

## SECTION SEVEN:

---

# Malnutrition

---

**Malnutrition is an important predictor of dialysis patient mortality. More frequent dialysis regimens have been shown to significantly increase patient appetite and important measures of nutrition such as albumin/pre-albumin levels, nPCR, protein intake, and lean body mass.**

## INTRODUCTION

Protein-energy malnutrition (PEM) is common in chronic renal failure patients, affecting 10% to 75% of patients receiving renal replacement therapy.<sup>104</sup>

Numerous studies have documented a strong association between malnutrition and increased morbidity and mortality in large cohorts of patients.<sup>104,105</sup> Serum prealbumin, a measure of improved nutrition, has been found to be useful for predicting mortality risk; prealbumin levels >30 mg/dL are associated with a significantly greater survival.<sup>106</sup>

Multiple factors contribute to malnutrition in ESRD patients. Kidney disease itself disrupts protein-energy metabolism and hormonal balance. Uremic toxins may depress appetite, cause anorexia, and reduce protein and energy intake. In addition, side effects of medications, dietary limitations, the dialysis process itself, and psychosocial factors related to ESRD may reduce appetite and enhance the production of inflammatory compounds that can impair nutritional status.

Malnutrition is often accompanied by chronic inflammation, and the two conditions adversely affect a number of physiological processes in the body. Chronic inflammation is known to play a role in the development of atherosclerosis, thereby contributing to cardiovascular disease.<sup>104</sup> A malnutrition-inflammation score (MIS) was found to correlate significantly with hospitalization and mortality as well as with measures of nutrition, inflammation, and anemia.<sup>107</sup>

<sup>104</sup>

## POTENTIAL BENEFITS OF MORE FREQUENT THERAPY

The potential benefits of more frequent therapy on nutrition are likely multifactorial. Whether through improved toxin removal or reductions in medications, dietary and fluid restrictions, and interdialytic symptoms, daily dialysis may increase appetite and improve overall patient status.

## **SUMMARY OF PUBLISHED RESULTS**

Both short daily and long nocturnal therapies appear to improve nutritional status. Patients frequently report feeling better and having an improved appetite. Nutrient intake may be improved because the daily dialytic removal of excess water, salts and toxins allows a more liberalized diet.<sup>2, 6</sup>

Several indicators of nutritional status increased significantly in many studies.

<b>Parameter Measured</b>	<b>Observations</b>
Serum prealbumin	Significant increase <sup>21, 23, 96, 108</sup>
Serum albumin	Significant increase <sup>8, 21, 23, 26, 46, 48, 80, 95, 96, 108-111</sup> Increased slightly or remained stable <sup>2, 5, 18, 56, 59, 61, 69, 76, 79, 100, 112 65, 66, 111</sup>
Protein/energy intake	Increase <sup>21, 22, 66, 69, 102, 108</sup>
nPCR	Significant increase <sup>22, 23</sup>
Dry weight/lean body mass	Significant increase <sup>96, 108, 113</sup>

