard deviation)	40 (11)	39 (11)	40 (10)	<0.001
Percent male	42	41	42	<0.001
Race (%)				<0.001
White	72	70	73	
Black	14	14	14	
Asian	2	3	2	
Other	12	13	11	
Relationship to recipient				<0.001
Sibling	50	37	57	
Parent	13	22	7	
Other relative	7	4	10	
Spouse	12	27	2	
Unrelated	18	10	24	
Median household income (quintiles)				<0.001
<\$30 962	16	19	15	
\$30 962–37 314	18	19	17	
\$37 315–44 723	20	20	20	
\$44 724–56 580	22	21	23	
>56 580	24	21	25	
Donor RUCA group				<0.001
Metropolitan	81	79	83	
Micropolitan	10	11	9	
Rural	9	10	8	
Recipient characteristics				
Age (mean ± standard deviation)	43 (16)	40 (17)	45 (14)	<0.001
Percent male	59	60	58	<0.001
Race				<0.001
White	69	64	69	
Black	15	15	15	
Asian	3	4	3	
Other	13	13	13	
Cause of end-stage renal disease				<0.001
Diabetes	21	20	21	
Hypertension	27	26	28	
Glomerular disease	13	13	14	
Other	30	33	28	
Duration of dialysis prior to transplantation				<0.001
Preemptive	22	23	22	
<1 year	37	37	38	
1.0–1.9 years	21	22	21	
2.0–2.9 years	9	9	9	
≥3.0 years	11	9	10	
Repeat transplant recipient	7	7	8	<0.001
Median household income (quintile)				<0.001
(<\$30 962)	16	18	15	
\$30 962–37 314	18	19	17	
\$37 315–44 723	20	20	20	
\$44 724–56 580	22	21	23	
>56 580	24	22	25	
Recipient RUCA group				<0.001
Metropolitan	82	79	83	
Micropolitan	9	11	9	
Rural	9	10	8	

RUCA = rural urban commuting area.

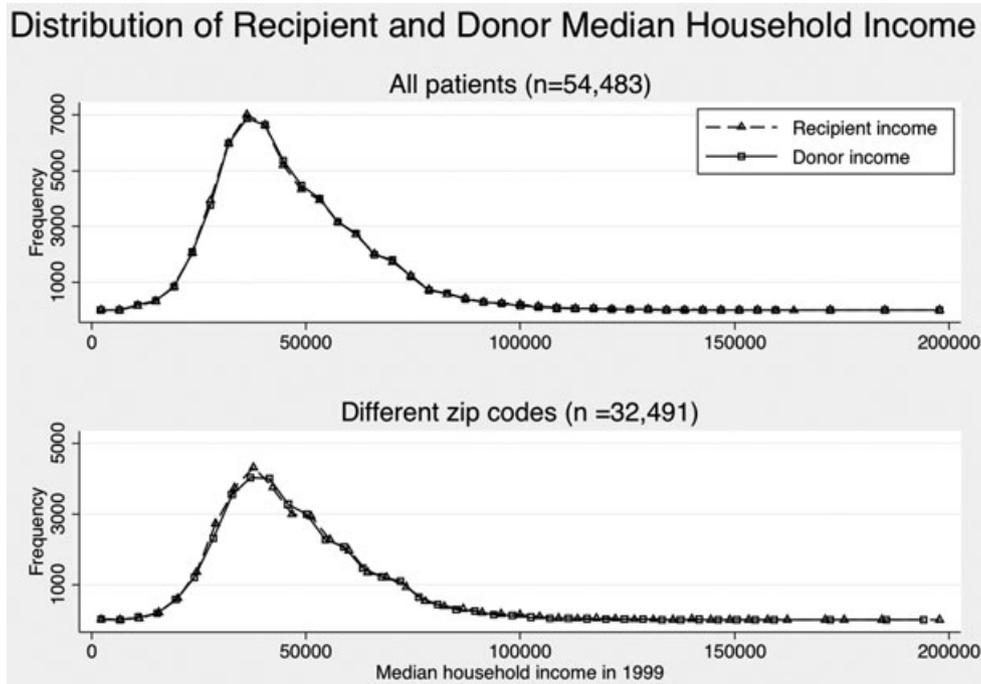


Figure 1: Distribution of donor and recipient income. The figure shows that distribution of donor and recipient income was very similar. Top panel includes data from all living donor transplants studied, while the bottom panel includes only those transplants where recipient and donor resided in different zip codes.

