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Original Article

Anemia in Female Students of Ethnic Minorities in Northern Vietnam

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Abstract

Anemia is one of the health problems among ethnic minorities. Iron deficiency (ID) is assumed to be the main cause. This study aimed to determine the prevalence of anemia and iron deficiency anemia (IDA) among reproductive-age women of ethnic minorities in northern Vietnam. Participants included 275 medical female students of various minority groups studying at Thai Nguyen University. Information on socio-demographic and health status was collected by means of interview. Blood samples were collected and investigated for complete blood count. Anemia was defined by hemoglobin level of less than 12 g/dl. Blood samples of anemic individuals were determined further for serum ferritin (SF). IDA was diagnosed in anemic individual with SF <15 ng/ml. Mean corpuscular volume (MCV) and the dichlorophenol-indophenol precipitation (DCIP) test were used to identify thalassemia carriers. Of the 275 women, the prevalence of anemia and irondeficiency anemia (IDA) was 31.6% (95% CI= 26.2-37.5%), and 7.6 % (95% CI=4.8-11.4%), respectively. Based on MCV/DCIP, thalassemia was identified in 95 women (34.5%, 95% CI=28.9-40.5). Amongst anemic women, 75.9% had normal iron status. ID accounted for 24% of anemic women. Approximately 68% were found to be thalassemia carriers. The only factor associated significantly with anemia was positive thalassemia screening (OR=8.9; 95% CI=5.0-15.9). The findings are useful for establishing preventive measures not only for anemia but also for thalassemia among the ethnic minorities.

***Keywords*:** *Anemia, Iron Deficiency, Thalassemia, Ethnic Minorities*

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นิพนธ์ต้นฉบับ

ภาวะเลือดจางในนักศึกษาหญิงชนกลุ่มน้อยชาติพันธุ์ในตอนเหนือ ประเทศเวียดนาม

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บทคัดย่อ

ภาวะเลือดจางเป็นหนึ่งในปัญหาสุขภาพที่พบในชนกลุ่มน้อย โดยมีสมมติฐานว่าเกิดจากการขาดธาตุเหล็กเป็นหลัก การศึกษานี้มีวัตถุประสงค์เพื่อหาค่าความชุกภาวะเลือดจาง และภาวะเลือดจางจากการขาดธาตุเหล็กในผู้หญิงวัยเจริญพันธุ์ที่เป็นชนกลุ่มน้อยในเขตภาคเหนือของประเทศเวียดนาม อาสาสมัครเป็นนักศึกษาแพทย์กลุ่มชาติพันธุ์ที่กำลังศึกษา ณ มหาวิทยาลัยไทเหงียน เก็บรวบรวมข้อมูลด้านประชากรและสังคม และสถานะสุขภาพโดยการสัมภาษณ์ เก็บตัวอย่างเลือดและนำไปตรวจความสมบูรณ์ของเม็ดเลือด (Complete blood count: CBC) วินิจฉัยภาวะเลือดจางโดยอาศัยเกณฑ์ระดับฮีโมโกลบินน้อยกว่า 12 กรัม/เดซิลิตร นำตัวอย่างเลือดที่พบภาวะเลือดจางมาตรวจวัดระดับเฟอร์ไรตินในซีรั่ม วินิจฉัยภาวะเลือดจางจากการขาดธาตุเหล็กในผู้ที่มีภาวะเลือดจางและมีระดับเฟอร์ไรตินในซีรั่มน้อยกว่า 15 นาโนกรัมต่อมิลลิลิตร ส่วนการบ่งชี้พาหะธาลัสซีเมียใช้ค่าปริมาตรเม็ดเลือดแดงเฉลี่ย (Mean corpuscular volume: MCV) และการทดสอบ Dichlorophenol-indophenol precipitation (DCIP) จากผู้หญิงจำนวน 275 คน พบความชุกภาวะเลือดจาง และภาวะเลือดจางจากการขาดธาตุเหล็ก ร้อยละ 31.6 (ช่วงเชื่อมั่น ร้อยละ 95 =26.2-37.5) และ ร้อยละ 7.6 (ช่วงเชื่อมั่นร้อยละ 95 =4.8-11.4) ตามลำดับ จากการคัดกรองด้วย MCV/DCIP พบพาหะธาลัสซีเมียในผู้หญิง 95 คน (ร้อยละ 34.5, ช่วงเชื่อมั่นร้อยละ 95 = 28.9-40.5) ในกลุ่มผู้หญิงที่มีภาวะเลือดจาง พบว่า ร้อยละ 75.9 มีสถานภาพเหล็กปกติ มีภาวะขาดธาตุเหล็ก ร้อยละ 24 และเป็นพาหะธาลัสซีเมีย ประมาณร้อยละ 68 ปัจจัยที่สัมพันธ์กับภาวะเลือดจางอย่างมีนัยสำคัญทางสถิติ คือ ผลการตรวจคัดกรองบวก (Odds Ratio=8.9; ช่วงเชื่อมั่นร้อยละ 95 =5.9-15.9) ข้อค้นพบนี้ นอกจากจะเป็นประโยชน์สำหรับการกำหนดมาตรการป้องกันภาวะเลือดจางแล้ว ยังเป็นประโยชน์ต่อการกำหนดมาตรการป้องกันโรคธาลัสซีเมียในชนกลุ่มน้อยอีกด้วย

