

## Supplemental Material

### Table of Contents:

**Supplemental Appendix 1.** Methodology for estimating the number of healthy and less-healthy food outlets within patient residential zip code and dialysis unit neighborhood

**Supplemental Appendix 2.** Components of the AHRQ SES Index

**Supplemental Figure 1.** Geographic distribution of dialysis units included in the final cohort

**Supplemental Figure 2.** The proportion of patients with serum phosphorus  $> 5.5\text{mg/dL}$  or  $>6.5\text{mg/dL}$  is greater among patients who are younger

**Supplemental Figure 3.** Correlation between AHRQ SES Index from US Census data from 2000 and SES Index calculated using US Census data from 2007-2011.

**Supplemental Table 1.** Availability of healthy and less-healthy food outlets in the neighborhood of the dialysis unit

**Supplemental Table 2.** Correlation between zip code socioeconomic status for dialysis unit and patient home location

**Supplemental Table 3.** Individual components of the mixed effects linear model demonstrating the relationship between availability of healthy food outlets and serum phosphorus levels

**Supplemental Table 4.** Individual components of the mixed effects linear model examining the relationship between neighborhood socioeconomic status index and serum phosphorus levels

**Supplemental Table 5.** Mixed effects linear model examining the relationship between availability of healthy food outlets within 0.6 miles (1-kilometer) of a dialysis unit on serum phosphorus level

**Supplemental Table 6.** Mixed effects linear model examining the relationship between availability of less-healthy food within 0.6 miles (1-kilometer) of a dialysis unit on serum phosphorus level

**Supplemental Appendix 1.** Methodology for estimating the number of healthy and less-healthy food outlets within patient residential zip code and dialysis unit neighborhood

We identified food outlets as healthy or less-healthy using classification described in the modified retail food environment index (mRFEI) published by the Centers for Disease Control.

Healthy food outlets were identified by the following NAICS codes (North American Industry Classification System): 445110 (supermarkets and larger grocery stores), 445230 (fruit and vegetable markets), and 452910 (warehouse clubs).

Less-healthy food outlets were identified by the following NAICS codes: 722211 (fast food restaurants), 445120 (convenience stores), and 445110 (small groceries – less than 3 or fewer employees).

*Estimation of Food environment in the residential zip code:*

Using data from the United States County Business Patterns dataset between the years 2007 and 2011, we extracted information on retail food outlets (<https://www.census.gov/content/census/en/programs-surveys/cbp/data/datasets.html/>). We then identified NAICS codes which corresponded to healthy and less-healthy food outlets within each zip code. Finally, we obtained the mean number of healthy and less-healthy food outlets within each zip code between 2007 and 2011.

*Estimation of Food environment in the neighborhood of the dialysis unit:*

We first geocoded the location of every dialysis unit in our dataset using R package “ggmap.” We then used Esri Business Locations and Business Summary Data file 2016 to obtain the geographic coordinates for retail business in the United States. The retail businesses were restricted to healthy and less-healthy food outlets using NAICS codes described above. We then built drive time service areas around dialysis units using the Network Analyst extension in ArcGIS Desktop 10.6.1 in the following order: 1) Driving distance of 1000 meters (1 kilometer) around each dialysis unit, 2) distance covered by a driving time of 10 minutes from each dialysis unit, and 3) distance covered by a driving time of 15 minutes from each dialysis unit. Finally, we calculated the number of healthy and less healthy food outlets that would be located within each geographic boundary.

