# STATUS OF MICRONUTRIENT DEFICIENCIES AND RELATED FACTORS AMONG WOMEN AGED 18 - 55 YEARS OLD AT SOME COMPANIES IN 2019

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*The cross-sectional study determined the prevalence and possible factors associated with micronutrient deficiencies (MNDs) among women aged 18 – 55 working at two companies in Northern Vietnam. Anemia, iron deficiency (ID), iron deficiency anemia (IDA) and calcium deficiency prevalence was 9.52%, 20.24%, 5.16% and 28.17%, respectively. Intakes of iron, zinc, calcium, folate and vitamin A, C, D were below recommendations. Age and the number of children were found to be risk factors of calcium deficiency. Inadequate dietary intakes of vitamin A, C and iron varied with age. Lower education level was associated with IDA status, and people with higher BMI had a lower risk of folate intake deficiency. Participants with inadequate vitamin A intake had a lower risk of deficiency in serum iron and serum ferritin. Adjusting food patterns to provide a balanced diet and further research on associations between dietary micronutrient intakes and micronutrient status are needed. Our findings may be useful for nutrition policymakers and public health workers, in terms of providing appropriate interventions to improve micronutrient status of female workers.*

**Keywords: Micronutrient deficiency, female workers, nutrient intake.**

## I. INTRODUCTION

Micronutrient deficiencies (MNDs) affect more than 2 billion people worldwide, causing adverse health consequences.[1] Despite positive improvements in nutrition status over the past decades, MNDs remains a major public health challenge in developing countries, including Vietnam.[2]

Micronutrients are essential for women, especially women of reproductive age (WRA), because of the relation to pregnancy and lactation, given that they have a greater need for vitamins and minerals. Approach to women's nutrition, however, should also be considered for their role in the social workforce. A comparative study in India (2016) showed that intakes of energy and micronutrients in female workers who did moderate and heavy work was significantly lower than their non - working counterparts.[3] A study of female workers in a garment factory in Cambodia (2017) revealed that 26.8% of participants were anemic and 22.1% of them were iron deficient.[4]

MNDs still remain a public health problem in Vietnam. According to a national survey in 2014 - 2015, 80.3% of pregnant women and 63.3% of non - pregnant women were deficient in zinc, while 32.8% of pregnant women and 25.5% of non - pregnant women were iron deficient.[5] 70% of Vietnamese women participate in the labor force, most of them often approach more vulnerable work than men.[6] However, studies in women nutrition usually concentrate more in those who are pregnant or planning to have a child, without considering their working status. Thus, to fulfill the gap of the literature, this study

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aims to (1) assess the prevalence of MNDs among women aged 18 – 55 years old working at Trang An and Vian companies in northern Vietnam and (2) describe the associations between the prevalence of MNDs and some related factors.

## II. METHODS

### 1. Participants

Healthy and non - pregnant women aged 18 - 55 who are working at two different facilities of Trang An and Vian companies from 1st August 2019 to 1st March 2010.

- Inclusion criteria

+ Women who are working at the companies.

+ From 18 to 55 years old.

- Exclusion criteria

+ Women who have mental health problems or use any mental medicine and do not agree to join the study.

+ Women who refuse to join the research.

+ Pregnant or lactating women.

### 2. Methods

*Design:* A cross - sectional study was applied.

*Study time and settings*

- Location: The interview was held at Trang An company, located in Thach That - Quoc Oai Industrial Park and Vian company, located in Dong Anh District, Ha Noi.

- Time:

+ Study time: From 1 June 2019 to 31 December 2019.

+ Data collection: October 2019.

*Sample size:* The sample size for this study was estimated on the basis of anemia prevalence among women of reproductive age from a survey in Vietnam (2015), with 19.7% of the non - pregnant women had anemia.[7] A sample size of 243 women was calculated to get a precision of 5.0% with an expected design effect of 2.0. Anticipating an estimated 5% refusal or absence of women during data collection, the study required a total of 255 participants. The final sample was 252 women.