LURD (32%) compared to LRD transplants (30%). Further the proportion of transplants where the recipient income exceeded the donor income was 36% in LRD transplants compared to 34% in LURD transplants (Table 2). The proportion of income-concordant LRD and LURD transplants was similar across recipient groupings defined by income

quintile. In addition, the proportion of transplants in which the recipient was wealthier was consistently higher in LRD transplants across all recipient income quintiles (Table 2). Collectively these results do not suggest a greater discrepancy in recipient/donor income in LURD compared to LRD transplants.

Table 2: Discordance in recipient and donor income in transplants where donors and recipients reside in different zip codes

	Living-related transplants			Living-unrelated transplants		
	N = 24 692			N = 7799		
	Income concordant	Recipient income higher	Donor income higher	Same income	Recipient income higher	Donor income higher
All transplants (%)	30	36	34	32	34	34
Recipient income (<\$30 962)	33	n/a	67	30	n/a	70
Recipient income \$30 962–37 314	22	19	59	23	14	61
Recipient income \$37 315–44 723	23	32	45	24	32	44
Recipient income \$44 724–56 580	28	47	25	30	43	27
Recipient income >\$56 580	41	59	n/a	44	56	n/a
Metropolitan recipient residence	30	38	32	32	37	31
Micropolitan recipient residence	29	21	50	32	22	46
Rural recipient residence	31	16	53	32	19	49

Living related transplants included spousal transplants.

Recipients and donors were classified as having the same income if they were in the same income quintile.

Donors were classified as having a lower income if they were in a lower income quintile than their recipient.

Donors were classified as having a higher income if they were in a higher income quintile than their recipient.

RUCA groups: metropolitan (RUCA 1.0–3.9; cities with population of >50 000 and their associated suburban areas); micropolitan (RUCA 4.0–6.0; towns or cities with population of 10 000–50 000; and rural (RUCA >6.0; towns with population of <10 000).

Table 3: Quantification of income difference between recipients and donors

Transplants involving a wealthier recipient (recipient in top 50% of all recipient income and donor in bottom 50% of all donor income (N = 6179))							
Recipient income– donor income	<\$10 000	\$10 001– \$20 000	\$20 001– \$30 000	\$30 001– \$40 000	\$40 001– \$50 000	\$50 001– \$100 000	>\$100 000
N (%)							
All patients	1047 (17)	2102 (34)	1513 (24)	863 (14)	343 (6)	300 (5)	11 (0.2)
LRD (%)	786 (17)	1533 (34)	1122 (25)	645 (14)	250 (5)	220 (5)	9 (0.2)
LURD%	261 (16)	569 (35)	391 (24)	218 (14)	93 (6)	80 (5)	2 (0.1)
Transplants involving a wealthier donor (donor in top 50% of all donor income and recipient in bottom 50% of all recipient income (N = 6180))							
Donor income– recipient income	<\$10 000	\$10 001– \$20 000	\$20 001– \$30 000	\$30 001– \$40 000	\$40 001– \$50 000	\$50 001– \$100 000	>\$100 000
N (%)							
All patients	1006 (16)	2121 (34)	1617 (26)	807 (13)	371 (6)	251 (4)	7 (0)
LRD	747 (16)	1592 (34)	1236 (27)	603 (13)	284 (6)	195 (4)	5 (0)
LURD	259 (17)	529 (35)	381 (25)	204 (13)	87 (6)	56 (4)	2 (0)

Income concordance and discordance among transplants involving recipients living in rural, micropolitan and metropolitan areas

The proportion of income-concordant transplants was similar among recipients living in rural, micropolitan and metropolitan areas (Table 2). However, the proportion of transplants in which the recipient income exceeded the donor income was notably higher when the recipient lived in a metropolitan compared to micropolitan or rural area (Table 2). This finding is explained by the fact that metropolitan dwellers had higher and more variable incomes than micropolitan or rural dwellers (annual income in rural, micropolitan, and metropolitan dwellers was \$34 089 ± 7 448, \$36 635 ± 8 163 and \$49 829 ± 18 135 respectively), and that 90% of the 26 813 income-discordant transplants involving a metropolitan recipient were from a metropolitan donor.

