Modern Society and Prospects of Low Vitamin B$_{12}$ Intake

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Key Words
Vitamin B$_{12}$ · Animal products consumption · Fortification of food with vitamin B$_{12}$ · High socioeconomic status

Introduction

Over recent years, physicians have become aware of many medical conditions associated with vitamin B$_{12}$ deficiency, including neurological problems of various degrees of severity, with and without the usual or expected hematological pathology [1], developmental problems of infants whose mothers have severe vitamin B$_{12}$ deficiency [2], psychiatric problems and mental disturbances [3]. Possible effects of vitamin B$_{12}$ deficiency on multiple sclerosis [4], homocysteine [5], cutaneous hyperpigmentation [6] and recurrent aphthous stomatitis [7] are currently being studied.

Vitamin B$_{12}$ deficiency is a common problem. Early detection of vitamin B$_{12}$ deficiency is essential in order to prescribe opportune treatment, and there is evidence that such deficiency occurs more frequently than would be expected. Persons with vitamin B$_{12}$ deficiency may be asymptomatic. There are no generally accepted guidelines for the definition, diagnosis, treatment, and follow-up of cobalamin deficiency. Total serum vitamin B$_{12}$ may not reliably indicate vitamin B$_{12}$ status. Probability of ‘functional’ vitamin B$_{12}$ deficiency decreases upon increasing the blood level of vitamin B$_{12}$. Vitamin B$_{12}$ deficiency can occur in individuals with dietary patterns that exclude animal foods and patients who are unable to absorb vitamin B$_{12}$ in food. We know that not only vegetarians can suffer from vitamin B$_{12}$ deficiency, but also patients with low meat intake. A
high prevalence of symptomatic vitamin B$_{12}$ deficiency was discovered in a peri-urban Bedouin area in Southern Israel due to low intake of animal products [8]. In the past decade we have also become aware that vitamin B$_{12}$ deficiency occurs commonly in industrial countries with different levels of economic and social status. For example, at least 40% of Latin Americans have deficient or marginal plasma vitamin B$_{12}$ concentrations in almost all locations and in all age groups [9]. Today there is a tendency in modern society to change habits, such as cessation of smoking, ‘fighting’ with overweight, accentuating physical exercise, correct eating habits, etc. Our patients are not an exception to this rule. We hypothesize that a decrease of level of vitamin B$_{12}$ in our population is caused by a premeditated decrease in consumption of animal products.

**Methods**

The Clalit Health Services Clinic in the small town of Lehavim serves high-income population living in Southern Israel. According to the 2003 census of the Israeli Central Bureau of Statistics, the population of Lehavim was 5,300 [10]. The clinic serves about 2,100 people over the age of 18. The study population included patients 18 years old and older as of 1998 (the year that files were computerized) and who up to 2005 had undergone at least one blood test for vitamin B$_{12}$ level. We analyzed 512 medical histories of patients undergoing blood tests for vitamin B$_{12}$ level for various reasons (macrocytosis, anemia workup, paresthesias, fatigue, dizziness, decrease in memory, mood fluctuations, vegetarian diet, etc.). Vitamin B$_{12}$ was measured by a microparticle enzyme immunoassay (AxSYM, Abbot Laboratories, Abbot Park, Ill., USA).

**Results**

The average age was 45.3 years ($\pm$17.1) and about 30% of the sample population were men. The level of vitamin B$_{12}$ in 192 patients (37.5%) was less that 250 pg/ml. The laboratory results of the patients are presented in Table 1. The comorbidity measured by the Total Score of Charlson Comorbidity Index was 0.34 ($\pm$0.91) [11]. Because its authors designed this index primarily as a predictor of mortality, it presents a list of 19 conditions with fixed degrees of severity according to the relative risk of death. If a risk was calculated at $\geq 1.2$ but $< 1.5$, this disease received a score of 1; if the relative risk was $\geq 1.5$ but $< 2.5$ a score of 2; if $\geq 2.5$ but $< 3$ a score of 3; both a second metastatic solid tumor and AIDS received a score 6. A total score (TS) is calculated. The age score (AS) represents an extra point for each decade above age 50 and is used for adjusting the CCI for age. The data were analyzed using the SPSS software (Statistical Package for the Social Sciences, SPSS Inc., Chicago, Ill., USA) on a mainframe computer. The vitamin B$_{12}$ level served as the main dependent variable. To analyze the association of vitamin B$_{12}$ levels with different variables $\chi^2$ statistic or t tests were used as appropriate. A logistical regression model was developed to examine which of the variables are statistically significant in predicting low levels of vitamin B$_{12}$. Statistical significance was determined at the $p < 0.05$ level throughout.