## Supplemental Appendix 2. Components of the AHRQ SES Index

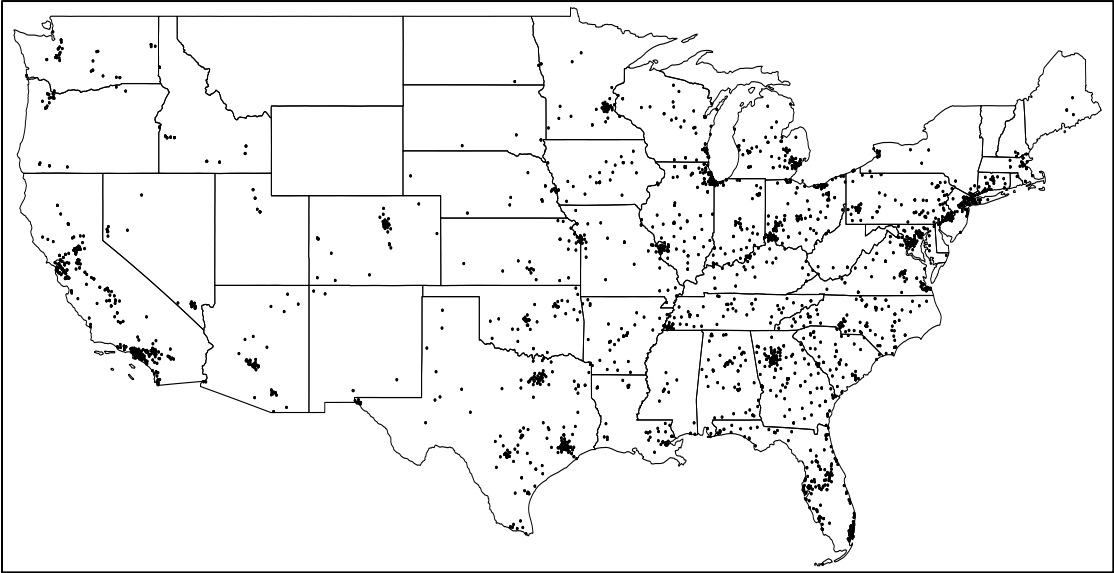
Variable	Definition
crowded	Percentage of households containing one or more person per room
Prop100	Median value of owner-occupied values standardized to range from 0 to 100
Pct_poverty	Percentage of persons below the federally defined poverty line
Hhinc100	Median household income standardized to range from 0 to 100
High_educ	Percentage of persons aged $\geq 25$ years with at least 4 years of college
Low_educ	Percentage of persons aged $\geq 25$ years with less than a 12 <sup>th</sup> -grade education
Pct_unemp	Percentage of persons aged 16 years or older in the labor force who are unemployed (and actively seeking work)

Final formula for calculation of SES Index Score:

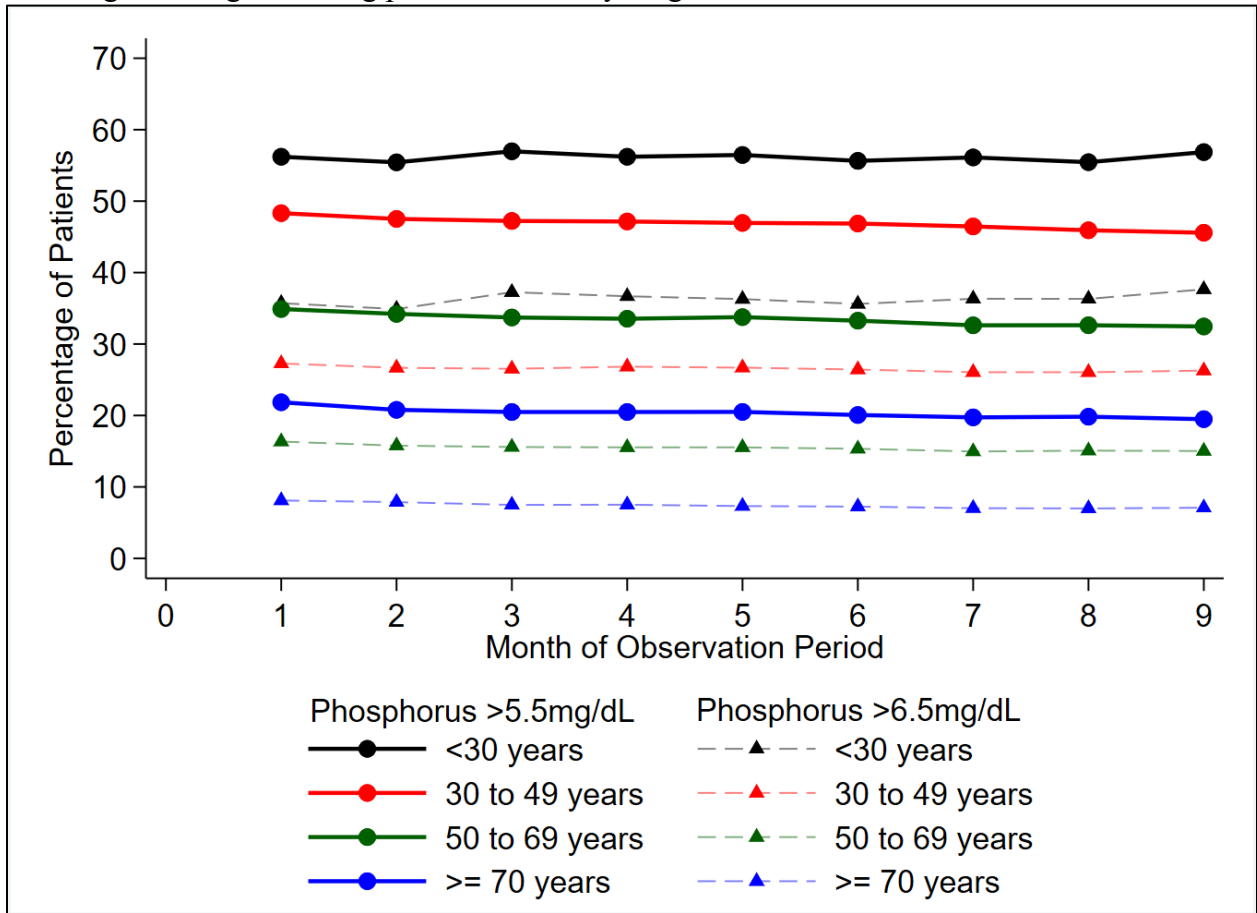
$$\text{SES Index Score} = 50 + (-0.07 * \text{crowded}) + (0.08 * \text{prop100}) + (-0.10 * \text{pct\_poverty}) + (0.11 * \text{hhinc100}) + (0.10 * \text{high\_educ}) + (-0.11 * \text{low\_educ}).$$

