and to evaluate, beyond urea, the adequacy of treatments in terms of MM removal. Moreover, eKt/V\textsubscript{2-M} could be used as an input for equations to be developed to account for the effects of GFR and different dialysis schedules.

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References

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Standard Kt/V thresholds to accurately predict single-pool Kt/V targets for children receiving thrice-weekly maintenance haemodialysis

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Abstract

**Background.** Urea standard Kt/V (stdKt/V) provides a tool to normalize weekly small solute clearance for patients dialysed at various intervals, but it has not been studied in the paediatric haemodialysis (HD) population.
Methods. Using retrospective monthly adequacy data from children with end-stage renal disease receiving chronic thrice-weekly haemodialysis (n = 30), single-pool (spKt/V), equilibrated (eKt/V) and standard Kt/V (stdKt/V) were calculated for each individual HD session. eKt/V was estimated using Goldstein’s logarithmic extrapolation method. Standard Kt/V was calculated using Leypoldt’s formula based on eKt/V, duration and dialysis frequency. A spKt/V vs stdKt/V dose/frequency table was then derived from our thrice-weekly data.

Results. Using spKt/V of ≥1.2 as the minimal acceptable HD dose, receiver operating characteristic curve analysis was used to determine the corresponding target stdKt/V across a number of potential cutoff values. Single-pool Kt/V ≥1.2 was delivered with near certainty [sensitivity: 93.5%, specificity: 96.7%, area under the curve (AUC): 0.98] when a stdKt/V ≥2.0 was targeted. For a spKt/V ≥1.4, a target of stdKt/V ≥2.2 provided sensitivity and specificity of 73.4 and 96.1%, respectively, with an AUC of 0.94.

Conclusions. Our data demonstrate that one should deliver a stdKt/V ≥2.0 for thrice-weekly paediatric HD in order to achieve a spKt/V ≥1.2; and if one wishes to ensure a spKt/V ≥1.4, then the stdKt/V must be ≥2.2. For children receiving a spKt/V ≥1.6 more than thrice weekly, the currently published adult dose/frequency table will overestimate the stdKt/V dose delivered and should be replaced by paediatric derived values.

Keywords: adequacy; equilibrated Kt/V; haemodialysis; single-pool Kt/V; standard Kt/V

Introduction

Current National Kidney Foundation’s Kidney Disease Outcomes Quality Initiative (K/DOQI) guidelines and clinical practice recommendations suggest single-pool Kt/V (spKt/V), calculated monthly via urea kinetic modelling or Daugirdas’s second-generation natural logarithm formula, be used to monitor delivered haemodialysis (HD) dose [1]. For patients receiving thrice-weekly HD, K/DOQI recommends prescribing a target dose of ≥1.4 to ensure delivery of spKt/V ≥1.2 per session [1].

Currently, the only randomized control trial validated outcome measure for adult thrice-weekly haemodialysis is spKt/V [2,3]. All other methods of estimating dialysis dose are based on mathematical modelling from the underlying spKt/V values, and any outcomes based on these metrics, e.g. eKt/V, are assumed to map directly back to the underlying spKt/V values from which they were created.

Unfortunately, spKt/V overestimates the true dialysis dose delivered by failing to account for post-dialysis urea rebound. This is of particular relevance in children, on the basis of different nutritional requirements and greater metabolic rates. Moreover, as children demonstrably require more efficient dialysis (weight for weight) [4,5], they may be disadvantaged by estimates of a dialysis dose that fails to account for urea rebound.

Double-pool kinetic modelling, represented by the concept of equilibrated Kt/V (eKt/V), addresses urea rebound by incorporating an equilibrated BUN (eqBUN) value drawn at 60 min post-dialysis, when urea rebound is nearly complete, making eKt/V a more accurate reflection of the ‘true’ urea mass removed by haemodialysis [6–8]. However, the need to wait for a 60-min post-dialysis BUN sample is inconvenient for patients and dialysis staff, rendering this ‘gold standard’ measurement impractical. The need for a more practical tool to estimate HD dose led to the development of several adult-derived formulae to estimate equilibrated Kt/V based on spKt/V and 30-s post-dialysis BUN values [8–11].