### 3. Data collection

- Socio - demographic and anthropometric data

+ Data on socio - demographic information was collected using a structured interview, which was conducted at the facilities where the participants work.

- Body weight and height were measured without shoes or sandals and wearing light clothes. Body Mass Index (BMI) was calculated as the body weight (in kg) divided by the height square (in meters). Participants were classified using BMI cut - off suggested for Asian populations as underweight (BMI < 18.5 kg/m²) and obese (BMI ≥ 25 kg/m²) [8].

- Blood sampling and analysis: An intravenous fasting blood sample was collected at the field site by HMU's licensed medical technicians. Blood samples were stored in a cool box and transferred to the laboratory of the Department of Nutrition Biochemistry and Metabolism at the National Institute of Nutrition for analysis. Anemia was defined as hemoglobin (Hb) concentration < 120 g/L, ID was defined as serum ferritin concentration < 15 mg/L, IDA was defined as a combination of anemia and ID.[9] Calcium deficiency was defined as total serum calcium concentration in serum was < 2.2 mmol/l.[10]

- Dietary and nutrient intakes: Dietary and nutrient intakes were assessed using the 24 - hour recall method. Participants were asked to estimate all the food they ate in 24 hours during the previous day, including breakfast, snacks before lunch, lunch, snacks before dinner, dinner and snacks after dinner. The portion size was determined using a range of different sized

spoons, bowls, cups or estimated units such as gram, milliliter.

**4. Data analysis**

Data entry was performed with Excel 2016. Stata software version 12.0 was used for statistical analysis. The Kolmogorov - Smirnov test was used to assess normality. Descriptive data were presented as means and standard deviations (Mean ± SD) for normally distributed variables, median (range, IQR) for non - normally distributed variables. Bivariate logistic regression (95% confidence interval) was used to access the associations between socio - demographic factors and the deficiencies of selected micronutrients as well as nutrient supplements information intakes (as dependent variables). All related variables in bivariate regression analysis with a P value ≤ 0.2 were included in multivariate model, which were constructed using stepwise backward elimination procedure. Differences were considered significant at $p < 0.05$.