คำสำคัญ: *ภาวtเลือดจาง, ภาวะขาดธาตุเหล็ก, ธาลัสซีเมีย, ชนกลุ่มน้อยชาติพันธุ์*

Introduction

Anemia, a condition in which hemoglobin (Hb) and/or red blood cell (RBC) production is reduced, is the most common hematologic problem worldwide. Individuals with anemia may have several unpleasant outcomes including fatigue, dizziness, headache and shortness of breath; and this affects work performance. When anemia becomes severe, heart failure may occur (World Health Organization [WHO], 2008; Glade, 2009).

Population in developing countries are considered at high risk due partly to the low socio-economic status. According to the World Health Organization (WHO), approximately 54% of Southeast Asian populations are anemic (WHO, 2005). Iron deficiency is thought to be the main cause, so-called iron deficiency anemia (IDA). Preschool-age children and pregnant women are at high risk because of the increased iron requirement. Non-pregnant women of reproductive age are also at-risk due to regular blood loss via menstruation. Other causes include parasitic infections and micronutrient deficiency as well as inherited hemoglobin disorders, thalassemia and hemoglobinopathies. Several studies conducted in the region have shown that the inherited disorders rather than ID are associated with anemia (Sanchaisuriya et al., 2006; Thurlow et al., 2005; Panomai et al., 2010; Karakochuk et al., 2015).

Vietnam is one of the low-middle income countries in Southeast Asia where there are up to 54 different ethnic groups. Amongst these ethnicities, the Kinh (Viet) is the majority group, accounting for nearly 86% of Vietnamese population (General Statistical Office, 2009). Other minority groups reside in mountainous areas where health care accessibility is limited. Being reproductive-age females of ethnic minorities, the risk of anemia is thought to be high. Previous studies reported the high prevalence of thalassemia and hemoglobinopathies in various groups of ethnic minorities [9-11]. It is therefore of interest to determine the burden of anemia and the contribution of thalassemia and ID among reproductive-age women of ethnic minorities.

In this study, we determined the prevalence of anemia and IDA among reproductive-age females of ethnic minorities studying at the Thai Nguyen University of Medicine and Pharmacy (TUMP). The contribution of thalassemia and ID on anemia was also investigated.

Methodology

- **Study design and setting**

A cross-sectional study was conducted at the TUMP, one of the major universities in northern region. Its duty is to produce medical doctors and allied health personnel to serve the population of mountainous provinces in the north and northeastern parts. TUMP has approximately nine thousand students, of which more than one-third are of various ethnic minorities. The major groups of ethnic minorities studying at the TUMP include Tay, Nung, Muong Thai. Dao and San Diu.

- **Study population and samples**

A total of 275 reproductive-age women were recruited. Criteria to include participants were as follows; any ethnic minority group; studying at TUMP; age 18-45 years; apparently healthy (i.e. had no any significant disease that affected physical activity); and voluntarily participated. A sample size was calculated using a formula for estimating proportion with finite populations. The study was approved by the Ethics Committee of the relevant institutions; i.e. TUMP, Vietnam and Khon Kaen University, Thailand (HE602272). All participants gave written informed-consent

prior to data collection.

- **Data collection**

Basic information was collected by interviewing using structured questionnaires. This process was done by well-trained research assistants. After interviewing, blood sample was collected by staff of Thai Nguyen Institute of Hematology and Blood Transfusion. Three milliliters (ml) of venous blood sample anticoagulated with EDTA was taken from all participants. After collection, all blood samples were kept at 2-6oC and sent to Thai Nguyen Institute of Hematology and Blood Transfusion where laboratory investigation was performed.

Within 6 hours of blood collection, complete blood count (CBC) was carried out using an automated hematology analyzer (Unicel DxH 800, Beckman Coulter, USA). Anemia was defined according to the WHO criteria, i.e. Hb <12.0 g/dl (WHO, 2008). Blood samples of anemic cases were investigated further for serum ferritin using the latex agglutination reagent kit (Beckman Coulter Inc., CA, USA). Anemic individual with SF <15 ng/ ml was diagnosed as IDA (Savongsy et al., 2008).