AHRQ: Agency for Healthcare Related Quality; SES: Socio-economic status

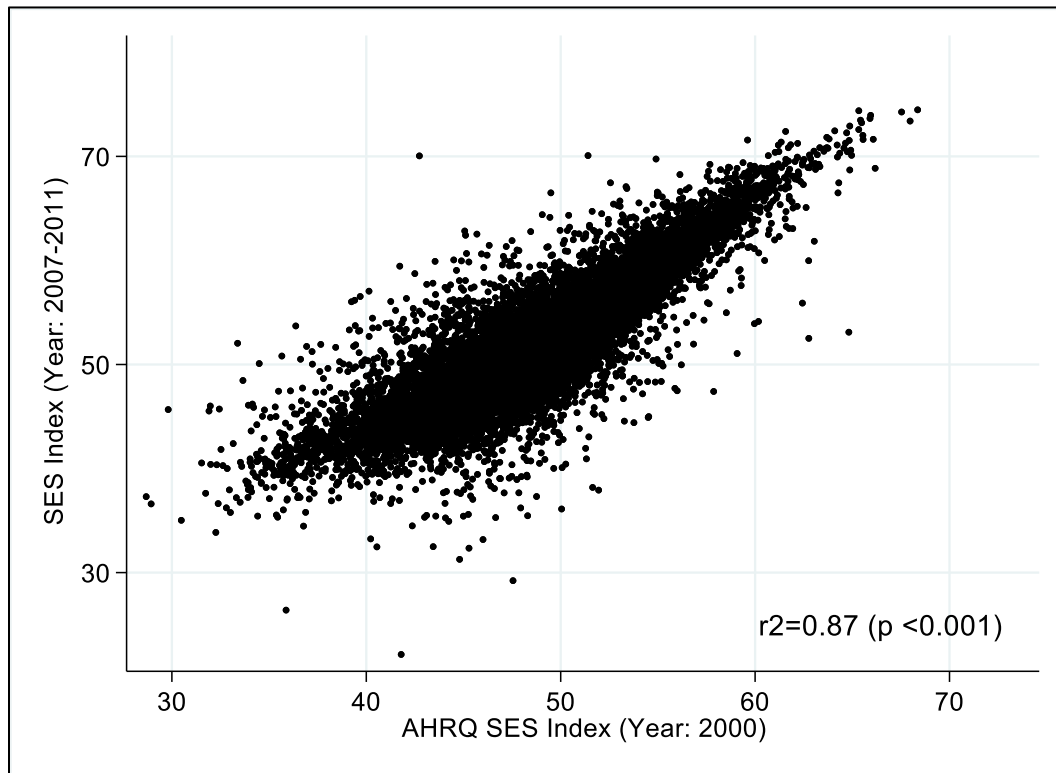
**Supplemental Figure 1.** Geographic distribution of dialysis units included in the final cohort