In children on HD, Goldstein derived and validated a logarithmic extrapolation equation for estimating equilibrated BUN (estBUN, from which eKt/V is calculated using a 30-s and 15-min post-dialysis [12]). This method compares favourably to the 60-min equilibrated Kt/V, with a mean absolute difference of only 3.4 ± 2.3% [12].

As correction for urea rebound post-dialysis does not eliminate the effect of intermittence (frequency) on solute disequilibrium and dialysis efficiency, neither spKt/V nor eKt/V is validated as a measure of adequacy in frequent HD (more than three sessions per week). In adults, the approach for addressing this issue is to calculate a weekly urea ‘standard’ Kt/V (stdKt/V), which normalizes and expresses the dose of haemodialysis independent of frequency, duration or modality [13]. More precisely, stdKt/V is defined as the weekly continuous urea clearance (normalized for continuous treatment and urea distribution volume) that would achieve a constant blood urea concentration identical to the mean pre-dialysis urea concentration for a given haemodialysis session [14]. In the most recent guidelines, KDOQI defines a weekly stdKt/V ≥2.0 as being acceptable in adults on thrice-weekly HD [1], and stdKt/V has recently been chosen as one adequacy metric in two current large multicenter randomized trials conducted by the Frequent Hemodialysis Network [15]. In paediatrics, addressing the intermittency issue and urea rebound has taken on increasing significance as the value of more frequent or intense HD, with benefits for growth, nutrition, fluid management and quality of life, is better recognized [16–19] and as more children are being prescribed such therapies.

The primary aim of this retrospective cross-sectional study of conventional thrice-weekly haemodialysis was to determine the paediatric equivalent minimum and target urea stdKt/V doses required to ensure achievement of the minimum goals of a spKt/V dose of ≥1.2 and target dose of ≥1.4. Our secondary aim was to derive a single-pool vs stdKt/V dose frequency table from patient data to facilitate the performance of, and comparison between, paediatric dialysis outcome studies across a variety of dialysis dosing regimens/frequencies.

Materials and methods

All patients (n = 30) had end-stage renal disease (ESRD) and were receiving maintenance thrice-weekly haemodialysis for >60 days at the Texas Children’s Hospital Renal Dialysis Unit in Houston, Texas. Patients ranged in age from 9.25 to 25.5 years. Monthly adequacy data were collected between January 2006 and September 2007. The primary dis-
cases leading to ESRD were dysplasia/obstructive uropathy (n = 8), sickle cell disease (n = 1), systemic lupus erythematos (n = 3), focal segmental glomerulosclerosis (n = 9), pANCA vasculitis (n = 1), autosomal recessive polycystic kidney disease (n = 1), IgA nephropathy (n = 1), immune complex glomerulonephritis (n = 3), Alport syndrome (n = 2) and Goodpasture’s disease (n = 1). The distribution of vascular access was central venous catheter (n = 12), arterio-venous fistula (n = 17) and arterio-venous graft (n = 1). Complete data were available from 398 sessions to calculate adequacy measures (median 17 data sets per patient, range 1–21). Median patient target dry weight was 46.9 kg (range 21.6–99.1 kg). Duration of individual dialysis sessions ranged from 3 to 4.5 h (median 3.3 h), with the majority between 3 and 3.5 h (346/398).

Blood sampling protocols
The first post-HD blood sample was obtained using the slow flow method as recommended by K/DOQI, i.e. dialysate flow was turned off and blood pump speed decreased to 50 mL/min prior to the sample being drawn at 30 s. Patients were then disconnected from the dialyzer; needles (for permanent access) were left in situ with heparinized saline, flushed and accessed as per unit policy at exactly 15 min for the second blood sample. Samples were sent to and analysed at the routine clinical laboratory (Spectra Laboratories, Fremont, CA).