Red blood cell indices including the mean corpuscular volume (MCV) obtained from the hematology analyzer were used to identify cases suspected for either α- or β-thalassemia. Individuals with MCV <80 fl were considered positive for thalassemia screening (14). Hb E carriers were identified by using the KKU-DCIP-Clear reagent kit (PCL Holdings, Bangkok, Thailand).

- **Statistical analysis**

Data were analyzed with the STATA version 10.1. Prevalence of anemia and IDA was summarized as percentage with 95% confidence interval (95% CI). Descriptive statistics, mean and standard deviation, were used to describe hematological parameters**.** The contribution thalassemia and ID on anemia was analyzed by comparing the corresponding proportions in anemic women. A Chi-square test was applied to determine the association between anemia and selected factors (including socio-economic information, health status and history of blood loss, as well as thalassemia screening result). Odd ratios and 95% confidence interval were calculated to demonstrate the magnitude of effect of the risk factors. P-value<0.05 was considered statistically significant.

Results

1. General characteristics of the study population

Table 1 shows the socio-demographic characteristics of the study participants. Mean age of participants was 22.8±1.8 years. Almost half (42.2%) of participants were of the Tay group. The rest were Nung (17.8%), Muong (16.7%), Thai (5.5%), Dao (4.7%), San Diu (4.7%), Mong (2.6%), San Chi (1.8%), Cao Lan (1.5%), Pa Di (0.7%), Tho (0.7), Giay (0.4%), Hoa (0.46%), Ngan (0.4%). The majority of participants (~90%) were from rural areas. More than half (~60%) of participants were senior students (4^{rd}-6^{th} year). Almost 1/3 (30%) of students were underweight. Eighty percent of women reported menstrual bleeding lasting within 5 days.

2. Prevalence of anemia, IDA and thalassemia among 275 women of ethnic minorities

Prevalence of anemia, IDA and thalassemia among 275 women of ethnic minorities is given in Table 2. Anemia was identified in 87 women (31.6%). IDA was diagnosed in 21 women (7.6%). Based on MCV/DCIP approach, a total of 95 (34.6%) were assumed to be thalassemia carriers.

3. Hematologic features of anemic and non-anemic women

Hematologic features of anemic and non-anemic women; categorized by iron and thalassemia status are shown in Table 3. Amongst anemic women, a total of 66 women (75.9%) had normal iron status (non-ID). Based on MCV/ DCIP screening, 23 out of 66 non-ID women were categorized as non-thalassemia (non-thal), and 43 were assumed to be thalassemia carriers. Coincidence of ID with thalassemia was observed in 16 women with significantly lower Hb and RBC values as compared to non-ID women with thalassemia. Hematologic features of 5 ID women showed a slight reduction in Hb concentration with normal MCV and MCH values.

Amongst 188 non-anemic women, 36 were positive for thalassemia screening as indicated by the low MCV and MCH values. The rest were categorized as non-thalassemia. Hematologic features of these 152 women were in normal range.

4. Factors associated with anemia among 275 women of ethnic minorities

Applying Chi-square test as crude analysis, no association between socio-demographic factors and anemia was observed (data not shown). The only factor associated significantly with anemia was the result of thalassemia screening ($p<0.0001$). Calculating the OR revealed that women with positive thalassemia screening were likely to have anemia 8.9 times as compared to those with negative thalassemia screening (95% CI=5.0-15.9, $p<0.0001$).

Discussions

According to the global prevalence in 2011 estimated by the WHO, anemia prevalence in non-pregnant Vietnamese women of reproductive- age was 14% (95% CI=9-24%) (WHO, 2005). In contrary, we found a higher anemia prevalence of around 32% (Table 2). Considering that participating women were of ethnic minorities, the high prevalence is therefore not unexpected, and this indicates a need for the determination of its causes.

Amongst causes of anemia, ID and thalassemia are most potential as they relate directly to hemoglobin synthesis (Glade, 2009; Weatherall & Clegg, 2001). Due to the poverty and inaccessibility to health care system, the prevalence of IDA among women of ethnic minorities is expected to be high. In this study, we found an unexpectedly low prevalence of IDA of 7.6% (Table 2). This was confirmed by the finding of a lower proportion of ID than thalassemia among anemic women. As shown in Table 3, ID was found in only one-fourth of anemic women whereas around 50% of them were found to be thalassemia carriers. This indicates that ID was not the main contributing factor for anemia among the study participants. Consistent with this study, previous studies in Thailand and Cambodia reported that factors associated significantly with anemia were thalassemia and hemoglobinopathies (Sanchaisuriya et al., 2006; Thurlow et al., 2005; Panomai et al., 2010; Karakochuk et al., 2015). Based on these results, it is recommended that prevention program for anemia in this region needs to take thalassemia and hemoglobinopathies into account.