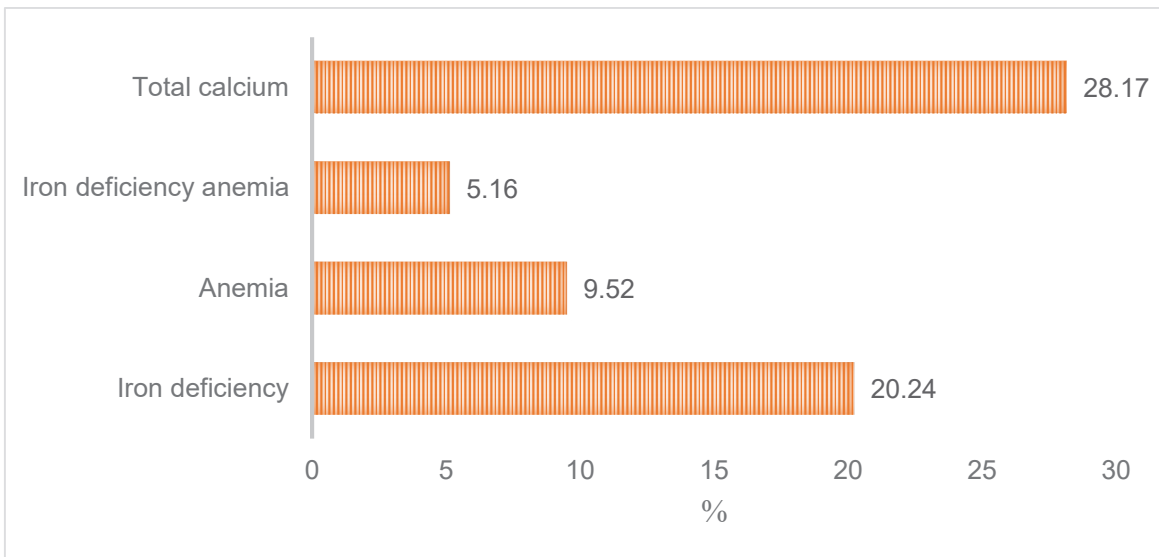
**5. Ethical issues**

This research received ethical approval from the Institutional Review Board for Ethics in Biomedical Research - Hanoi Medical University (number 33/HMUIRB) in 09th September, 2019). All participants were informed about the aim and procedures of the study before the collecting data period.

## III. RESULTS

**1. Socio - demographic and nutrient**

Among 252 female workers, 93.3% were in the 18 – 49 age group. The mean age of participants was 35.33 years old. Most of them were from the Kinh majority group (99.2%). 73.4% of the surveyed women completed high school or at least one year of higher education. The large majority (89.3%) of the participants were married, and 89.78% of them had at least 1 child. The median (range, IQR) BMI for the study sample was 20.97 kg/m² (16.59, 27.73). 9.13% of women were underweight (BMI < 18.5 kg/m²) and 5.56% of women were overweight and obese (BMI ≥ 25 kg/m²). 71.8% and 69.4% of women were not using iron and other micronutrient supplements, respectively.




**2. Micronutrient status and dietary intakes**

Micronutrient deficiencies according to biochemical measures are shown in Figure 1. Total serum calcium concentration deficiency was 28.17%. The prevalence of anemia and ID was 9.52% and 20.24%, respectively. IDA prevalence was 5.16%. Insufficient vitamin D intake prevalence was 99.6% (Figure 2). 92.86% of participants were deficient in daily iron intake. 95.63% of people had insufficient calcium intake. The prevalence of folate intake deficiency was 78.17%. Vitamin A and vitamin C intake deficiencies were lower, at 36.11% and 36.51%, respectively. 34.13% of the participants were affected by zinc intake deficiency.

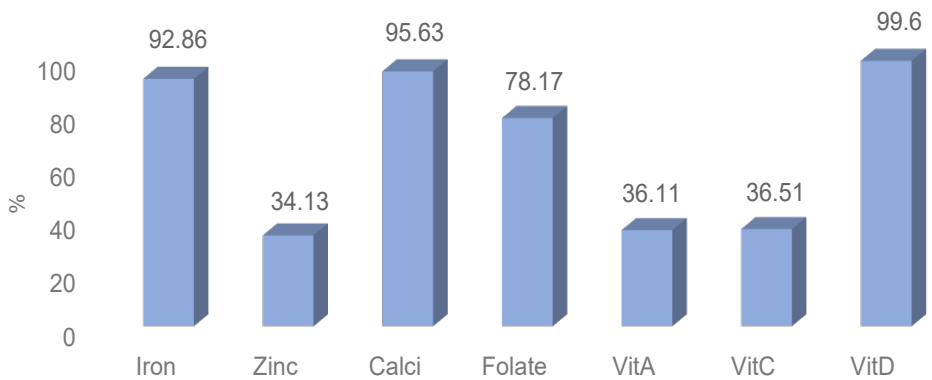



**Figure 2. Prevalence of inadequate micronutrient intakes among women aged 18 – 55**

**2. Associations between biochemical micronutrient measures and related factors**

Bi - variate analysis indicated that older people had approximately 2 times higher risk for calcium deficiency as compared to their younger counterparts (OR = 2.2, 95% CI = 1.25 – 3.86) (Table 1). Similarly, calcium deficiency was positively associated with women who have more than 2 children (OR = 2.33, 95% CI = 1.17 – 4.66). Multivariate analysis showed the association between age and calcium deficiency remained even after adjusting for other factors (adjusted OR = 2.26, 95% CI = 1.25 – 4.07). In addition, women who accomplished higher education had less risk of IDA (adjusted OR = 0.25, 95% CI = 0.07 – 0.91).

