Riboflavin deficiency in an adolescent population in New York City

Rafael Lopez, M.D., June V. Schwartz, M.D., and Jack M. Cooperman, Ph.D.

ABSTRACT  An adolescent population ranging in age from 13 to 19 years and of a low socioeconomic status in New York City was surveyed for riboflavin deficiency. Deficiency was determined from estimation of erythrocyte glutathione reductase activity, an accurate reflector of riboflavin nutritional status. The overall prevalence of deficiency among those not on vitamin supplements was 26.6%. The prevalence did not depend on sex or age. There was a correlation between milk consumption and riboflavin nutritional status. The prevalence was highest among those consuming less than 1 cup/week and least among those taking 3 or more cups a day. The latter group was comparable in this respect to those receiving daily vitamin supplements. Adolescents are at a high risk for nutritional deficiencies because of their notoriously poor dietary habits, and the estimation of riboflavin deficiency may be an indicator of overall nutritional status.  

We have previously shown that riboflavin deficiency occurred with an 11% frequency in a pediatric population of low socioeconomic status (1). In the report of the Ten State Nutrition Survey it was pointed out that the adolescent may be prone to nutritional deficiencies because of rapid growth and poor dietary habits. Riboflavin deficiency was found in 17% of adolescents in poverty levels in the survey (2). This was based on estimations of urinary excretion of riboflavin. The latter has been shown to be a less precise measure of the vitamin deficiency than the estimation of erythrocyte glutathione reductase, a flavin adenine dinucleotide containing enzyme (3). We have used this method to measure the riboflavin nutritional status in an adolescent population of low socioeconomic status.

Subjects and methods

Two hundred ten adolescents ranging in age from 13 to 19 years who were enrolled in a union health care program were evaluated for riboflavin deficiency. Although of low socioeconomic status, none belonged to families who qualified for public assistance. Blood for vitamin estimation was obtained during visits for routine check-ups or minor health problems. None had either acute or chronic conditions that would interfere with their dietary intake. None of the females was pregnant; four were on oral contraceptive agents. The group included 109 males and 101 females. There were 26 white Americans, 126 Hispanic-Americans, and 58 blacks in the study.

Of the 210 subjects, detailed dietary history was taken from 141. Questions concerning the intake of foods rich in riboflavin such as milk and milk products were asked of the adolescent and the mother. Considerable time was spent on dietary recall in order to get an approximation of the intake of riboflavin-rich foods and to determine whether multivitamin preparations were taken. Twenty-six subjects had a regular intake of vitamins.

Although the purpose of this study was to determine the prevalence of riboflavin deficiency in this population, 11 subjects found deficient were given riboflavin supplements and subsequently rechecked for the deficiency.

1From the Departments of Community and Preventive Medicine, and Pediatrics, New York Medical College, New York, New York 10029.
2Preliminary results were presented at Annual Meeting of the American Institute of Nutrition April 1978 in Atlantic City.
3Address reprint requests to: Rafael Lopez, M.D., New York Medical College, 1249 Fifth Avenue, New York, New York 10029.
4Associate Professor of Pediatrics and Community and Preventive Medicine. 5Assistant Professor of Pediatrics. 6Professor of Community and Preventive Medicine and Pediatrics.
One to five milliliters of intravenous blood was collected in acid-citrate-dextrose for measurement of erythrocyte glutathione reductase activity by a method previously described (4). In this method the erythrocytes are harvested and a hemolysate prepared. Glutathione reductase activity is estimated both in the absence and presence of added flavin adenine dinucleotide, and the results given in activity coefficient values (AC) which represent the degree of saturation of the apoenzyme with the riboflavin coenzyme. Normal values range from 0.9 to 1.2.

Results

Forty-nine of the 210 adolescents surveyed had biochemical evidence of riboflavin deficiency with AC values ranging from 1.21 to 2.20 (Fig. 1). The overall prevalence of the deficiency was 23.3%. However, if the 26 subjects who took multivitamin preparations were excluded, the prevalence would be 26.6%. Of the 49 subjects, 26 were males and 23 females. The deficiencies were distributed among all age groups with no discernible concentration in any age.

Four of the 26 whites (15.4%), 25 of 126 Hispanics (19.8%), and 20 of 58 blacks (34.5%) had evidence of deficiency. However, the mean AC values were 1.13, 1.13, and 1.16, respectively, for these groups with no significant differences between the means of the groups.