Formulae of interest for dialysis adequacy

**Single-pool Kt/V**
SpKt/V was calculated using the natural logarithm formula of Daugirdas II [20], which has been validated in children [21].

Equation I

\[
spKt/V = -\ln \left( \frac{C1}{C0} - 0.008 \ast t \right) + \left( 4 - 3.5 \ast \frac{C1}{C0} \right) \ast \frac{UF}{W}
\]

where \(C0\) is pre-dialysis BUN (in milligrams per decilitre), \(C1\) is the post-dialysis BUN (in milligrams per decilitre), \(t\) is session length in hours, \(UF\) is the ultrafiltrate in kilograms and \(W\) is post-dialysis weight in kilograms. In this formula, \(C1\) is substituted by the measured BUN30sec.

**Equilibrated Kt/V**
An equilibrated BUN was estimated (estBUN) using a method of logarithmic extrapolation of the post-dialysis BUN increase from a measured BUN30sec to BUN15min as previously described by Goldstein [12].

Equation II

\[
estBUN = \left( \frac{BUN_{30min} - BUN_{30sec}}{0.69} \right) + BUN_{30sec}
\]

The equilibrated Kt/V (Goldstein eKt/V) was then calculated by substituting the value of estBUN for \(C1\) in the Daugirdas II equation for spKt/V.

Equation III

\[
eKt/V \text{ (Goldstein)} = -\ln \left( estBUN/C0 - 0.008 \ast t \right) + \left( 4 - 3.5 \ast \frac{estBUN}{C0} \right) \ast \frac{UF}{W}
\]

**Standard Kt/V**
As proposed by Leyboldt, the stdKt/V was calculated as [14]:

Equation IV

\[
stdKt/V = 168 \ast \left[ 1 - \exp\left( -eKt/V \ast t \right) / \left( 1 - \exp\left( -eKt/V/spKt/V \right) \right) + 168 / (N \ast t) - 1 \right]
\]

where \(t\) is the duration in hours and \(N\) is the number of sessions per week. In this study, we followed the adult conventions for eKt/V vs spKt/V substitutions in the equation [1,22].

Other calculations

Percentage of urea rebound (%UR) was calculated (using estBUN as representative of BUN60min) as:

Equation V

\[
%UR = 100 \ast \left( estBUN - BUN_{30sec} \right) / BUN_{30sec}
\]

Percent ultrafiltration fraction (%UFF) was calculated as:

Equation VI

\[
%UFF = 100 \ast \left( \text{pre–treatment weight} - \text{post–treatment weight} \right) / \text{post–treatment weight}
\]

Statistical analysis

Having pre-specified, as per K/DOQI, the minimum and target doses of spKt/V to be ≥1.2 and ≥1.4, respectively, we used receiver operating characteristic (ROC) curve analysis to compare these values against a variety of stdKt/V cutoffs in order to determine an equivalent minimum and target stdKt/V dose. Two ROC curves were constructed utilizing a range of stdKt/V cutoffs (1.90–2.30 in 0.05 increments) as predictors of a spKt/V ≥1.2 and ≥1.4. Note that these stdKt/V cutoffs were selected to cover the range of potential values based on an adult nomogram [22]. The stdKt/V value identified by the apex point (X) of each ROC curve represents the best combination of sensitivity and specificity for having achieved the spKt/V value of interest, i.e. minimum (Figure 2; ≥1.2) and target (Figure 3; ≥1.4). Area under the curve (AUC) was reported for each of the ROC curves and is representative of the prediction accuracy of stdKt/V in relation to spKt/V.

Next, using all 398 dialysis sessions, we rank ordered the data based on spKt/V, rounded to one decimal point (range 0.9–2.0). For each 0.1 unit of spKt/V, we individually applied Leyboldt’s stdKt/V equation [Equation IV] to all individual sessions that delivered this dose and then averaged those stdKt/V values. By substituting an ascending value for \(N\) (number of sessions) in Equation IV, we were then able to extend our data to predict values for each 0.1 unit of spKt/V at two to seven dialysis sessions per week.

