MATHEMATICAL MODEL FOR VITAMIN B12 AND FOLATE FROM RIA CORRELATION CURVE, A SHORT REPORT

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ABSTRACT

Good nutrition is an important aspect of healthy living. Blood levels of vitamin B12 and folate are key markers of an individual's nutritional status. Laboratory support for the diagnosis and management of these multiple clinical entities is controversial and somewhat problematic. Although, the radioimmunoassay can be a useful reliable tool to perform these two tests but it is not easily available. Nevertheless, it is very expensive and seems not cost effective for the present situation of economic crisis. Here, we developed a new mathematical model to be an alternative for determination of estimated level of vitamin B12 and folate. The first model for vitamin B12 can be shown as the equation plot hemoglobin (x) versus vitamin B12 (Y): $Y = 1.7X + 252$. The second model for folate can be shown as the equation plot hemoglobin (x) versus folate (Y): $Y = 1.4X - 6.2$. The reference range for vitamin B12 and folate from our method are similar to the reference range by RIA in the text. However, before the conclusion to state that this model is an effective model, an in depth analysis of this new method as the comparative study including to the cost effectiveness analysis is recommended.

INTRODUCTION

Good nutrition is an important aspect of healthy living. Choosing foods that supply essential nutrients and limiting intake of certain fats and salts can help promote good health. Blood levels of vitamin B12 and folate are key markers of an individual's nutritional status. Vitamin B12 is important in maintaining heart health and minimizing the risk of anemia. In conjunction with folic acid, it helps regulate the use of iron and the formation of red blood cells. While, folate (folic acid) is a B vitamin that is essential to fetal development; adequate intake of folate during pregnancy can prevent certain types of birth defects. There is evidence that increased intake of folate and other B vitamins can lower levels of homocysteine, a risk factor for heart disease.[1]

However, these two tests are difficult to perform. Although, the radioimmunoassay can be a useful reliable tool to perform these two tests but it is not easily available.[2] Nevertheless, it is very expensive and seems not cost effective for the present situation of economic crisis. Here, we tried to develop the new method to determine the value of vitamin B12 and folate to be a simple crude tool for determination of these two hematologic parameters by means of mathematical model.

MATERIALS AND METHODS

REVIEW OF THE LITERATURE OF RIA ASSAYS FOR VITAMIN B12 AND FOLATE

We perform a literature review to find the relevance publications on the RIA assays for vitamin B12 and folate. We used the main search engine as the PubMed, Medscape, Science

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Citation index and Thai Index Medicus to find the most proper paper for the further analysis. According to the searching, the most proper papers for the further analysis was the paper of Supawan et al.[3] Although this work did not present the correlation among haemoglobin, folic acid and vitamin B12. The trend as the correlation curves was presented.

DEVELOPMENT OF THE MATHEMATICAL MODEL FOR VITAMIN B12 AND FOLATE

The development of the mathematical model was performed as the three step procedures:

1. We randomly collected the laboratory results of hemoglobin from different 300 healthy patients of both sex from routine hematology test at Out-Patient Division, King Chulalongkorn Memorial Hospital.

2. We used the reported correlation curves for Vitamin B12 VS hemoglobin and folate VS hemoglobin to find the vitamin B12 and folate level according to the hemoglobin result for each subject.

3. Since the correlation curves were non-linear, we developed a new linear model by regression analysis of the determined vitamin B12 and folate to the hemoglobin. Then the least square equation was calculated.

TRIAL OF THE MATHEMATICAL MODEL FOR REFERENCE RANGE SETTINGS

We performed a trial of the new developed mathematical model by

1. Collection of the hemoglobin results from the other 200 non anemic healthy subjects

2. Finding the reference range for serum vitamin B12 and folate for these subjects using the new mathematical model. The reference range was calculated as the expected range (95% Confidence Interval). The statistical level was p value = 0.05.

3. The new reference range was compared to the previous reference range.

RESULTS

NEW MATHEMATICAL MODEL DEVELOPING

The average hemoglobin level for our subjects was 13.2 ± 2.4 g/dL. The average serum vitamin B12 and folate level using the correlation curve was and 354.2 ± 82.4 pg/mL, 5.1 ± 3.6 ng/mL, respectively. The least square equation plot hemoglobin (x) versus vitamin B12 (Y) was $Y = 1.7X + 252$. The least square equation plot hemoglobin (x) versus folate (Y) was $Y = 1.4X - 6.2$.

REFERENCE RANGE SETTINGS

Using the two new mathematical models, the reference ranges for vitamin B12 and folate are 326.3 - 641.6 pg/mL and 3.4 - 5.2 ng/mL, respectively.

DISCUSSION

Vitamin B(12) and folate are two vitamins that have interdependent roles in nucleic acid synthesis. Deficiencies of either vitamin can cause megaloblastic anemia; however, inappropriate treatment of B(12) deficiency with folate can cause irreversible nerve degeneration.[4] Inadequate folate nutrition during early pregnancy can cause neural tube defects in the developing fetus. In addition, folate and vitamin B(12) deficiency and the compensatory increase in homocysteine are a significant risk factor for cardiovascular disease. Laboratory support for the diagnosis and management of these multiple clinical entities is controversial and somewhat problematic. Automated ligand binding measurements of vitamin B(12) and folate are easiest to perform and widely used.[1-2] Nevertheless, the costs of these tests are high and may not suitable for the developing countries including to Thailand.

Presently, healthcare strategies that consider the impact of laboratory tests on the overall costs and quality of care should consider the advantages of all tests in use. The RIA test for vitamin B12 and folate seem not fit for the Era of Universal Coverage, therefore, finding for the simple crude method for the primary use of the physician is necessary. Here, we developed a new mathematical model to be an alternative for determination of estimated level of vitamin B12 and folate. Of interest, our developed model can provide the similar result comparing to the standard RIA method. The reference range for vitamin B12 and folate from our method are similar to the reference range by RIA in the text (vitamin B12: 243 - 894 pg/mL, folate: > 4.1 ng/mL). However, before the conclusion to state that this model is an effective model, an in depth analysis of this new method as the comparative study including to the cost effectiveness analysis is recommended.

References

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