**Discussion**

Lately, we see more and more patients with a deficient or marginal level of vitamin B$_{12}$. There are many articles indicating the increasing prevalence of low vitamin B$_{12}$ levels in different segments of the general population [8, 9, 12–15]. As a rule, it appears to be prevalent in 30–40% of those in the lower socioeconomic levels. We conducted a comprehensive Medline search and did not find any reference to vitamin B$_{12}$ status in a population of higher

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Vitamin B$_{12}$, pg/ml</th>
<th>FA, ng/ml</th>
<th>HDL, mg/dl</th>
<th>LDL, mg/dl</th>
<th>TRG, mg/dl</th>
<th>Hb, g/dl</th>
<th>MCV, fl</th>
<th>TSH, $\mu$IU/ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>512</td>
<td>462</td>
<td>352</td>
<td>347</td>
<td>399</td>
<td>471</td>
<td>471</td>
<td>376</td>
</tr>
<tr>
<td>SD</td>
<td>308.1</td>
<td>10.1</td>
<td>53.2</td>
<td>117.7</td>
<td>122.2</td>
<td>13.3</td>
<td>87.1</td>
<td>2.5</td>
</tr>
<tr>
<td>Minimal</td>
<td>32.5</td>
<td>4.7</td>
<td>14.8</td>
<td>35.7</td>
<td>74.3</td>
<td>1.5</td>
<td>6.1</td>
<td>1.5</td>
</tr>
<tr>
<td>Maximal</td>
<td>50</td>
<td>1.5</td>
<td>26</td>
<td>38</td>
<td>39</td>
<td>8.8</td>
<td>56</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Vitamin B$_{12}$ = Vitamin B$_{12}$ level; FA = folic acid level; HDL = high-density lipoprotein; LDL = low-density lipoprotein; TRG = triglycerides; Hb = plasma hemoglobin; MCV = mean corpuscular volume; TSH = thyroid-stimulating hormone.
socioeconomic level. Frequency of deficient or marginal vitamin B12 levels (<250 pg/ml) in our study population was 37%. We cannot extrapolate our discovery to the general population in this municipality because the study population is a selected sample, but we suppose that a prevalence of a low level of vitamin B12 in the overall population in this town may be similar.

Changes in lifestyle among segments of the population with high socioeconomic level on the one hand, and the existence of poverty on the other are two main factors in the decreasing consumption of animal products (particularly red meat). This causes a decrease in the level of vitamin B12 in the general population and, as a consequence, this will increase pathologies due to vitamin B12 deficiency. In the light of our research, we can ask the following question: Why in a population with low comorbidity, considered as a typical, prosperous population living in the modern world, did we find evidence of unanticipated decreased vitamin B12 levels? As a result of conversations with our patients, we have come to the conclusion that as a result of media information disseminating the relationship between meat, cholesterol and cardiovascular diseases, consumption of meat, particularly beef, has decreased. In the majority of families, meat (chicken or turkey) is eaten 2–3 times per week, and beef is not eaten at all. The fare usually includes a lot of vegetables and fruits and a small amount of milk products. The maximal daily intake of vitamin B12 is about 1.3–1.5 μg. Also there is a tendency for ideological motives, particularly among the younger generation to be vegans.

The important role played by vitamin B12 in bodily processes is becoming increasingly clear as its involvement in a broad range of organs and systems is recognized and documented. It affects normal growth and development in children, the peripheral and central nervous systems, bone marrow, bones, skin, mucous membranes and vessels [16]. We understand that vitamin B12 deficiency has various and serious health effects. In lieu of these possible developments and in order to prevent serious health problems, possibility of vitamin B12 fortification should be seriously considered and discussed.

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**References**