Results

The following results are based on analysis of 398 HD sessions. Mean spKt/V was 1.50 ± 0.20 (range 0.9–2.0), with spKt/V ≥1.2 achieved in 378 (94.9%) of dialysis sessions and spKt/V ≥1.4 achieved in 279 (70.1%) of sessions. Mean eKt/V was 1.23 ± 0.17 and ranged from 0.77 to 1.80, whereas the mean stdKt/V was 2.18 ± 0.16 with a range of 1.66–2.59. Mean %UR post-dialysis was 22.5 ± 10.7% (range 5.4–66.9%), and mean %UFF was 4.2 ± 2.4% (range 0–12.5%).

Standard Kt/V was similar across vascular access type (arterio-venous fistula or arterio-venous graft vs central venous catheter) in terms of mean (2.19 vs 2.15), median (2.20 vs 2.16) and range (1.66–2.59 vs 1.66–2.53). Standard Kt/V was also plotted against post-dialysis weights in 20-kg increments and revealed similar distributions across the 20–40-, 40–60- and 60–80-kg subgroups but a significantly lower stdKt/V mean (2.09) in the 80–100-kg group revealed by one-way ANOVA and Tukey’s HSD (honestly significant differences) test at the alpha 0.05 level (Figure 1). Lastly, stdKt/V and %UR were compared across the range of session durations (3–3.5 vs 3.6–4 vs ≥4 h) and demonstrated slightly higher mean and median stdKt/
V and lower %UR values as session duration increased (Table 1).

**Standard Kt/V thresholds to achieve single-pool Kt/V targets**

A stdKt/V cutoff of ≥2.0 provided the optimal combination of sensitivity (93.5%) and specificity (96.7%) to ensure the minimum goal of spKt/V of ≥1.2 was achieved with an AUC of 0.98 (Figure 2). In a separate analysis, stdKt/V ≥2.2 offered the best combination of sensitivity (73.4%) and specificity (96.1%) to ensure that a target dose of spKt/V of ≥1.4 was achieved with an AUC of 0.94 (Figure 3).

**Single-pool vs standard Kt/V dose/frequency table**

Table 2 represents the extrapolation of stdKt/V values across a variety of dialysis frequencies and was derived from actual patient sessions as above. The number of sessions upon which the value in each cell is based is provided and the form of the table mirrors that used by Daugirdas [22].

Table 3 represents the percentage age difference of stdKt/V units between the paediatric and adult tables in the range of spKt/V delivered in our population. For spKt/V between 1.0 and 1.5 and at a frequency of equal to or greater than six times per week, the values differ ≤10% with the paediatric values generally lower. However, for any dialysis doses equal to or greater than spKt/V 1.6 delivered more than thrice weekly, this relationship fails to hold with paediatric values ranging from 10.1 to 55.8% lower.

**Discussion**

While this paper is written with the paediatric HD population in mind, it is important to realize that the standard Kt/V model, first described by Frank Gotch in 1998 [23], is applicable to all forms of renal replacement therapy and offers the unique ability to standardize urea (small solute) clearance across continuous and intermittent dialysis modalities with varying frequencies and durations [11,13]. (Readers interested in the theoretical derivation of stdKt/V would benefit from reviewing references 11, 13, 14 and 23 in greater detail.)

At its most basic, stdKt/V represents the total weekly urea clearance provided by renal function, dialysis or a combination, which is then normalized to the patient’s total body water (volume of distribution of urea). If one presumes a normal urea clearance of 45 mL/min and a total body water volume of 35 L, one can calculate that in 7 days—or 10 800 min—a total of 12.96 volumes of urea clearance for every litre of body water will be achieved, which has been called the reference stdKt/V [23]. This form of calculation can be utilized directly in continuous forms of dialysis where the deli-
very of urea clearance occurs without interruption, e.g. continuous ambulatory peritoneal dialysis or continuous forms of haemofiltration or haemodiafiltration. For intermittent forms of clearance, e.g. intermittent haemodialysis, mathematical modelling and a number of assumptions about the delivery of each dialysis dose allow for the conversion of urea concentrations pre- and post-dialysis into a theoretical steady-state urea concentration, which can then be used to predict the continuous urea clearance that would be required to achieve such a concentration.