It is of note that around one-fourth of anemic women could not be explained by thalassemia and ID (Table 3). It is possible that these women may have micronutrient deficiencies such as vitamin A, zinc and selenium (Nguyen et al., 2006; Nhien et al., 2008; Nhien et al., 2008; Van Nhien et al., 2009; Aikawa et al., 2006). Vitamin B12, folic acid is unlikely to be the cause

because Vietnamese food usually contains fish source. Infection with malaria and hookworm seems not to cause anemia as participants were medical students who received regular health-checks. It is also of importance to note that anemia among participants did not associate with any socio-demographic status. This could probably be explained by the well education of the participants.

A limitation of this study was the lack of feasibility to confirm thalassemia among the positive-screened women due to budget constraints. It is however conceivable that thalassemia prevalence among participants was high. In this study, the combined test (MCV/DCIP) was used to identify cases with thalassemia. This approach has been proven to be highly effective for screening thalassemia in Southeast Asia (Sanchaisuriya et al., 2005; Fucharoen et al., 2004). Several investigators have shown that almost all of the positive cases carried thalassemia genes (Sanchaisuriya et al., 2006; Sanchaisuriya et al., 2005; Fucharoen et al., 2004; Savongsy et al., 2008; Wongprachum et al., 2016). In addition, as a high frequency of thalassemia in the Tay, Nung, and Moung groups residing in southern Vietnam has been reported (O' Riordan et al., 2010), the finding of a positive rate of 34.5% is therefore attainable. The typical characteristics of hematologic features among the positive-screened women (as shown in Table 3) also supported the high prevalence of thalassemia among participants.

In conclusion, this study demonstrates a high prevalence of anemia among reproductive-age women of ethnic minorities in northern Vietnam. It appears that this high anemia prevalence was likely to be due to thalassemia rather than ID. The odds of having anemia among women with positive for thalassemia were 8.9 times compared to negative-screened women. Further studies on the actual types of thalassemia in each minority group is necessary for establishing prevention program not only for anemia but also for thalassemia.

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Table 1 General characteristics of the study participants

Characteristic	N	Percent
Ethnicity		
- Tay	119	43.27
- Muong	55	20.0
- Nung	48	17.45
- San Dui	18	6.55
- Thai	14	5.09
- Dao	13	4.73
- Others*	8	2.91
BMI		
- <18.5	80	29.1
- 18.5-22.9	171	62.2
- >=23.0	24	8.7
Resident		
- Rural	247	89.8
- Urban	28	10.2
Education level		
- 1^{st}-3^{rd} year	108	38.5
- 4^{th}-6^{th} year	169	61.5
Marital status		
- No	260	94.6
- Yes	15	5.4
Menstrual bleeding		
- Normal (<5 days)	223	81.1
- High (>5 days)	52	18.9

*Including 4 Cao Lan, 1 Giay, 1 Hoa, and 2 unspecified

Table 2 Prevalence of anemia, iron deficiency anemia, and thalassemia among 275 women

Disorder	n	Percent	95% CI
Anemia	87	31.6	26.2-37.5
Iron deficiency anemia	21	7.6	4.8-11.4
Thalassemia*	95	34.5	28.9-40.5

* Based on thalassemia screening using MCV/DCIP approach

Table 3 Hematologic features of anemic and non-anemic women; categorized by iron and thalassemia statuses

Group	Iron status	Thal status*	n	RBC ($x10^{12}$/l)	Hb (g/dl)	MCV (fl)	MCH (pg)	RDW (%)	SF# (ng/ml)
Anemia	Non-ID	Non-thal	23	4.1±0.2	11.7±0.2	86.8±3.6	28.8±1.4	13.4±0.6	55.8 (28.8-87.4)
		Thal	43	5.4±0.5	11.1±0.6	65.9±6.9	20.8±2.5	15.4±1.4	70.8 (38.0-111.7)
	ID	Non-thal	5	4.1±0.1	11.3±0.6	84.0±2.6	27.2±1.1	14.5±0.8	8.4 (5.5-10.2)
		Thal	16	4.9±0.2	10.5±0.7	67.7±8.4	21.5±3.0	17.4±2.1	7.7 (4.6-10.3)
Non-anemia	ND	Non-thal	152	4.5±0.3	13.0±0.6	87.2±3.4	29.1±1.3	13.2±0.7	ND
		Thal	36	5.1±0.4	12.6±0.4	75.8±4.9	24.7±1.9	14.4±0.9	ND

RBC: red blood cell; Hb: hemoglobin; MCV: mean corpuscular volume; MCH: mean corpuscular hemoglobin; RDW: red cell distribution width; ID: iron deficiency; SF: serum ferritin; ND: not done

*Based on thalassemia screening using MCV/DCIP approach

#Presented as median (inter-quartile range)