## Nutrients Involved in the Wound Healing Process

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<tr>
<th>Nutrient</th>
<th>Function</th>
<th>Signs of Deficiency</th>
<th>DRI*</th>
<th>Recommendations for Wound Healing</th>
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</table>
| **Calories**<sup>1,2,3</sup> | • Spares protein for cellular and muscle maintenance and synthesis | • Decreased lean muscle mass  
• Decreased collagen synthesis  
• Protein-energy malnutrition | Not established | • Non-Obese: 30 to 35 kcal/kg/day  
(actual body weight)  
• Obese: 20 to 25 kcal/kg  
(actual body weight)  
• Predictive Equations (i.e., Harris Benedict, Ireton-Jones, or Mifflin, St. Jeor)  
• Indirect calorimetry (if available) |
| **Protein**<sup>4,5</sup> | • Neovascularization  
• Leukocyte formation  
• Fibroblast proliferation  
• Collagen synthesis  
• Platelet function | • Decreased collagen synthesis  
• Decreased tensile strength  
• Decreased T-cell function  
• Decreased phagocyte activity | 56 g  
(Men 19 to >70)  
46 g  
(Women 19 to >70) | • 1.2 to 1.5 g/kg/day  
• Up to 2.5 g/kg/day for severe wounds  
• 20% to 25% of total calories |
| **Arginine**<sup>6,7,8,9</sup> | • Collagen deposition  
• Supports immune response  
• Stimulates IGF-1 and nitric oxide synthesis  
• Stimulates T-cell function  
• Supports protein synthesis | During stress, endogenous synthesis may be inadequate, making arginine a conditionally essential amino acid. Inadequate intake may result in:  
• Decreased blood flow  
• Impaired wound angiogenesis, vasoconstriction  
• Decreased tensile strength and collagen accumulation | Not established | • Ideal dose is unknown  
• 2% of non-protein calories  
• Up to 30 g/day for up to one week has been tolerated |
| **Glutamine**<sup>10,11</sup> | • Major amino acid in muscle tissue  
• Primary fuel for fibroblasts, platelets, macrophages, and lymphocytes  
• Energy source for enterocytes  
• Stimulates release of human growth hormone  
• Precursor of nucleotides (RNA/DNA)  
• Stimulates early inflammatory and immune response  
• Precursor to glutamate for glutathione synthesis | During stress, endogenous synthesis may be inadequate, making glutamine a conditionally essential amino acid. Inadequate intake may result in:  
• Delayed and/or impaired healing  
• Decreased immune function  
• Loss of lean tissue and body mass | Not established | • Ideal dose is unknown  
• 0.5 to 0.6 g/kg/day for critically ill patients<sup>10</sup>  
• Typical dietary consumption is <10 g/day  
• Up to 40 g/day has been tolerated in a catabolic state |
| **Lipids**<sup>12,13</sup> **Omega-3 Fatty Acids**<sup>14</sup> | • Cellular energy  
• Cell membrane integrity  
• Precursors of prostaglandins and component of phospholipids  
• Omega-3 fatty acids are not precursors of inflammatory eicosanoids, as are Omega-6 fatty acids | • Impaired formation of the basement membrane of cells  
• Under conditions of stress, high n6:n3 ratios can promote a predominance of proinflammatory mediators | Lipids: Not established  
Omega-3 Fatty Acids  
1.6 g  
(Men 14 to >70)  
1.1 g  
(Women 14 to >70) | • Optimal ratio of n6:n3 is 2:1 or less |
| **Vitamin A**<sup>15,16</sup> | • Collagen synthesis, cross-linking, and remodeling  
• Epithelialization of cell membranes  
• Required for intact immune response  
• Associated with reversal of the anti-inflammatory effect of steroids on healing | • Impaired wound healing  
• Dermatitis  
• Night blindness | 3000 IU  