Complexities aside, and with the knowledge that each form of urea clearance (residual renal, continuous or intermittent) is additive when converted to a weekly normalized value, one can appreciate that comparisons of dose delivered has now become possible. This dose may then be expressed as either a ‘percent’ of the reference stdKt/V, i.e. percent of normal renal clearance replaced, or as an absolute number that will be equivalent across modalities, thus facilitating dosing and comparisons in terms of outcomes based on dose of clearance provided.

Because this study represents the first assessment of stdKt/V in paediatric HD, our initial objective was to establish equivalent stdKt/V values in comparison to validated outcome measures in thrice-weekly HD patients, e.g. K/DOQI spKt/V targets.

Based on our results, delivering a stdKt/V of ≥2.0 offers the best assurance of achieving spKt/V ≥1.2 in any given dialysis session, whereas in order to ensure delivery of this dose in every session, a higher stdKt/V of >2.2 should be delivered.

Of interest, although the stdKt/V distribution was similar across access types and the majority of weight groups, we did note a significantly lower stdKt/V, mean of 2.09, in the 80–100-kg group (Figure 1). We postulate that this may be due to local HD prescriptive limits that included a maximal duration of 4.5 h and blood flow of 400 mL/min, which inescapably led to lower stdKt/V values in patients with larger volumes of distribution. With respect to session duration, there was a positive trend towards a higher stdKt/V with longer treatment times, as originally noted by Gotch [23] (Table 1). This observation is supported in a previous study by Eloot et al., who demonstrated that total clearance of urea increased significantly by prolonging session lengths (4 vs 6 vs 8 h, P < 0.05 across groups) [24]. Finally, our observation, of a slight decrease in percent urea rebound as session duration increased (Table 1), is supported in part by the same study, stating that prolonged dialysis leads to attenuated post-dialysis urea rebound through more efficient sol

Table 1. Standard Kt/V and % urea rebound across dialysis duration

<table>
<thead>
<tr>
<th>HD duration</th>
<th>Number of sessions</th>
<th>Mean stdKt/V ± SD</th>
<th>Mean % rebound ± SD</th>
<th>Median stdKt/V</th>
<th>Median % rebound</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0–3.5 h</td>
<td>346</td>
<td>2.17 ± 0.16</td>
<td>22.9 ± 11.2</td>
<td>21.5</td>
<td>19.8</td>
</tr>
<tr>
<td>3.6–4.0 h</td>
<td>39</td>
<td>2.25 ± 0.16</td>
<td>19.9 ± 7.3</td>
<td>19.8</td>
<td>19.3</td>
</tr>
<tr>
<td>&gt;4 h</td>
<td>13</td>
<td>2.25 ± 0.14</td>
<td>18.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Standard Kt/V values for a given spKt/V delivered at varied dialysis frequencies

<table>
<thead>
<tr>
<th>spKt/V</th>
<th>Frequency of dialysis (sessions per week)</th>
<th>Data points used/cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>2×</td>
<td>1</td>
</tr>
<tr>
<td>1.0</td>
<td>3×</td>
<td>4</td>
</tr>
<tr>
<td>1.1</td>
<td>4×</td>
<td>15</td>
</tr>
<tr>
<td>1.2</td>
<td>5×</td>
<td>30</td>
</tr>
<tr>
<td>1.3</td>
<td>6×</td>
<td>69</td>
</tr>
<tr>
<td>1.4</td>
<td>7×</td>
<td>62</td>
</tr>
<tr>
<td>1.5</td>
<td>8×</td>
<td>29</td>
</tr>
<tr>
<td>1.6</td>
<td>9×</td>
<td>17</td>
</tr>
<tr>
<td>1.7</td>
<td>10×</td>
<td>3</td>
</tr>
<tr>
<td>1.8</td>
<td>11×</td>
<td>2</td>
</tr>
</tbody>
</table>

Fig. 3. Single-pool Kt/V ≥1.4 against standard Kt/V at various cutoffs.
ute removal from deeper compartments of the body [24]. However, our observed trends related to dialysis duration should be viewed cautiously in light of the small number of HD sessions >3.5 h.

