SHORT COMMUNICATION

Association between different levels of hemoglobin in pregnancy and pregnancy outcomes: a registry-based study in Northwest Russia

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INTRODUCTION

The association between maternal anemia and pregnancy outcomes has been investigated in many epidemiological studies, but the findings remain inconsistent. In our previous study based on the Kola Birth Registry (KBR), we observed that maternal anemia defined as hemoglobin concentration below 120 g/l was negatively associated with the risk of stillbirth and preterm birth and positively associated with foetal growth (1). However, our anemic group was heterogeneous and included women with hemoglobin between 110 and 120 g/l, which cannot be classified as anemic according to the WHO. This study aims to achieve a more detailed analysis of different maternal hemoglobin concentrations and their associations with stillbirth, preterm birth and foetal growth in using the data from the KBR.

MATERIAL AND METHODS

This registry-based study included 25,158 women who gave birth during 1973–2002 in Monchegorsk, Northwest Russia. For our analysis, we excluded 632 (2.5%) women with missing data on one or several variables. After excluding women with missing data on hemoglobin concentration, n=443 (1.8%); maternal age, n=3 (0.01%); gestational age, n=6 (0.02%); birth weight, n=6 (0.02%); parity, n=4 (0.02%); and multiple pregnancies, n=170 (0.7%), a total of 24,526 (97.5%) women were included in the analysis.

Five categories of hemoglobin concentration were used: <90 g/l, 90–99 g/l, 100–109 g/l, 110–119 g/l and 120 g/l and more. No absolute values of hemoglobin were available if it was above 120 g/l precluding more detailed analysis. Stillbirth and preterm birth were used as dichot-
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omous variables; birth weight was analysed as a continuous variable. Preterm birth was defined as gestational age below 37 completed weeks.

A multiple logistic regression was performed to study the association between hemoglobin and stillbirth and hemoglobin and preterm birth adjusted for maternal age, parity, marital status, alcohol consumption, tobacco smoking and time periods as in our previous study (1). The largest group (hemoglobin ≥ 120 g/l) was used as a reference group. Adjusted odds ratios (OR) and 95% confidence intervals (CI) were calculated. A multiple linear regression was used to study associations between hemoglobin levels and birth weight. Additional adjustments were performed for gestational age to separate the effects of hemoglobin concentration on foetal growth from the effects on preterm delivery. Moreover, tests for linear trends were performed across categories of maternal hemoglobin. In addition, we assessed the associations between anemia defined using the WHO cut-off criterion of 110 g/l and the above-mentioned pregnancy outcomes.

RESULTS

Women with a hemoglobin concentration of 90–99 g/l and 110–119 g/l had a significantly lower risk of stillbirth than women in the reference group. All levels of hemoglobin below 120 g/l were associated with a lower risk of preterm birth. Babies born to women from all other categories of hemoglobin concentrations were heavier than babies born to women with hemoglobin levels equal or exceeding 120 g/l. All trends across the categories were statistically significant (Table I). Women defined as anemic using the WHO cut-off of 110 g/l were less likely to have preterm births (OR=0.55, 95% CI: 0.46–0.63) and their babies were on average 52 g heavier (95% CI: 39–65) than babies born to women with hemoglobin higher than 110 g/l. No significant difference was observed for stillbirths (OR=0.85, 95% CI: 0.69–1.06).

Table I. Associations between maternal hemoglobin concentration in pregnancy and stillbirth, preterm birth and foetal growth.

| Hb levels | Stillbirth Crude OR (95% CI) | Adjusted OR (95% CI) | Preterm birth Crude OR (95% CI) | Adjusted OR (95% CI) | Birthweight difference a,b,g Crude (95% CI) | Adjusted (95% CI) |
|-----------|-----------------------------|----------------------|---------------------------------|----------------------|---------------------------------------------|------------------|
| <90       | 0.95 (0.52-1.75)            | 0.94 (0.50-1.77)     | 0.81 (0.52-1.27)                | 0.53 (0.33-0.87)     | 56 (5-108)                                  | 49 (7-91)        |
| 90-99     | 0.60 (0.39-0.92)            | 0.64 (0.42-0.99)     | 0.67 (0.51-0.92)                | 0.53 (0.39-0.72)     | 97 (68-126)                                 | 73 (49-97)       |
| 100-109   | 0.73 (0.57-0.93)            | 0.80 (0.62-1.04)     | 0.48 (0.40-0.59)                | 0.47 (0.38-0.58)     | 111 (92-130)                                | 68 (52-84)       |
| 110-119   | 0.74 (0.60-0.91)            | 0.79 (0.64-0.98)     | 0.71 (0.62-0.82)                | 0.76 (0.65-0.89)     | 64 (48-81)                                  | 34 (21-47)       |
| 120 +     | 1.0                         | 1.0                  | 1.0                             | 1.0                  | 0                                           | 0                |
| p for trends c | 0.030                       | 0.030                | <0.001                          | <0.001               | <0.001                                      | <0.001           |

a Stillbirths excluded.
b Additionally adjusted for gestational age.
c Test for trends across categories.
DISCUSSION

In this registry-based study we found that hemoglobin values of 90–109 g/l are associated with a lower risk of stillbirth and preterm birth and positively associated with foetal growth than in the reference group. Including stillbirths in the analyses on preterm birth and birth weight changed the estimates only marginally. Our results are in-line with several large studies reviewed by Rasmussen (2). The possible mechanisms behind this association were discussed in our previous paper as well as in other papers (1–3). The main limitations of this study include the absence of information from the KBR that identified at which point of pregnancy the lowest hemoglobin level was assessed and the missing absolute value of hemoglobin if it was 120 g/l or higher, thus complicating comparisons with other studies.

Conclusion

A maternal hemoglobin concentration of 90–109 g/l is associated with a lower risk of preterm birth and positive foetal growth. The most favourable pregnancy outcomes occurred within hemoglobin concentrations below the cut-off for anemia established by the WHO for pregnant women, which warrants reconsideration of the current iron supplement recommendations.

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