Analysis of the dietary histories of the 141 adolescents revealed that the intake of milk or milk products was an important determinant of riboflavin nutritional status. Of this number, 25 subjects received regular vitamin supplements and were not considered in these determinations. Four of five subjects whose milk intake was less than the equivalent of 1 cup/week (240 ml) had biochemical evidence of riboflavin deficiency. Of those whose dietary history revealed the consumption of the equivalent of up to 1 cup/day, 14 of 42 had evidence of vitamin deficiency. Those who stated that their consumption was between 2 and 3 cups numbered 55 and of these 13 had evidence of deficiency. Of those consuming over 3 cups/day only 1 subject had evidence of deficiency.

From a perusal of Table 1 it is evident that there was no significant difference in AC values between the group taking vitamin supplements and those receiving 3 or more cups of milk per day (1.08 and 1.09, respectively). However, there were significant differences between the mean AC values of those whose milk intake was 3 or more cups per day and those whose intake was less. For those whose intake was less than 1 cup/week the mean AC value was 1.37; for those with an intake of 2 to 3 cups/day 1.16, all compared to a mean AC value of 1.09 for those consuming 3 or more cups per day.

Further analysis of the data revealed that 17 of 23 (74%) white Americans not on vitamin supplements drank more than 2 cups of milk per day. Among the Hispanic-Americans 58 of 84 (69%) similarly drank more than 2 cups/day. However, the blacks with

this consumption numbered only 13 of 32 (41%).

Of the 49 with elevated AC values, riboflavin supplements were prescribed for approximately one-half this number but only 11 returned for follow-up. Of these 11 subjects, the AC values ranging initially from 1.21 to 2.00 were reduced within 2 weeks to normal levels (0.9 to 1.17).

Discussion

In this study, 210 adolescents ranging in age from 13 to 19 years and residing in an urban blue collar neighborhood were surveyed for riboflavin deficiency. The overall prevalence of deficiency was 26.6% for those not taking vitamin supplements based upon erythrocyte glutathione reductase activity estimations. This method was shown by Sauberlich et al. (5) to reflect accurately the riboflavin nutritional status of a Tennessee high school population. In our study there was no difference in the prevalence of deficiency between males and females. The prevalence among the three ethnic groups in this survey depended primarily on their dietary regimens and more particularly their milk consumption. These results were similar to those of Yeh et al. (6) who found a higher incidence of riboflavin deficiency by erythrocyte glutathione reductase activity estimation among those who consumed less than 16 oz of milk per day than those who consumed more. They studied 42 adolescents, including lactose malabsorbers.

Milk is an excellent source of riboflavin, and 4 cups will provide the recommended daily dietary allowance for this vitamin. In a study of teenage eating habits in Canada, the intake of riboflavin was closely related to the milk consumption (7). Similar findings were reported in a survey of the nutritional status of teenagers in Iowa (8). Teenagers consider milk as an ideal food even though they may not consume much of it (9, 10). In a study of teenage girls the correlation of milk intake and the selection of a good diet was high, suggesting that the daily consumption of milk may be a reliable index of the adequacy of the diet (10).

In our study the greatest prevalence of riboflavin deficiency was found among those who consumed less than 1 cup of milk per
week, and the prevalence was lowest among those who consumed more than 3 cups/day. Of the ethnic groups, the prevalence of deficiency was greatest among blacks. This may be because members of the latter group with lactose intolerance often avoid milk because of the gastrointestinal discomfort associated with milk drinking. In addition, black adolescents in general have been shown to have irregular eating habits (11, 12).

Adolescents as a group are noted for their poor dietary habits. In a study of 484 high school students in New Jersey only 5% were on what would be considered a good dietary regimen. Their diets were low in milk, fruit, and vegetables but with a liberal sprinkling of snack foods (13).

The diet of the teenager does not necessarily depend upon the economic status (14). The influence of the mother in planning well-balanced meals is important (9, 15). Nevertheless, because of their many activities meals are skipped and snack foods are used as a filler (15, 16).

The adolescent is at high risk for nutritional inadequacy and it is likely that this inadequacy is not limited to riboflavin. In view of the fact that milk consumption is often correlated with a good dietary intake, the determination of riboflavin deficiency may be an indicator of the general nutritional status of the adolescent.

The erythrocyte glutathione reductase test should be used to evaluate riboflavin nutritional status. It has recently been reconfirmed that this test accurately reflects over-all riboflavin status (17).

References