**Supplemental Figure 2.** Proportion of patients with a serum phosphorus greater than 5.5mg/dL or 6.5mg/dL is higher among patients who are younger



**Supplemental Figure 3.** Correlation between AHRQ SES Index from US census data from year 2000 and SES Index calculated using US American Community Survey census data from years 2007-2011



AHRQ: Agency for Healthcare Research and Quality; SES: Socioeconomic status

**Supplemental Table 1.** Availability of healthy and less-healthy food outlets in the neighborhood of the dialysis unit

	Socioeconomic Status Index Quartile				All	p-value
	Lowest	Medium Low	Medium High	Highest		
Number of Dialysis Units	667	485	444	562	2158	n/a
Access to Food Outlets Near Dialysis Units						
Healthy within 1km (median, (IQR))	1 (0, 2)	0 (0, 1)	0 (0, 1)	1 (0, 1)	0 (0, 1)	<0.001
Less-healthy within 1km (median, (IQR))	1 (0, 3)	1 (0, 2)	1 (0, 2)	1 (0, 2)	1 (0, 2)	<0.001
Healthy within 10 min (median, (IQR))*	17 (6, 34)	12 (5, 21)	12 (6, 20)	18 (11, 26)	15 (7, 26)	<0.001
Less-healthy within 10 min (median, (IQR))*	41.5 (15, 82)	24 (10, 54)	26 (12, 50)	36 (21, 57)	32 (14, 61)	<0.001
Healthy within 15 min (median, (IQR))*	38 (10, 87)	21 (7, 52)	24 (10, 48)	42 (24.5, 66)	32 (12, 63)	<0.001
Less-healthy within 15 min (median, (IQR))*	97.5 (23, 212)	44 (15, 127)	50 (20, 120)	88.5 (42, 147)	69 (24, 151)	<0.001

\*Geographic boundary was estimated using driving time around each dialysis unit  
 IQR: Interquartile range

**Supplemental Table 2.** Correlation between zip code socioeconomic status for dialysis unit and patient home location

	<b>Dialysis Unit Zip code SES Index</b>				
	<b>Total</b>	<b>Low</b>	<b>Medium Low</b>	<b>Medium High</b>	<b>High</b>
<b>Patient Zip code SES Index</b>					
Lowest Quartile	82,847	<b>48,306</b>	14,050	9,202	11,289
(%)	100	<b>58.31</b>	16.96	11.11	13.63
Medium Low	52,155	9,076	<b>23,747</b>	9,840	9,492
(%)	100	17.4	<b>45.53</b>	18.87	18.2
Medium High	48,771	6,307	7,233	<b>22,179</b>	13,052
(%)	100	12.93	14.83	<b>45.48</b>	26.76
Highest Quartile	67,452	6,302	6,575	11,077	<b>43,498</b>
(%)	100	9.34	9.75	16.42	<b>64.49</b>
Total	251,225	69,991	51,605	52,298	77,331
(%)	100	27.86	20.54	20.82	30.78

SES: Socioeconomic stats



**Supplemental Table 3.** Individual components of the mixed effects linear model demonstrating the relationship between availability of healthy food outlets and serum phosphorus levels