The secondary aim of this study was to derive a paediatric single-pool vs standard Kt/V dose/frequency table as per Daugirdas’ Table A-7 [22]. The Daugirdas approach relies on empirical data and assumptions in order to calculate an eKt/V from which to determine its stdKt/V values. These include a minimum session length of 120 min for any spKt/V between 0.1 and 0.8, delivery of K/V of 0.4 units/h for all spKt/V ≥0.8 and the validity of Tattersall equation for post-dialysis rebound in sessions ≥150 min [9].

Despite the differing populations, and the empirical (Daugirdas) vs patient-derived (current study) approaches taken, we present the data in Table 3 to highlight the importance of deriving paediatric specific values for such dialysis dose/frequency conversions. While a <10% discrepancy in stdKt/V values exists between Daugirdas’ values and our own in the range of spKt/V 1.0–1.5, fully a third of our patients (131/398 sessions) achieved a spKt/V ≥1.6; and in this group at a dialysis frequency of more than thrice weekly, the adult table predicts a significantly higher stdKt/V value as being delivered, an error that could affect prospective dialysis dosing studies based on stdKt/V, leading to significant underdosing for children and invalidate dose comparisons between paediatric studies who dosed based on the adult vs paediatric tables.

Our study does have a number of limitations. While urea is the most commonly used marker of dialysis adequacy, one major limitation of all urea-based adequacy models is failing to account for other uraemic toxins. We know little about how the clearance of these so-called middle molecules (e.g. D-amino acids, guanidines and protein-bound solutes) affects morbidity and mortality in the dialysis population.

We did not have a true 60-min ‘gold standard’ urea for the calculation of eKt/V. Instead, we have used a previously validated paediatric formula to derive an estimated BUN [12]. The concept of the 60-min BUN, or a derived surrogate of it, as the gold standard for estimating urea clearance and/or use in dose formulae that were not derived from high frequency/intensity dialysis regimens might also be questioned. A seminal paper by Pedrini et al. demonstrates equilibration at 48 but not 60 min [6]. Also, other factors commonly modified in frequent dialysis regimens such as blood flow, dialysate bath composition, temperature or flow might all contribute to differences in urea equilibration compared to conventional thrice-weekly schedules, and potentially invalidate the use of current urea kinetic models and equations in this population.

Leypoldt’s stdKt/V formula assumes a symmetric weekly schedule of dialyses, no residual renal function and a fixed volume of distribution of urea [14], and these assumptions may not remain true in a growing child and/or one who is receiving HD four, five or six times per week. Finally, Leypoldt’s formula for calculating stdKt/V was originally based on a single-pool model of urea kinetics using a 30-s post-BUN value [14], and our analysis involved more complex kinetics utilizing an equilibrated BUN based on a double-pool model and 15-min post-dialysis BUN samples. However, since we chose to use a more accurate method of Kt/V estimation, based on a 15-min post-BUN, this should minimize any errors in these calculations [12].

In conclusion, we suggest that the stdKt/V target dose for thrice-weekly paediatric HD be set at 2.2 to ensure meeting or exceeding the minimal goal of a stdKt/V ≥2.0. Our proposed paediatric stdKt/V target is higher than the currently recommended adult target of ≥2.0, but the need for a higher target in children appears to be supported by a recent adult study. In this paper, a re-analysis of data from the HEMO study, in which stdKt/V was calculated and then corrected for body surface area, suggested that target stdKt/V should be set higher in women and smaller patients [25]. We suggest, as have the National Institutes of Health-sponsored Frequent HD Network for adults [15,26], that stdKt/V become the frequency-normalized expression to monitor and control for delivered haemodialysis doses in future studies of paediatric HD patient outcomes. Future studies validating the concept and thresholds for stdKt/V should compare hard outcomes, both morbidity and mortality, in patients randomized to a variety of achievable targets within a given modality, e.g. short daily HD, and between modalities, e.g. short daily vs nocturnal HD.