(Men 14 to >70)  
2300 IU  
(Women 14 to >70) | • Up to 25,000 IU/day for up to 10 days  
(if deficiency is suspected, or for those receiving high dose steroids) |
| **Vitamin C**<sup>15,16</sup> | • Required for conversion of proline and lysine to hydroxyproline and hydroxylysine  
• Involved in angiogenesis  
• Collagen synthesis  
• Antioxidant function to help neutralize free radicals  
• Supports immune response  
• Plays role in fibroblast proliferation | • Reduced wound strength  
• Wound dehiscence  
• Capillary fragility  
• Bleeding  
• Anemia  
• Ecchymosis  
• Fatigue  
• Depression | 90 mg  
(Men 19 to >70)  
75 mg  
(Women 19 to >70) | • Up to 2000 mg/day in divided doses<sup>17</sup> |
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<td><strong>Vitamin E</strong>&lt;sup&gt;15,18&lt;/sup&gt;</td>
<td>Maintains and stabilizes cellular membrane integrity • Antioxidant function reduces damage from free radicals • Supports immune response</td>
<td>• Impaired healing • Damage from free radicals</td>
<td>22 IU (Men and women 14 to &gt;70)</td>
<td>• DRI • Ideal dose is unknown (&lt;1500 IU)</td>
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<tr>
<td><strong>Copper</strong>&lt;sup&gt;19&lt;/sup&gt;</td>
<td>Collagen cross linking • Strengthening of metabolism of hemoglobin, collagen, and elastin • Development of connective tissue • Essential enzyme catalyst • Antioxidant</td>
<td>• Decreased tensile strength • Microcytic hypochromic anemia • Neutropenia</td>
<td>0.9 mg (Men and women 19 to &gt;70)</td>
<td>2 mg copper per 25 mg zinc/day (Zinc:Copper = 12.5:1)</td>
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<tr>
<td><strong>Iron</strong>&lt;sup&gt;15,19&lt;/sup&gt;</td>
<td>Oxygen transport • Hydroxylation of proline and lysine in collagen synthesis • Enhances bacterial activity of leukocytes</td>
<td>• Anemia • Impaired collagen synthesis</td>
<td>8 mg (Men 19 to &gt;70) 18 mg (Women 19 to 50)</td>
<td>20 to 30 mg/day</td>
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<tr>
<td><strong>Magnesium</strong>&lt;sup&gt;19,20&lt;/sup&gt;</td>
<td>Cofactor of numerous enzymes involved in protein synthesis • Provides structural stability to ATP • Showed to decrease inflammatory response</td>
<td>• Impaired healing • Altered immune response • Free radical damage • Endothelial dysfunction</td>
<td>420 mg (Men 31 to &gt;70) 320 mg (Women 31 to &gt;70)</td>
<td>• DRI</td>
</tr>
<tr>
<td><strong>Selenium</strong>&lt;sup&gt;19,21&lt;/sup&gt;</td>
<td>Oxidation of glutathione • Antioxidant</td>
<td>• Impaired immune function • Free radical damage</td>
<td>55 mcg (Men and women 14 to &gt;70)</td>
<td>100 to 400 mcg/day</td>
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<tr>
<td><strong>Zinc</strong>&lt;sup&gt;15,19&lt;/sup&gt;</td>
<td>Cofactor for enzymes involved in protein synthesis (nucleotides, [RNA, DNA]) • Collagen formation • Cellular replication • Stabilizes cell membranes</td>
<td>• Decreased wound strength • Delayed epithelialization • Diarrhea • Alopecia • Hypoguesia • Dermatitis</td>
<td>11 mg (Men 14 to &gt;70) 8 mg (Women 19 &gt;70)</td>
<td>25 to 50 mg elemental zinc 1 time/day for up to 14 days&lt;sup&gt;16&lt;/sup&gt; • Equal to: 110 to 220 mg ZnSO&lt;sub&gt;4&lt;/sub&gt;</td>
</tr>
</tbody>
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**References**


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**Notes**

- *2003 Dietary Reference Intake (DRI).*
- *References* included for further reading and research.