

Table 1. Health Implications of Various Levels of Serum 25(OH)D

25(OH)D Level (ng/mL)	25(OH)D Level (nmol/L)	Health Implications
<20	<50	Deficiency
20-32	50-80	Insufficiency
32-100	80-250	Sufficiency
54-90	135-225	Normal in sunny countries
>100	>250	Excess
>150	>325	Intoxication

in high-latitude countries, serum 25(OH)D levels in winter tend to be low.<sup>126</sup>

Cancer is a disease for which incidence and mortality rates generally increase with age and there is generally a time lag between dietary effects and discovery of cancer. A 23-year lag between the introduction of Western dietary factors, reduced total dietary fiber, and colon cancer was found for Japan after 1947.<sup>127</sup> Exercise is associated with reduced risk for cancer,<sup>128,129</sup> and the elderly generally exercise less than their younger counterparts. The most important reason, however, for increased risk of cancer with increasing age is likely chromosomal changes, such as aneuploidy (having an abnormal number of chromosomes) and telomere erosion.<sup>130</sup> Telomeres, the end caps of chromosomes, are thought to shorten with each instance of cell division, and the rate of division increases with energy consumption and body mass index. Also involved are advanced glycation end products and reactive oxygen species.<sup>131</sup> Active vitamin D induces ovarian cell apoptosis through down-regulation of telomerase.<sup>132</sup> Telomerase activity is inversely correlated with telomere length.<sup>133</sup>

Osteoporotic fractures are of significant concern for the elderly. Several factors contribute to the risk of such fractures, including low BMD, muscle weakness, and neurological control of balance/neuromuscular function.<sup>134,135</sup> Vitamin D sufficiency, adequate dietary calcium and related minerals, and exercise help reduce the risk of falls and fractures.<sup>85,136-138</sup>

An added benefit is reduced tooth loss.<sup>139</sup>

### Vitamin D Recommendations

Having demonstrated the importance of optimal vitamin D at all stages of life, from fetal development to old age, dosage recommendations for vitamin D can be addressed. The most important consideration is serum 25(OH)D levels. The consensus of scientific understanding<sup>13,14,140-143</sup> is presented in Table 1. Several studies have found calcium absorption and parathyroid hormone (PTH) levels plateau for 25(OH)D levels near 30 ng/mL.<sup>140,144-147</sup> Although the optimal range of 25(OH)D is still the subject of debate, it is assumed to be approximately 30-50 ng/mL (75-125 nmol/L) or higher.<sup>142</sup> Exposure to solar UVB irradiation as it contributes to serum 25(OH)D levels depends on latitude, time of day, season, fraction of body exposed, whether one visits indoor tanning facilities,<sup>76</sup> skin pigmentation, body mass index, and amount of body fat.<sup>148</sup> Non-UVB factors include diet, vitamin D supplementation, and use of certain pharmaceutical drugs, such as glucocorticoids.<sup>149,150</sup>

The guidelines currently in place in the United States recommend 5 µg/day (200 IU/day) of vitamin D for children and younger adults, 400 IU/day for those ages 51-70, and 600 IU/day for those over age 70.<sup>151</sup> These guidelines are based on maintaining bone health. Since 1997, much has been learned