Acknowledgements. We would like to acknowledge the nursing staff, patients and families at Texas Children’s Hospital, Houston, Texas for their

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Table 3. Percent difference between paediatrica and adultb stdKt/V across dialysis dose and frequency

<table>
<thead>
<tr>
<th>spKt/V</th>
<th>2x</th>
<th>3x</th>
<th>4x</th>
<th>5x</th>
<th>6x</th>
<th>7x</th>
<th>Paediatric data points/spKt/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>12.3%</td>
<td>18.2%</td>
<td>25.0%</td>
<td>31.8%</td>
<td>39.4%</td>
<td>46.1%</td>
<td>1</td>
</tr>
<tr>
<td>1.0</td>
<td>2.2%</td>
<td>−4.4%</td>
<td>−5.1%</td>
<td>−5.8%</td>
<td>−6.4%</td>
<td>−6.8%</td>
<td>4</td>
</tr>
<tr>
<td>1.1</td>
<td>2.1%</td>
<td>3.3%</td>
<td>4.7%</td>
<td>6.2%</td>
<td>8.0%</td>
<td>9.9%</td>
<td>15</td>
</tr>
<tr>
<td>1.2</td>
<td>2.5%</td>
<td>4.0%</td>
<td>5.7%</td>
<td>6.7%</td>
<td>9.0%</td>
<td>9.0%</td>
<td>30</td>
</tr>
<tr>
<td>1.3</td>
<td>0.1%</td>
<td>0.1%</td>
<td>−0.6%</td>
<td>0.1%</td>
<td>−0.7%</td>
<td>0.0%</td>
<td>69</td>
</tr>
<tr>
<td>1.4</td>
<td>−1.3%</td>
<td>−1.4%</td>
<td>−2.9%</td>
<td>−3.9%</td>
<td>−4.3%</td>
<td>−6.0%</td>
<td>62</td>
</tr>
<tr>
<td>1.5</td>
<td>−2.0%</td>
<td>−3.3%</td>
<td>−4.9%</td>
<td>−7.0%</td>
<td>−9.3%</td>
<td>−11.0%</td>
<td>87</td>
</tr>
<tr>
<td>1.6</td>
<td>−3.8%</td>
<td>−7.3%</td>
<td>−10.1%</td>
<td>−14.0%</td>
<td>−18.2%</td>
<td>−22.5%</td>
<td>70</td>
</tr>
<tr>
<td>1.7</td>
<td>−5.0%</td>
<td>−7.9%</td>
<td>−10.8%</td>
<td>−14.9%</td>
<td>−20.0%</td>
<td>−26.0%</td>
<td>39</td>
</tr>
<tr>
<td>1.8</td>
<td>−7.4%</td>
<td>−12.2%</td>
<td>−18.1%</td>
<td>−24.0%</td>
<td>−31.7%</td>
<td>−40.2%</td>
<td>17</td>
</tr>
<tr>
<td>1.9</td>
<td>−4.9%</td>
<td>−8.0%</td>
<td>−13.0%</td>
<td>−19.0%</td>
<td>−25.9%</td>
<td>−34.5%</td>
<td>3</td>
</tr>
<tr>
<td>2.0</td>
<td>−9.6%</td>
<td>−16.0%</td>
<td>−23.3%</td>
<td>−33.4%</td>
<td>−43.2%</td>
<td>−55.8%</td>
<td>2</td>
</tr>
</tbody>
</table>

aValues from current paper, representing 398 dialysis sessions.
conflict to this study. This work was presented in part by C.M. at the 19th Annual Pediatric Dialysis Conference in Orlando, Florida, March 2008.

Conflict of interest statement. None declared.

References


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Physical exercise among participants in the Dialysis Outcomes and Practice Patterns Study (DOPPS): correlates and associated outcomes

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