# TABULATED STUDY RESULTS ON MALNUTRITION

Study & Design	Supporting Points
<p>Galland, R. Sem Dial. 2004; 17:104 <sup>96</sup></p> <p>Daily HD 17 pts; 3.25 yr Prospective</p>	<ul style="list-style-type: none"> <li>• Mean serum albumin increased from 40.2 ± 3.3 to 45.1 ± 4.1 g/L (p&lt;0.001)</li> <li>• Mean serum prealbumin increased from 0.32 ± 0.06 to 0.36 ± 0.09 g/L (p&lt;0.05)</li> <li>• Lean body mass increased from 47.7 ± 4.9 to 50.5 ± 6.2 kg (p&lt;0.05)</li> </ul>
<p>Jaber, BL. Blood Purif. 2004; 22:481 <sup>54</sup></p> <p>Daily HF 12 pts; 4 wk Prospective</p>	<ul style="list-style-type: none"> <li>• Mean serum prealbumin increased from 0.33 ± 0.05 to 0.378 ± 0.084 g/L (p=0.06)</li> <li>• Daily caloric intake increased on DHF to 2044 ± 564 kcal/day compared to 1778 ± 441 kcal/day on conventional HD (p=0.01)</li> <li>• PCR increased from 0.88±0.17 g/kg/day on conventional HD to 1.00±0.35 g/kg/day on DHF (p=0.05)</li> </ul>
<p>Lockridge Jr, RS. Hemodial Int. 2004; 8:61 <sup>9</sup></p> <p>Nocturnal HD 25 pts; 1-5 yr Prospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels increased from 3.9–4.1 mg/dL at baseline to 4.2–4.5 mg/dL after 1–5 years</li> </ul>
<p>Reynolds, JT. Blood Purif. 2004; 22:320 <sup>55</sup></p> <p>Daily HD 11 pts; 12 mo Prospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels did not change significantly (4.0 mg/dL at baseline to 3.9 mg/dL after 1 year)</li> </ul>
<p>Agar, JWM. Hemodial Int. 2003; 7:278 <sup>8</sup></p> <p>Nocturnal HD 10 pts; 3 mo Prospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels increased from 35.3 ± 0.9 to 38.3 ± 0.7 g/L (p&lt;0.02)</li> </ul>
<p>Lorch, J. J Am So Nephrol.2003; 14:232A <sup>65</sup></p> <p>Nocturnal HD 10 pts; 10-23 mo Prospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels increased from 40.3 to 45.9 g/L</li> </ul>

## Section 7: Malnutrition

<p>Rocco, MV. J Am Soc Nephrol. 2003; 14:502A<sup>102</sup></p> <p>Daily HD 18 pts; 8 mo Prospective</p>	<ul style="list-style-type: none"> <li>At 8 months patients on daily HD consumed more protein (96 g) and energy (2,337 kcal) than at baseline (68 g and 1,672 kcal) (<math>p &lt; 0.05</math>)</li> </ul>
<p>Spanner, E. Am J Kid Dis. 2003; 42:S30<sup>111</sup></p> <p>Daily HD 11 pts Nocturnal HD 12 pts; 1.5 yr Prospective</p>	<ul style="list-style-type: none"> <li>Serum albumin levels increased from <math>3.86 \pm 0.2</math> to <math>4.04 \pm 0.24</math> g/dL (<math>p &lt; 0.05</math>) during DHD</li> <li>Serum albumin levels decreased from <math>3.91 \pm 0.44</math> to <math>3.66 \pm 0.37</math> g/dL (<math>p &lt; 0.05</math>) during NHD (not significant)</li> <li>Serum prealbumin levels and lean body mass did not change significantly with DHD or NHD</li> </ul>
<p>Zimmerman, DL. ASAIO Journal. 2003; 49:426<sup>66</sup></p> <p>Daily HF 11 pts; 4 wk Prospective</p>	<ul style="list-style-type: none"> <li>Protein intake increased from 0.94 g/kg/day on conventional HD to 1.06 g/kg/day on daily hemofiltration.</li> <li>Serum albumin levels did not change significantly.</li> </ul>
<p>André, MB. Am J Nephrol. 2002; 22:473<sup>48</sup></p> <p>Daily HD 5 pts; 2 yr Prospective</p>	<ul style="list-style-type: none"> <li>Serum albumin levels increased from <math>4.1 \pm 0.4</math> to <math>4.3 \pm 0.3</math> g% (<math>p &lt; 0.05</math>)</li> </ul>
<p>Friedman, AN. J Am Soc Nephrol. 2002; 13:265<sup>109</sup></p> <p>Nocturnal HD 23 pts Conventional HD 31 pts Case-control</p>	<ul style="list-style-type: none"> <li>Serum albumin levels were higher (4.5 g/dL) in patients on nocturnal HD than patients on conventional HD (3.9 g/dL) (<math>p &lt; 0.001</math>)</li> </ul>
<p>Goffin, E. Kidney Int. 2002; 61:1909<sup>113</sup></p> <p>Daily HD 9 pts; 6 mo Prospective</p>	<ul style="list-style-type: none"> <li>Lean body mass increased from <math>47.2 \pm 3.9</math> to <math>48.5 \pm 4.2</math> kg (<math>p &lt; 0.008</math>)</li> </ul>