Quantification of the difference in recipient/donor income

Comparing transplants involving a wealthier recipient to those with a wealthier donor, the distribution of the income differences between recipients and donors was very similar (Table 3). Among wealthy recipient transplants, income differences were similar between living-related and unrelated transplants, and the income differences were relatively small (in only 11% of transplants was the recipient income ≥ \$40 000 greater than donor income) (Table 3). Similar findings were observed among wealthier donor transplants: income differences were again similar between living related and living unrelated transplants, and only 10% of transplants involving a wealthier donor had a ≥\$40 000 difference in recipient/donor income.

Factors associated with a large difference (≥ \$40 000) in recipient and donor income

Table 4 shows that no donor characteristics were significantly associated with a higher odds of a transplant in which the recipient income exceeded the donor income

by ≥\$40 000. Compared to recipients 18–39 years, recipients aged 40–59 and ≥ 60 years had a higher odds of a transplant with this large income difference. Compared to white recipients, Asian recipients and recipients of other race had a higher odds, while Black recipients had a lower odds of a transplant with this large income difference. Male recipients, as well as those with a college education (compared to grade school), and preemptive recipients also had a higher odds of such transplants. We found a higher odds of a transplant with this large income difference when the recipient and donor resided in the same RUCA group. This association was specifically the result of transplants involving donor and recipients living in metropolitan areas (100% of all transplants with an income difference ≥ \$40 000 involved a metropolitan dwelling recipient and donor).

Discussion

Like other chronic diseases, end-stage kidney disease is more common in people of lower socioeconomic status. However, the impact of socioeconomic status on access to optimal disease treatment (transplantation) is potentially much greater for end-stage kidney disease than for other chronic conditions, illustrated by the fact that inability to pay for immunosuppressant medications remains a relative contraindication to transplantation in the United States (11). Although multiple studies have demonstrated an association between socioeconomic status and access to transplantation (12–15), the financial barriers to living donor transplantation in particular have been underemphasized (16,17). The description of recipient income in this study provides the context necessary to understand the financial burden of living kidney donation. A wide range of out-of-pocket costs of living donation have been reported (\$0–\$20 000), and have been conservatively estimated to be \$2225–\$5,000 (6). Assuming average donor costs of \$5000, this cost is greater than 1 month's household income for 76% of living donors.

Our finding that most recipients have similar incomes to their related and unrelated donors suggests that recipients have limited ability to help compensate their donors for expenses permissible under NOTA, including out-of-pocket expenses and lost wages. The financial burden may be greatest in settings where both the recipient and the donor contribute to the median household income and are unable to work after transplantation. With relatively few employers providing paid leave for organ donation, the cost of living donation may be an important, potentially modifiable factor limiting access to living donor transplantation. Whether programs that reimburse at least some of donation-related expenses have led to increased rates of living donation remains unclear. In one study legislation to provide modest financial support (including paid and unpaid leave or tax credits) was associated with increased living unrelated (but not living related) kidney donation (18).

This study also provides indirect evidence about the potential scope of illegal incentives from recipients to donors. The proportion of transplants in which the recipient had a higher income than their donor was similar to the proportion in which the donor had a higher income than recipient. Further, in transplants where the recipient was wealthier than their donor, the differences in income were modest, and only 10% had a difference in median household income that exceeded \$40 000. Given that most donors and recipients have similar, modest incomes, it is unlikely that large payment of donors is frequent in the United States. Importantly the findings were consistent in living related and unrelated transplants. These results should inform the debate regarding the use of incentives to increase living donation, and may be of interest to policy makers in countries where ongoing concerns about the potential for corruption in living donation (particularly between unrelated individuals) limits the number of transplants performed.

A number of recipient factors, including older age, male gender, college education, preemptive transplantation, and Asian race, were associated with a large difference in annual income (\geq \$40 000) between recipients and donors. A large difference in recipient and donor income does not prove donor exploitation. However, there is literature to suggest that patient groups susceptible to organ trafficking and transplant tourism can be identified by sociodemographic characteristics (19). We and others have previously reported a higher likelihood of transplant tourism in foreign born Canadian patients and preemptive transplant recipients (19). Of note, we found a higher odds of transplant with a \geq \$40 000 income difference when the donor and recipient resided in the same RUCA group (Table 4). This association was due to the fact that all of transplants where both the recipient and donor resided in the same RUCA group with an income difference \geq \$40 000 involved metropolitan dwellers. It is important to emphasize that this study only provides an indirect picture of the poten-

Table 4: Odds of a transplant in which the recipient income exceeds the donor income by \geq \$40,000