**Table 1. Socio - demographic factors among women aged 18 - 55 associated with MNDs by biochemical measure**

| | | **Total calcium deficiency** | | **Anemia** | | **Iron deficiency anemia** | |
|---|---|---|---|---|---|---|---|
| | | OR[a] (95% CI) | aOR[b] (95% CI) | OR (95% CI) | aOR (95% CI) | OR (95% CI) | aOR (95% CI) |
| Age | 18 - 35 | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | |
| | 36 - 50 | **2.2 (1.25 - 3.86)** | **2.26 (1.25 - 4.07)** | 1.31 (0.56 - 3.05) | 1.13 (0.47 - 2.72) | 0.92 (0.3 - 2.83) | 0.99 (0.52 - 1.88) |

| | | Total calcium deficiency | | Anemia | | Iron deficiency anemia | |
|---|---|---|---|---|---|---|---|
| | | OR[a] (95% CI) | aOR[b] (95% CI) | OR (95% CI) | aOR (95% CI) | OR (95% CI) | aOR (95% CI) |
| Marital status | Unmarried | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | |
| | Married | 1.83 (0.66 - 5.02) | 1.8 (0.63 - 5.18) | 0.82 (0.23 - 2.97) | 0.49 (0.12 - 1.98) | 0.37 (0.1 - 1.45) | 0.17 (0.03 - 0.86) |
| Number of children | ≤ 2 | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | |
| | > 2 | **2.33 (1.17 - 4.66)** | 1.89 (0.89 - 4.03) | 2.35 (0.91 - 6.09) | 2.29 (0.81 - 6.42) | 2.43 (0.71 - 8.29) | 2.81 (0.74 - 10.63) |
| Education | Secondary and lower | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | |
| | High school and higher | 1.35 (0.70 - 2.57) | 1.59 (0.8 - 3.15) | 0.47 (0.2 - 1.11) | 0.4 (0.16 - 1.02) | 0.4 (0.13 - 1.24) | **0.25 (0.07 - 0.91)** |
| Deworming | Yes | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | |
| | No | 0.69 (0.39 - 1.22) | 0.66 (0.36 - 1.23) | 0.82 (0.34 - 1.95) | 0.93 (0.37 - 2.34) | 0,79 (0.25 - 2.49) | 0.97 (0.28 - 3.3) |
| Iron supplement | Yes | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | |
| | No | 0.83 (0.45 - 1.5) | 1.14 (0.56 - 2.33) | 0.62 (0.26 - 1.5) | 0.58 (0.2 - 1.64) | 0.61 (0.19 - 1.93) | 0.36 (0.09 - 1.52) |

*[a]Bivariate logistic regression (OR: Odds ratio)*

*[b]Multivariate logistic regression (aOR: Adjusted odds ratio)*

Logistic models illustrated positive associations between age and the deficiencies of vitamin A, vitamin C and iron intakes (Table 2). In the 18 - 35 year old age group, inadequate vitamin A intake was less likely to happen (adjusted OR = 0.57, 95% CI = 0.33 – 0.97), while the risk of dietary vitamin C deficiency was higher compared with older participants (OR = 1.76, 95% CI = 1.05 – 2.9; adjusted OR = 1.85, 95% CI = 1.08 – 3.16). Likewise, the probability of deficient iron intake was nearly 10 times higher in younger women (OR = 9.83, 95% CI = 2.21 – 4.71; adjusted OR = 9.62, 95% CI = 2.14 – 4.33). Overweight and obese women were less likely to have a lack of folate intake in comparison with underweight women (OR = 0.2, 95% CI = 0.04 – 0.92; adjusted OR = 0.2, 95% CI = 0.04 – 0.98). Bi - variate logistic model showed that people with inadequate vitamin A intake had a lower risk of deficiencies in iron (OR = 0.48, 95% CI = 0.23 – 0.96) (Data not shown).