<p>Klarenbach, S. ASAIO J. 2002;48:57 <sup>79</sup></p> <p>Daily HD 7 pts Nocturnal HD 2 pts; 15 mo Case-control</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels did not change significantly between conventional HD (<math>39 \pm 1.8</math> g/L) and daily HD (<math>38 \pm 1.6</math> g/L) (<math>p &lt; 0.298</math>)</li> </ul>
<p>Fagugli, RM. Am J Kid Dis. 2001; 38:371 <sup>18</sup></p> <p>Daily HD 12 pts; 1 yr (6 mo random crossover)</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels did not change significantly between conventional HD (<math>3.9 \pm 0.6</math> g/dL) and daily HD (<math>4.0 \pm 0.2</math> g/dL)</li> </ul>
<p>Galland, R. Am J Kid Dis. 2001;37Suppl 2:S95 <sup>21</sup></p> <p>Daily HD 10 pts; 13-38 mo Prospective</p>	<ul style="list-style-type: none"> <li>• After starting daily HD, measurements of the following increased protein intake (<math>1.32 \pm 0.25</math> g/day/kg to <math>1.64 \pm 0.49</math> g/day/kg; <math>p = 0.031</math>); albumin (<math>38.5 \pm 3.44</math> g/L to <math>41.3 \pm 3.03</math> g/L; <math>p = 0.0165</math>); prealbumin (<math>0.33 \pm 0.05</math> g/L to <math>0.41 \pm 0.1</math> g/L; <math>p = 0.0097</math>); body mass index (<math>19.9 \pm 2.7</math> to <math>21.1 \pm 1.8</math>; <math>p &lt; 0.05</math>)</li> </ul>
<p>Galland, R. Kidney Int. 2001;60:1555 <sup>108</sup></p> <p>Daily HD 8 pts; 1 yr Prospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels increased from <math>39 \pm 2.6</math> g/L to <math>43 \pm 2.6</math> g/L (<math>p &lt; 0.01</math>) on short daily HD) and prealbumin levels increased from an average of <math>0.36 \pm 0.04</math> g/L to <math>0.42 \pm 0.1</math> g/L (<math>p &lt; 0.05</math>) after 1 year</li> <li>• Protein intake increased from <math>1.29 \pm 0.2</math> g/kg/L to <math>1.90 \pm 0.7</math> g/kg/L after 1 year (<math>p &lt; 0.05</math>)</li> <li>• Dry body weight increased by <math>4.2 \pm 2.8</math> kg at 1 year (<math>p &lt; 0.05</math>)</li> </ul>
<p>Lindsay, RM. ASAIO J. 2001;47:449 <sup>5</sup></p> <p>Daily HD 9 pts Nocturnal HD 10 pts; 1-18 mo Prospective; Case-control</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels did not change significantly between conventional HD (<math>38.4 \pm 3.6</math> g/L and <math>38.6 \pm 1.9</math> g/L) and nocturnal HD (<math>37.4 \pm 5.2</math> g/L) or daily HD (<math>40.8 \pm 1.7</math> g/L)</li> </ul>
<p>Lugon, JR. Sao Paulo Med J. 2001;119:105 <sup>95</sup></p> <p>Daily HD 5 pts; 2 yr Prospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels increased significantly (<math>4.3 \pm 0.3</math> g/dL vs. <math>4.1 \pm 0.4</math> g/dL) on daily HD compared to conventional HD (<math>p &lt; 0.05</math>)</li> </ul>