Variable	Base Model	Base Model +	Base Model +	Base Model +	Base Model +
		Month +	Month +	Month +	Month +
			SES Index +	SES Index +	SES Index +
				Demographics	Demographics +
					Time updated variables
<b>Month on Dialysis</b>					
1st		Ref	Ref	Ref	Ref
2nd		-0.02498948	-0.0255204	-0.02719422	-0.02838339
(SE)		0.0031233	0.00315279	0.00326138	0.00327236
(p-value)		0	0	0	0
3rd		-0.03505819	-0.03547476	-0.03943846	-0.04057377
(SE)		0.0031713	0.00320118	0.0033093	0.00332729
(p-value)		0	0	0	0
4th		-0.03979909	-0.03940712	-0.04310662	-0.04476543
(SE)		0.00321478	0.00324515	0.00335372	0.00337726
(p-value)		0	0	0	0
5th		-0.04212536	-0.04276891	-0.04698347	-0.04875381
(SE)		0.00325475	0.00328548	0.00339468	0.00342473
(p-value)		0	0	0	0
6th		-0.0587392	-0.05868269	-0.06370848	-0.06550525
(SE)		0.00329646	0.00332764	0.00343805	0.0034754
(p-value)		0	0	0	0
7th		-0.07578109	-0.07615327	-0.08302452	-0.08491457
(SE)		0.00333737	0.003369	0.00348092	0.00352601
(p-value)		0	0	0	0
8th		-0.07613521	-0.07621489	-0.08368326	-0.08564235
(SE)		0.00337629	0.00340819	0.00352148	0.00357271
(p-value)		0	0	0	0
9th		-0.08260489	-0.0832526	-0.09106041	-0.09324126
(SE)		0.00341571	0.00344767	0.0035624	0.00361787
(p-value)		0	0	0	0
<b>SES Index</b>					
Lowest Quartile			Ref	Ref	Ref
Medium Low			0.0013016	0.010332	0.01019952
(SE)			0.00808514	0.00783319	0.00783779
(p-value)			0.8721	0.1872	0.1931

Medium High			-0.03241927	-0.00103144	-0.00154273
(SE)			0.00824529	0.00805305	0.00805848
(p-value)			0.0001	0.8981	0.8482
Highest Quartile			-0.06293372	0.01684644	0.01484387
(SE)			0.00774875	0.00773305	0.00773949
(p-value)			0	0.0294	0.0551
<b>Patient Age (years)</b>				-0.0275492	-0.02758053
(SE)				0.00016848	0.00017008
(p-value)				0	0
<b>Sex (Female)</b>				-0.01336045	-0.01046363
(SE)				0.00487114	0.0049089
(p-value)				0.0061	0.033
<b>Race/Ethnicity (White)</b>				Ref	Ref
Black				-0.21784389	-0.21705395
(SE)				0.00646921	0.006484
(p-value)				0	0
Hispanic				-0.08230184	-0.08558283
(SE)				0.00807098	0.0080728
(p-value)				0	0
<b>Cause of ESRD</b>					
Glomerulonephritis				Ref	Ref
Diabetes				0.09238472	0.09238994
(SE)				0.00871269	0.00872227
(p-value)				0	0
Hypertension				0.08550395	0.08550118
(SE)				0.00920813	0.00921452
(p-value)				0	0
Cystic Disease				0.14206395	0.1371193
(SE)				0.01900603	0.01901992
(p-value)				0	0
Other				0.00371288	0.00581287
(SE)				0.01100277	0.01101629
(p-value)				0.7358	0.5977

<b>Treatments missed (per month)</b>					
Less than 2					Ref
2 to 3					-0.04299928
(SE)					0.00252063
(p-value)					0
4 or more					-0.09653973
(SE)					0.00327731
(p-value)					0
<b>Types of binders</b>					
None					Ref
One					0.0340024
(SE)					0.0031265
(p-value)					0
Two or more					0.02090001
(SE)					0.00501036
(p-value)					0
<b>Average time on dialysis (per month)</b>					
< = 3hrs					Ref
3 to 3hr 30min					0.00375084
(SE)					0.00643157
(p-value)					0.5598
3 hr 30 min to 3hr 45					-0.02688566
(SE)					0.00773732
(p-value)					0.0005
3hr 45 min to 4 hrs					0.03368687
(SE)					0.00870322
(p-value)					0.0001
> 4hrs					-0.00450615
(SE)					0.00857769
(p-value)					0.5994
<b>Model fit statistics</b>					
AIC	5097884.5	5096878.4	5006405.6	4547878.7	4523312.7
BIC	5097970.6	5097062.9	5006626.8	4548195.9	4523727.4

