

## **Suboptimal biochemical riboflavin status is associated with lower hemoglobin and higher rates of anemia in a sample of Canadian and Malaysian women of reproductive age**

### **ABSTRACT**

**Background:** Riboflavin is required for several redox reactions. Clinical riboflavin deficiency occurs mainly in low-income countries, where it is associated with anemia. The functional significance of suboptimal riboflavin status in different populations and its role in anemia is not well understood. **Objectives:** We assessed the biomarker status of riboflavin and its association with hemoglobin concentration and anemia in women living in Vancouver, Canada, and Kuala Lumpur, Malaysia. **Methods:** Healthy nonpregnant, nonbreastfeeding women (19-45 y) were recruited from Canada (n = 206) and Malaysia (n = 210) via convenience sampling. Fasting blood was collected to assess riboflavin status [erythrocyte glutathione reductase activity coefficient (EGRac)], hematological indicators, soluble transferrin receptor (sTfR), ferritin, vitamin A, folate, and vitamin B-12 concentrations. Linear and logistic regression models were used to assess the association of riboflavin status with hemoglobin concentration and anemia. **Results:** EGRac (mean  $\pm$  SD) values were higher, indicating poorer riboflavin status, in Malaysian compared with Canadian women ( $1.49 \pm 0.17$  compared with  $1.38 \pm 0.11$ ). Likewise, riboflavin biomarker deficiency (EGRac  $\geq 1.40$ ) was significantly more prevalent among Malaysians than Canadians (71% compared with 40%). More Malaysian than Canadian women were anemic (hemoglobin  $< 120$  g/L; 18% compared with 7%). With use of linear regression (pooled sample; n = 416), EGRac values were negatively associated with hemoglobin concentration (r = -0.18; P < 0.001). This relation remained significant (P = 0.029) after adjusting for age, parity, ethnicity, vitamin B-12, folate, sTfR, ferritin, and vitamin A. Women with riboflavin deficiency (EGRac  $\geq 1.40$ ) were twice as likely to present with anemia (adjusted OR: 2.38; 95% CI: 1.08, 5.27) compared with women with EGRac  $< 1.40$ . **Conclusions:** Biochemical riboflavin deficiency was observed in Canadian and Malaysian women, with higher rates of deficiency among Malaysian women. Deficient biomarker status of riboflavin was a weak but significant predictor of hemoglobin and anemia, suggesting that the correction of riboflavin deficiency may potentially play a small protective role in anemia, but this requires further investigation.

**Keyword:** Riboflavin; Vitamin B-12; Anemia; Women; Canada; Malaysia; Erythrocyte glutathione reductase activity coefficient; EGRac