**Table 2. Socio - demographic factors among women aged 18 - 55 associated with MNDs based on energy and nutrient intakes**

| | | Vitamin A deficiency | | Vitamin C deficiency | | Folate deficiency | | Iron deficiency | |
|---|---|---|---|---|---|---|---|---|---|
| | | OR (95% CI) | aOR (95% CI) | OR (95% CI) | aOR (95% CI) | OR (95% CI) | aOR (95% CI) | OR (95% CI) | aOR (95% CI) |
| Age | 36 - 50 | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | |
| | 18 - 35 | 0.6 (0.36 – 1.01) | **0.57 (0.33 - 0.97)** | **1.76 (1.05 – 2.97)** | **1.85 (1.08 - 3.16)** | 0.88 (0.48 – 1.60) | 0.9 (0.48 - 1.66) | **9.83 (2.21 – 43.71)** | **9.62 (2.14 - 43.33)** |
| Education status | Secondary and lower | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | |
| | High school and higher | 0.93 (0.52 - 1.66) | 0.99 (0.55 - 1.83) | 0.62 (0.35 - 1.1) | 0.57 (0.32 - 1.03) | 0.82 (0.4 - 1.64) | 0.82 (0.4 - 1.67) | 1.07 (0.37 - 3.12) | 0.86 (0.28 - 2.64) |
| Deworming | Yes | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | |
| | No | 0.81 (0.47 - 1.4) | 0.62 (0.35 - 1.11) | 0.84 (0.49 - 1.44) | 0.85 (0.48 - 1.49) | 1.19 (0.64 - 2.22) | 1.03 (0.54 - 1.98) | 0.38 (0.1 - 1.34) | 0.47 (0.12 - 1.84) |
| Iron supplement | Yes | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | |
| | No | 2.2 (1.18 – 4.09) | 2.38 (1.18 - 4.82) | 1.18 (0.66 – 2.10) | 1.06 (0.52 - 2.62) | 1.64 (0.87 – 3.09) | 1.62 (0.79 - 3.34) | 0.49 (0.14 – 1.74) | 0.45 (0.11 - 1.94) |
| Micronutrient supplement | No | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | |
| | Yes | 1.49 (0.84 - 2.65) | 1.11 (0.58 - 2.13) | 1.29 (0.73 - 2.72) | 1.17 (0.62 - 2.2) | 1.26 (0.67 - 2.39) | 1 (0.49 - 2.03) | 1.15 (0.41 - 3.18) | 1.67 (0.51 - 5.42) |
| BMI | Skinny | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | | **1 (Reference)** | |
| | Normal | 0.5 (0.21 – 1.22) | 0.5 (0.2 - 1.24) | 0.93 (0.38 - 2.25) | 0.86 (0.34 - 2.14) | 0.35 (0.08 - 1.59) | 0.35 (0.08 - 1.59) | 1.37 (0.29 – 6.56) | 1.29 (0.25 - 6.65) |

| | | Vitamin A deficiency | | Vitamin C deficiency | | Folate deficiency | | Iron deficiency | |
|---|---|---|---|---|---|---|---|---|---|
| | | OR (95% CI) | aOR (95% CI) | OR (95% CI) | aOR (95% CI) | OR (95% CI) | aOR (95% CI) | OR (95% CI) | aOR (95% CI) |
| | Obese - overweight | 0.38 (0.14 – 1.09) | 0.37 (0.12 - 1.09) | 0.73 (0.25 – 2.08) | 0.65 (0.22 - 1.91) | **0.2 (0.04 – 2)** | **0.2 (0.04 - 0.98)** | 0.95 (0.16 – 5.63) | 0.80 (0.12 - 5.21) |