**Supplemental Table 4.** Individual components of the mixed effects linear model examining the relationship between neighborhood socioeconomic status index and serum phosphorus levels

<b>Variable</b>	<b>Base Model</b>	<b>Base Model + Month</b>	<b>Base Model + Month + Demographics</b>	<b>Base Model + Month + Demographics + Time updated variables</b>
<b>Month on Dialysis</b>				
1st Month		Ref	Ref	Ref
2 <sup>nd</sup>		-.02551857***	-.02719381***	-.02838266***
3 <sup>rd</sup>		-.03547308***	-.0394378***	-.04057262***
4 <sup>th</sup>		-.03940416***	-.04310576***	-.04476387***
5 <sup>th</sup>		-.04276538***	-.04698252***	-.04875208***
6 <sup>th</sup>		-.05867767***	-.06370749***	-.06550334***
7 <sup>th</sup>		-.07614822***	-.08302352***	-.08491256***
8 <sup>th</sup>		-.07620902***	-.08368223***	-.0856402***
9 <sup>th</sup>		-.08324641***	-.09105928***	-.09323895***
<b>Patient Age in Years</b>			-.02754958***	-.02758107***
<b>Sex Female</b>			-.0133321**	-.01043706*
<b>Race (White)</b>			Ref	Ref
Black			-.21764053***	-.21685135***
Hispanic			-.08207742***	-.08535633***
<b>Cause of ESRD</b>				
Glomerulonephritis			Ref	Ref
Diabetes			.0924107***	.09241313***
Hypertension			.08556085***	.08555246***
PKD/CAKUT			.14203708***	.13708397***
Other			0.0037326	0.00582409
<b>Missed Treatments</b>				
Less than 2				Ref
2 to 3				-.04299993***
>= 4				-.0965391***
<b>Phosphate Binders</b>				
None				Ref
One				.03399696***
Two or more				.0208914***
<b>Average time on dialysis (per month)</b>				
<= 3hrs				Ref
3 to 3hr 30min				0.00374759

3hr 30min to 3hr 45min				-.02690897***
3hr 45min to 4hrs				.03366741***
>= 4hrs				-0.00453741
<b>Model fit statistics</b>				
AIC	5007400.5	5006408.3	4547873.1	4523307
BIC	5007486.5	5006592.6	4548153.7	4523685.1

\*p-value <0.05, \*\* p-value <0.01, \*\*\* p-value <0.001

**Supplemental Table 5.** Mixed effects linear model examining the relationship between availability of healthy food outlets within 0.6 miles (1-kilometer) of a dialysis unit on serum phosphorus level

Variable	Base Model	Base Model +	Base Model +	Base Model +	Base Model +
		Month	Month +	Month +	Month +
			SES Index	SES Index +	SES Index +
				Demographics +	Demographics +
					Time updated variables
<b>Healthy Food Outlets</b>					
0	Ref	Ref	Ref	Ref	Ref
1	-0.0193343	-0.01941911	-0.02291469	-0.01439326	-0.01548812
>=2	0.02066761	0.02105125	0.01743946	0.01384047	0.01322588
<b>Dialysis Month (1st)</b>		Ref	Ref	Ref	Ref
2nd		-.02502844***	-.02560794***	-.02731356***	-.02858803***
3rd		-.03448579***	-.0349915***	-.03855586***	-.03988009***
4th		-.0395688***	-.03914714***	-.04233871***	-.04416002***
5th		-.04208611***	-.04282247***	-.04683518***	-.04877479***
6th		-.05894516***	-.05897273***	-.06374671***	-.06572291***
7th		-.07590521***	-.07633124***	-.08302341***	-.08509092***
8th		-.0756284***	-.07572451***	-.08321715***	-.08534253***
9th		-.08214508***	-.0827659***	-.09032044***	-.09263363***
<b>SES Index Quartile</b>					
Lowest			Ref	Ref	Ref
Medium Low			0.00377894	0.01125309	0.01109567
Medium High			-.03280737***	-0.00071872	-0.00133583
Highest			-.06206081***	.01896177*	.01708503*
<b>Patient Age in Years</b>				-.02758159***	-.02761683***
<b>Sex Female</b>				-.01463395**	-.01166064*
<b>Race (White)</b>				Ref	Ref
Black				-.21830686***	-.21767056***
Hispanic				-.0824861***	-.08581807***
<b>Cause of ESRD</b>					
Glomerulonephritis				Ref	Ref
Diabetes				.09237407***	.09222784***
Hypertension				.08542015***	.08527721***
PKD/CAKUT				.14181927***	.13716437***
Other				0.00300943	0.00495868
<b>Missed Dialysis Treatments</b>					
Less than 2					Ref