	Univariate odds ratio	Multivariate odds ratio
Donor age (ref)		
18-29	1.00	1.00
30-39	0.95 (0.79-1.15)	0.91 (0.75-1.10)
\geq 40	1.14 (0.97-1.36)	1.00 (0.75-1.10)
Female donor	0.88 (0.77-1.01)	0.89 (0.78-1.01)
Donor race		
White	1.00	1.00
Black	0.81 (0.66-1.00)]	1.52 (0.98-2.39)
Asian (including Indian, Chinese, Japanese, Korean, Philippine, etc.)	1.72 (1.20-2.46)	1.16 (0.67-2.00)
Other	0.74 (0.58-0.93)	1.43 (0.99-2.03)
Donor education		
Grade school	1.00	1.00
High school	0.79 (0.34-1.82)	0.71 (0.31-1.64)
College or higher	1.47 (0.66-3.34)	1.08 (0.47-2.46)
Living unrelated (Ref related)	1.16 (1.00-1.34)	1.11 (0.96-1.28)
Recipient age		
18-39	1.00	1.00
40-49	1.22 (1.03-1.46)	1.27 (1.06-1.50)
50-59	1.34 (1.13-1.58)	1.16 (0.97-1.38)
>60	1.41 (1.16-1.70)	1.42 (1.17-1.72)
Recipient male	1.16 (1.01-1.32)	1.14 (1.00-1.31)
Recipient race		
White	1.00	1.00
Black	0.74 (0.60-0.90)	0.59 (0.38-0.92)
Asian	1.87 (1.37-2.55)	1.66 (1.04-2.66)
Other	0.56 (0.43-0.73)	0.55 (0.37-0.81)
Recipient education		
Grade school	1.00	1.00
High school	0.88 (0.55-1.39)	0.81 (0.50-1.28)
College or higher	2.58 (1.66-4.00)	2.14 (1.36-3.34)
PRA		
(0-30)	1.00	1.00
>30	1.07 (0.86-1.33)	1.22 (0.88-1.68)
Repeat transplant	0.98 (0.77-1.26)	1.20 (0.96-1.51)
Preemptive	1.00	1.00
Dialysis 0-1 years	0.84 (0.72-0.99)	0.89 (0.77-1.03)
Dialysis 1-2	0.69 (0.57-0.84)	0.76 (0.62-0.92)
Dialysis > 2	0.63 (0.51-0.77)	0.71 (0.58-0.88)
RUCA		
Same	1.00	1.00
Different RUCA	0.76 (0.64-0.90)	0.78 (0.66-0.93)

tial use of payment from recipients to donors. Because such payments are illegal, it is likely that any study will only be able to provide indirect information regarding this issue.

Our study has several strengths: it included nearly all the living donor kidney transplant performed in the United States; was able to determine associations in important

subgroups such as living-related and unrelated donors; and permitted quantification of differences in annual income between recipients and donors. The use of zip codes to determine median household income is frequent in the medical literature and assumes the same income for individuals living in a given zip code. This assumption may be incorrect, especially in metropolitan areas, although we found a similar proportion of income concordant transplants in metropolitan, micropolitan and rural areas. The consequence of a higher misclassification of individual donor's and recipient's income among metropolitan dwellers is anticipated to be equal among high- and low-income discordant transplants, and therefore no systematic error in estimating the income difference among transplants involving metropolitan dwellers would be expected. The most accurate estimates of income difference would be for transplants where neither the recipient nor donor were metropolitan dwellers. We acknowledge that the study outcomes are indirect measures of the ability of donors to absorb the economic consequences of donation and the capacity of recipients to reimburse acceptable expenses or provide unacceptable incentives. Further, data on income are not available for eligible recipients who did not proceed with transplantation, and as such this analysis cannot ascertain their household income. Primary data collection to fully capture these data points in all populations is needed.

In summary, our analysis is the first to examine income of donors and differences between recipients and donors in living donor kidney transplantation. The findings suggest that donor costs may be significant barrier to living donor transplantation, and that income disparities between donors and recipients are infrequent. As such, the capacity for donors to absorb the financial consequences of donation, or of recipients to reimburse allowable expenses is limited and may pose a barrier to donation. However this also suggests that the scope and value of any financial transaction between recipients and donors are limited. Our findings should encourage efforts to remove disincentives for living donors, and provide an indication of the scope of any financial transaction between recipients and donors in the United States.

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