## Section 7: Malnutrition

<p>Traeger, J. Dial Transplant. 2001;30:76<sup>22</sup></p> <p>Daily HD 15 pts; 1 yr or more Prospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels increased from <math>38.1 \pm 5.2</math> g/L to <math>41 \pm 5.2</math> g/L (<math>p &lt; 0.01</math>)</li> <li>• Serum prealbumin levels increased from <math>0.32 \pm 0.06</math> g/L to <math>0.38 \pm 0.1</math> g/L (<math>p &lt; 0.05</math>)</li> <li>• PCR increased from <math>1.2 \pm 0.2</math> to <math>1.4 \pm 0.3</math> g/day/kg (<math>p &lt; 0.05</math>)</li> </ul>
<p>Vos, PF. Am J Kid Dis. 2001;37:S99<sup>76</sup></p> <p>Daily HD 11 pts; 18 mo Prospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin remained at 4.3 g/dL on both daily HD and conventional HD</li> </ul>
<p>Cacho, C. Nephrol News Issues. 2000;14:36<sup>2</sup></p> <p>Nocturnal HD 6 pts; 6 mo Prospective</p>	<ul style="list-style-type: none"> <li>• Patients reported increased appetite while albumin levels remained the same or increased</li> </ul>
<p>Pierratos, A. Nephrol Dial Transplant. 1999;14:2835<sup>6</sup></p> <p>Nocturnal HD 37 pts; 5 yr Prospective</p>	<ul style="list-style-type: none"> <li>• Patients reported an increase in appetite on an unrestricted diet</li> </ul>
<p>Pinciaroli, AR. Sem Dial. 1999;12:455<sup>26</sup></p> <p>Daily HD 22 pts; 1 yr Retrospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels increased from 3.5 to 4.26 g/dL (no std. dev. or p values given)</li> </ul>
<p>Woods, JD. Kid Int. 1999;55:2467<sup>46</sup></p> <p>Daily HD 72 pts; 1 yr Retrospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels increased from 3.88 g/dL on conventional HD to 4.35 g/dL on daily HD (<math>p &lt; 0.001</math>)</li> </ul>
<p>Mucsi, I. Kidney Int. 1998;53:1399<sup>100</sup></p> <p>Nocturnal HD 8 pts; 5 mo Prospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels did not change significantly between conventional HD (<math>42 \pm 0.7</math> g/L) and nocturnal HD (<math>42.1 \pm 1.0</math> g/L)</li> </ul>

<p>O'Sullivan, DA. Mayo Clin Proc. 1998;73:1035<sup>56</sup></p> <p>Nocturnal HD 5 pts; 8 wk Prospective</p>	<ul style="list-style-type: none"> <li>• Daily caloric intake increased by about 400 Cal after 2 months on nocturnal HD</li> <li>• Serum albumin levels did not increase significantly (<math>3.63 \pm 0.52</math> g/dL on conventional HD and <math>3.68 \pm 0.41</math> g/dL; <math>p &lt; 0.1</math>) but protein catabolic rate increased from <math>1.07 \pm 0.12</math> mg/day/kg to <math>1.27 \pm 0.2</math> mg/day/kg (<math>p &lt; 0.075</math>)</li> </ul>
<p>Pierratos, A. J Am Soc Nephrol. 1998;9:859<sup>69</sup></p> <p>Nocturnal HD 11 pts; 3 yr Prospective</p>	<ul style="list-style-type: none"> <li>• Many patients reported an increase in appetite</li> <li>• Serum albumin levels did not change significantly between nocturnal HD and conventional HD</li> <li>• Protein intake increased from <math>1 \pm 0.3</math> to <math>1.44 \pm 0.2</math> g/day/kg (<math>p = 0.009</math>)</li> </ul>
<p>Quintaliani, G. J Am Soc Nephrol. 1998;9:238A<sup>112</sup></p> <p>Daily HD 21 pts; 6 mo Prospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels and PCR did not increase significantly after 6 months</li> </ul>
<p>Ting, G. J Am Soc Nephrol. 1998;9:228A<sup>61</sup></p> <p>Daily HD 7 pts; 6 mo Prospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels did not change significantly</li> </ul>
<p>Traeger, J. Artif Org. 1998;22:558<sup>23</sup></p> <p>Daily HD 4 pts; 1 yr Prospective</p>	<ul style="list-style-type: none"> <li>• Daily caloric intake increased on daily HD: <math>40.8 \pm 4.5</math> kcal/kg compared to <math>33.0 \pm 2.25</math> kcal/kg on conventional HD (<math>p &lt; 0.05</math>)</li> <li>• PCR increased from <math>1.14</math> g/day/kg on conventional HD to <math>1.31</math> g/day/kg on daily HD (<math>p &lt; 0.038</math>)</li> </ul>
<p>Buoncrisiani, U. J Am Soc Nephrol. 1997;8:216A<sup>80</sup></p> <p>Daily HD 50 pts; 1 yr Retrospective</p>	<ul style="list-style-type: none"> <li>• Serum albumin levels increased from <math>3.9 \pm 0.5</math> g/dL on conventional HD (<math>p = 0.001</math>) to <math>4.4 \pm 0.4</math> g/dL on daily HD</li> </ul>

