HEMOGLOBIN LEVELS IN NORMAL FILIPINO PREGNANT WOMEN

MIRIAM D. KUIZON, MARILOU G. NATERA, LEAH P. ANCHETA, TERESITA P. PLATON, GERONIMA D. REYES and MANUEL P. MACAPINLAC*

Food and Nutrition Research Institute, NSDB and* College of Medicine, University of the Philippines, Manila, Philippines.

INTRODUCTION

Although WHO has defined hemoglobin concentrations below which anemia is likely to be present, the need to determine arbitrary standards for different ethnic groups has been emphasized because of the increasing evidence that racial differences in hemoglobin concentration exist (Baker and De Maeyer, 1979).

The lower limit of "normal" hemoglobin concentration during the latter part of pregnancy has been reported to be as low as 10 gm/dl (Paintin *et al.*, 1966) and as high as 12 gm/dl (Bonnar and Goldberg, 1969).

The aim of this study was to determine hemoglobin levels during pregnancy among Filipinos who have no evidence of iron or other nutrient deficiencies known to be related to or causing anemia. The subjects were also prescribed an adequate intake of hematinics during the study. The hemoglobin levels thus obtained were used to define "normal" values for Filipinos.

MATERIALS AND METHODS

One hundred eleven pregnant women seeking prenatal care from two obstetricians practising in private hospitals in Manila were studied. The subjects belonged to the upper income level. A hematinic preparation containing 105 mg iron to be taken daily was prescribed throughout their prenatal period.

On the initial visit of each subject, hemoglobin, hematocrit, serum iron, total iron binding capacity, vitamin A, carotene, vitamin C, total serum protein and serum protein fractions were determined using procedures described earlier (Kuizon *et al.*, 1979). These tests were repeated at least once on follow-up during succeeding trimesters. Forty-five subjects were re-examined on two consecutive trimesters. Transferrin saturation was determined and those with $< 15\%$ saturation were considered iron deficient (WHO, 1972). Using this as basis, 18 values out of a total of 140 determinations were excluded.

Test of Applicability: Using the calculated hemoglobin values (gm/dl) which are less than one standard deviation from the mean for each trimester as lower limits of normal for Filipino pregnant women, the prevalence of anemia in subjects of an earlier study (Kuizon *et al*,, 1979) was calculated. The results were compared with the prevalence rates obtained when the current WHO criterion of <11.0 for all trimesters of pregnancy and the ICNND (1963) criteria of < 11.0 for the first and < 10.5 for the second and third trimesters were used.

Test of Validity: If all the subjects had the same iron stores and if it is assumed that they had undergone similar changes in hydration and increase in iron requirements as pregnancy progresses, one would expect that they will suffer the same change in hemoglobin levels during a similar period in pregnancy. Based on this assumption the changes in hemoglobin of subjects given placebo in an earlier study (Kuizon *et al.*, 1979) were examined. The difference in hemoglobin values obtained on their initial

visit and on the 32nd week of gestation were calculated.

The subjects were divided in two groups. Group 1 consisted of 56 women whose hemoglobin values were ≥ 11.0 gm/dl and which are considered normal by WHO criterion (1972). Group 2 consisted of 11 women whose hemoglobin ranged from 10.4 to 10.9 gm/dl, which are classified as normal using the present proposed lower limit of hemoglobin but considered anemic by WHO criterion.

Another group of women who were used as subjects in a different study were grouped into three, based on their initial hemoglobin levels. Group 1 had hemoglobin levels of > 11.0 gm/dl; Group 2, 10.4-10.9 gm/dl and Group 3, < 10.4. gm/dl. Group 3 were considered anemic based on the cut-off levels derived in this study. These women had concurrent measurement of serum ferritin levels and it was felt of interest to determine how this parameter of iron deficiency correlated with the groupings based on hemoglobin.

RESULTS

Table 1 shows the mean levels of serum iron and percentage saturation of transferrin of the subjects within the normal range (WHO, 1972). The levels of serum vitamin A, carotene vitamin C, total serum proteins, albumin and globulin were found acceptable (ICNND, 1963).

Mean hemoglobin levels obtained for the first, second, and third trimesters are shown in Table 2. The values for the second and the third trimesters were pooled since the difference between the mean levels was not significant. The mean level for the combined group was 11.0 ± 1.0 gm/dl.

A Gaussian curve was fitted to hemoglobin values for the first trimester and for the combined second and third trimester group. Chi-square tests of goodness of fit showed that the hemoglobin concentration indeed followed a Gaussian distribution. For the first trimester group, and for the combined second and third trimester group the values represented by the mean minus one standard deviation were used as arbitrary standards to define the prevalence of anemia.

Test of Applicability: Table 3 shows that when the present proposed lower limits of normal hemoglobin were applied to the group of pregnant women in an earlier study, the highest prevalence rate of anemia was in the first trimester (22.6%). On the other hand, in the second and third trimesters, the prevalence was only 25.0% which compared favorably with the ICNND value of 28.4% but was distinctly lower than the 41.6% obtained when the WHO criterion was used.