2 to 3					-.04283513***
>= 4					-.09701748***
<b>Phosphate Binders</b>					
None					Ref
One					.03439161***
Two					.02025365***
<b>Average Time on Dialysis</b>					
<= 3hrs					
3 to 3hr 30min					0.00395894
3hr 30min to 3hr 45min					-.02721621***
3hr 45min to 4hrs					.03412625***
>= 4hrs					-0.00388774
<b>Model fit statistics</b>					
AIC	5015316.3	5014331.1	4925078	4476649.9	4453454.9
BIC	5015390	5014503.1	4925286.6	4476954.5	4453856.8

\*p-value <0.05, \*\* p-value <0.01, \*\*\* p-value <0.001

**Supplemental Table 6** Mixed effects linear model examining the relationship between availability of less-healthy food within 0.6 miles (1-kilometer) of a dialysis unit on serum phosphorus level

Variable	Base Model	Base Model +	Base Model +	Base Model +	Base Model +
		Month	Month +	Month +	Month +
			SES Index	SES Index +	SES Index +
				Demographics +	Demographics +
					Time updated variables
<b>Healthy Food Outlets</b>					
0	Ref	Ref	Ref	Ref	Ref
1	0.0148622	0.01480685	0.00953397	-0.00024512	0.0001801
>=2	0.01665393	0.01706718	0.01057606	0.00426232	0.00491019
<b>Dialysis Month (1st)</b>		Ref	Ref	Ref	Ref
2nd		-.02502594***	-.02560477***	-.02731088***	-.02858528***
3rd		-.03448348***	-.03498827***	-.03855299***	-.03987721***
4th		-.03956523***	-.03914249***	-.04233475***	-.04415611***
5th		-.04208227***	-.0428175***	-.04683101***	-.04877073***
6th		-.05894139***	-.05896795***	-.06374288***	-.0657192***
7th		-.07590116***	-.07632603***	-.08301904***	-.08508672***
8th		-.07562441***	-.07571924***	-.08321286***	-.08533839***
9th		-.08214074***	-.08276022***	-.09031583***	-.09262929***
<b>SES Index Quartile</b>					
Lowest			Ref	Ref	Ref
Medium Low			0.00370916	0.0111676	0.01103975
Medium High			-.03284652***	-0.00088297	-0.00145242
Highest			-.06184137***	.01901658*	.01718791*
<b>Patient Age in Years</b>				-.02758222***	-.02761739***
<b>Sex Female</b>				-.01464688**	-.0116684*
<b>Race (White)</b>				Ref	Ref
Black				-.21827226***	-.21765681***
Hispanic				-.08218331***	-.08554848***
<b>Cause of ESRD</b>					
Glomerulonephritis				Ref	Ref
Diabetes				.09235839***	.09220371***
Hypertension				.08545234***	.08529812***
PKD/CAKUT				.14186628***	.13721027***
Other				0.00301957	0.00496629
<b>Missed Dialysis Treatments</b>					
Less than 2					Ref
2 to 3					-.04284194***



>= 4						-.09702495***
<b>Phosphate Binders</b>						
None						Ref
One						.03439073***
Two						.02026476***
<b>Average Time on Dialysis</b>						
<= 3hrs						Ref
3 to 3hr 30min						0.00387938
3hr 30min to 3hr 45min						-.02726724***
3hr 45min to 4hrs						.03411074***
>= 4hrs						-0.00381439
<b>Model fit statistics</b>						
AIC	5015322	5014337	4925085.4	4476654.5		4453459.6
BIC	5015395.7	5014509	4925294	4476959.1		4453861.6

\*p-value <0.05, \*\* p-value <0.01, \*\*\* p-value <0.001