Table 1

Serum iron* and transferrin saluration** levels of Filipino women.

Trimester of pregnancy	No.	Serum Iron (mcg/dl) $\bar{X} \pm$ S.D.	No.	Transferrin (%) $\bar{X} \pm$ S.D.
First	22	90.4 ± 32.0	21	25.0 ± 8.0
Second	39	99.8 ± 31.8	39	22.9 ± 6.0
Third	66	103.9 ± 46.0	66	22.4 ± 11.0

*Normal range 80 - 180 mcg/dl' (WHO, 1972) ; **Normal range 20 - 50% (WHO, 1972).

Table 2

Mean hemoglobin levels in normal Filipino pregnant women.

Trimester of pregnancy	No.	$\bar{X} \pm$ S.D. gm/dl
First	22	12.3 ± 0.9
Second	40	11.2 ± 0.9
Third	69	11.5 ± 1.0
Second and Third	109	11.4 ± 1.0

Table 3

Comparison of the prevalence of anemia in pregnant Filipinos using lower limits of normal hemoglobin levels proposed in this study, WHO and ICNND.

	Proposed (This study)	WHO (1972)	ICNND (1963)
Lower limits of normal Hb (gm/dl)			
First	11.4	11.0	11.0
Second & Third trimester	10.4	11.0	10.5
Prevalence of anemia (%)			
First	22.6	15.1	15.1
Second & Third trimester	25.0	41.6	28.4

Table 4

Serum ferritin levels of subjects classified according to hemoglobin levels.

Group	Hemoglobin Level gm/dl	No.	Serum Ferritin GM* ± S.D. ng/ml
1	≥ 11.0	27	9.04 ± 2.30
2	10.4-10.9	24	7.19 ± 1.99
3	< 10.4	40	4.84 ± 1.85

* Geometric mean.

Test of Validity: The hemoglobin level in Group 1 decreased by 0.70 ± 0.86 gm/dl (mean ± S.D.) while that of Group 2 decreased by only 0.30 ± 0.86 gm/dl which is contrary to what one would have expected if the latter group had lower body iron stores. The difference between these two mean decreases, however, was not significant by t-test, suggesting that the iron stores in the two groups were not significantly different.

In the other group of women, the correlation between hemoglobin and serum ferritin levels are shown in Table 4. The mean serum ferritin level of 7.19 ng/ml obtained from Group 2 was not significantly different from the mean level of 9.04 obtained from Group 1 (1 vs 2, $\rho > 0.05$). On the other hand, the mean of 4.84 ng/ml of Group 3 (the anemic group) was significantly lower than the means obtained from the other groups (1 vs 3, $\rho < 0.001$; 2 vs 3, $\rho < 0.05$). It may be noted, however that although the mean serum ferritin levels of women in Group 1 and in Group 2 were comparable, both mean levels were less than 12 ng/ml and could be considered indicative of deficient iron stores (Cook and Finch, 1979). These observations suggest that hemoglobin levels are preferentialy maintained over that of iron stores. It would be interesting in future studies, therefore, to determine what the hemoglobin concentration would be when serum ferritin levels are equal to 12ng/ml, which has been arbitrarily considered as the cut-off point for iron deficiency. The serum ferritin level is considered to be a more sensitive index of iron stores than transferrin saturation.

DISCUSSION

Different approaches have been used to derive the distribution of normal hemoglobin concentration (Garby *et al.*, 1969, Viteri *et al.*, 1972). In this study, subjects with iron deficiency using transferrin saturation levels as criterion were excluded in the study. The nutritional anemia in pregnant Filipinos is due to iron deficiency since it responds to iron supplemention (Kuizon *et al.*, 1979). The vitamin B_{12} status of Filipinos has been reported normal (Marzan *et al.*, 1971) and preliminary results of a supplementation study indicate that no significant improvement in hemoglobin response could be obtained by adding folic acid to iron (Unpublished observation).

Comparison of our data with WHO (1968) sponsored studies on nutritional anemias of pregnancy, showed that hemoglobin concentration in the present study are lower than the levels observed in Poland, Mexico and Venezuela. On the other hand, hemoglobin levels observed in this study are higher than those reported in Israel, Delhi and Vellore, India (WHO, 1968) and in Singapore (Kwa and Ko. 1969).

The lower limit of normal hemoglobin level derived in this study is lower for the last two trimesters of pregnancy when compared to prevailing standards. Wadsworth (1975) has expressed the opinion that the standards now in common use are appreciably higher than the true lower limits of hemoglobin concentration obtained for normal people. Consequently, standards such as those of WHO when applied to particular ethnic groups may exaggerate the prevalence of anemia. On the other hand, our lower limit for normal during the first trimester is higher than the other standards. Interestingly, this value (11.4 gm/dl) when applied to pregnant Filipinos gave a prevalence rate of anemia in the first trimester that is only slightly lower than the rate during the last two trimesters of pregnancy.

Race differences in hemoglobin levels have been reported by other investigations (Owen *et al.*, 1973; Kraemer *et al.*, 1975). Whether the lower hemoglobin concentration among Filipinos is genetic in nature or dietary in origin remains to be explored but the present

findings exemplify the need of establishing norms that should be more appropriate in the assessment of the nutritional status of a specific population group.

SUMMARY

The hemoglobin concentrations during pregnancy in Filipinos belonging to the upper income group, who were prescribed 105 mg elemental iron daily, and who had acceptable levels of transferrin saturation, were examined in an attempt to define normal levels. The hemoglobin concentrations for each trimester followed a Gaussian distribution. The hemoglobin values equal to the mean minus one standard deviation were 11.4 gm/dl for the first trimester and 10.4 gm/dl for the second and third trimesters. Using these values as the lower limits of normal, in one group of pregnant women the prevalence of anemia during the last two trimesters was found lower than that obtained when WHO levels for normal were used. Groups of women with hemoglobin of 10.4 to 10.9 gm/dl (classified anemic by WHO criteria but normal in the present study) and those with 11.0 gm/dl and above could not be distinguished on the basis of their serum ferritin levels nor on the degree of decrease in their hemoglobin concentration during pregnancy. Many subjects in both groups, however, had serum ferritin levels less than 12 ng/ml which indicate poor iron stores. It might be desirable in future studies to determine the hemoglobin cut-off point that will delineate subjects who are both non-anemic and adequate in iron stores using serum ferritin level as criterion for the latter.

ACKNOWLEDGEMENTS

The authors wish to express their thanks and appreciation to Dr. Natividad Puertollano, Dr. Belen Isidro and their staff for their cooperation and assistance; to Ms. Sabina B. Diezmos, Ms. Jane M. Marasigan, Ms. Mila Z. de Lara for their technical assistance; to Ms. Benigna V. Roxas for administrative support; to Mr. Leon G. Alejo and the members of the FNRI Technical Committee for their valuable suggestions during the preparation of this report.

REFERENCES

BAKER, S.J. and DE MAEYER, E.M., (1979). Nutritional anemia. Its understanding and control with special reference to the work of the World Health Organization. *Amer. J. Clin. Nutr., 32* : 368.

BONNAR, J. and GOLDBERG, A., (1969). The assesment of iron deficiency in pregnancy. *Scot. Med. J., 14* : 209.

COOK, J.D. and FINCH, C.A., (1979). Assessing iron status of a population. *Amer. J. Clin. Nutr., 32*:2115.

GARBY, L., IRNELL, L. and WERNER, I., (1969). Iron deficiency in women of fertile age in a Swedish community. III. Estimation of prevalence based on response to iron supplementation. *Acta Med. Scand., 185*:113.

ICNND, (1963). Manual for Nutritional Surveys. Interdepartmental Committee on Nutrition for National Defence, Washington D.C., U.S. Government Printing Office.

KRAEMER, M.D., MCFARLAND, R.M., DILLON, T.L. and SMITH, N.J., (1975). The magnitude and implications of apparent race differences in hemoglobin values. *Amer. J. Clin. Nutr., 28*:563.

KUIZON, M.D., PLATON, T.P., ANCHETA, L.P., ANGELES, J.C., NUÑEZ, C.B. and MACAPINLAC, M.P., (1979). Iron supplementation studies among pregnant women. *Southeast Asian J. Trop. Med. Pub.Hlth., 10* : 520.

KWA, S.B. and KO, M., (1968). Hemoglobin values in pregnancy - a survey of 1,000

consecutive normal mothers. *Singapore Med. J.*, *9*:27.

MARZAN, A.M., TANTENGCO, V.O. and CAVILLES, A.P., (1971). Nutritional anemias among Filipinos during pregnancy. *Southeast Asian J. Trop. Med. Pub. Hlth.*, *2*:564.

OWEN, G.M., LUBIN, A.H. and GARRY, P.J., (1973). Hemoglobin levels according to age, race and transferrin saturation in preschool children of comparable socio-economic status. *J. Pediat.*, *82*:850.

PAINTIN, D.B., THOMSON, A.M. and HYTTEN, F.E., (1966). Iron and the hemoglobin level in pregnancy. *J. Obstet. Gynec. Brit. Comm.*, *73*:181.

VITERI, F.E., DE TUNA, V. and GUZMAN, M.A., (1972). Normal hematological values in the Central American population. *Brit. J. Haemat.*, *23* : 189.

WADSWORTH, G.R., (1975). Nutritional factors in anemia. *Wld. Rev. Nutr. Diet.*, *21*:75.

W.H.O., (1968). Nutritional anemias. *WHO Techn. Rep. Ser.*, No. 405.

W.H.O., (1972). Nutritional anemias. *WHO Techn. Rep. Ser.*, No. 503.