*[a]Bivariate logistic regression (OR: Odds ratio)*

*[b]Multivariate logistic regression (aOR: Adjusted odds ratio)*

## IV. DISCUSSION

In our study, most of participants were at reproductive age (93.3%). Although we did not include pregnant women in this research, women of childbearing age always have the potential of becoming pregnant, and not all pregnancies are planned. Therefore, it is essential to maintain the optimal nutritional status throughout reproductive years. Considering working status of our study subjects, the burden of MNDs might be even higher. The prevalence of anemia (9.52%) was significantly lower than the high prevalence of 28.8% in a survey from the National Institute of Nutrition in Vietnam (2009 - 2010) for women of reproductive age .[11] The lower prevalence in present research suggests a significant improvement in anemia among Vietnamese women over the last decade. We found a notable prevalence of ID (20.24%), but the prevalence of IDA was quite trivial (5.16%), suggesting that in this population, additionally to ID, other etiologies of IDA should also be taken into consideration. Our results showed that 28.17% of women had calcium deficiency, which is contrary to a study in India (2017)[12] with normal calcium status found in all the participants. However, serum calcium only accounts for less than 1% of total body calcium, while more than 99% is stored in the bones and teeth. Serum calcium does not fluctuate with changes in dietary intake as it is always ready to be transferred from bones to maintain normal serum calcium levels.[13] Therefore, total calcium deficiency might not cause any early symptoms, but a long - term condition could result in severe complications. Intake of many important micronutrients were below recommendations, which was in line with results from other developing countries,[14,15] suggesting a common problem of unbalanced diets among women in developing nations.

Older women have a higher risk of calcium deficiency. This result could be explained by the decrease of calcium absorption with increased age, along with vitamin D regulation[13] which was not provided in this study. The burden of childcare was considered for calcium deficiency as well, indicating that with joint impacts of domestic and economic activities, women in the workforce are likely to have a poor diet and do not meet their daily nutrient needs. In present study, women with lower education were at higher risk of IDA. A study in Bangladesh in 2011 for women aged 15 – 49 years old showed that women with no education had higher risk of anemia.[16] This result indicates that with higher education, better knowledge and

practice in dietary habits can be achieved. The deficiencies of vitamins A, E and iron in the diet varied with age. We consider the differences in dietary patterns of participants, but there is a need of further studies to have more accurate understandings about the impact of age to the intake of each micronutrient mentioned above. The relationship between increasing BMI status and decreasing folate intake is in line with a previous study of Bird J.K (2015) that found an inverse relation between BMI and serum folate. [17] This finding suggest that the status of being overweight or obese might affect positively to the absorption of folate in the diet.

Surprisingly, the risk of ID of participants with inadequate vitamin A intake was lower than those with adequate intake. This result might be contradict, since vitamin A supplementation has been shown to have significant impact on Hb and other iron parameters.[18] However, the precise relationship between vitamin A and iron status need to be considered carefully with the coexist status of multiple micronutrient deficiencies and the metabolism of the body as well.

Our study has some limitations. Firstly, due to the cross - sectional nature of the data, we cannot assess causality and thus cannot firmly assert that the factors considered were the cause of micronutrient deficiencies in the study subjects. Therefore, further longitudinal studies in the future are needed to address this limitation. Secondly, our study sample were limited to employees working in light industry only, with a relatively small number of subjects and solely located in Hanoi. Therefore, our findings are not representative of all women in the labor force in Hanoi, as well as in other regions in Vietnam. In addition, because studies of working - age women are still quite scarce, there was difficulty in precisely comparing results from this study with previous researches. Future studies on working women should be conducted nationally, with a variety of jobs to gain a more accurate assessment. Thirdly, the use of 24 - hour recall method may affect the reliance on the accuracy of recall and the difficulties in portion size estimation, and since the dietary intakes were only assessed for the previous day, it may not assess correctly the MNDs status of the subjects.

## V. CONCLUSION

Findings from our study showed the highest deficiency of total serum calcium concentration at 28.17%. Anemia was only a mild public health concern among women aged 18 - 55 with the prevalence of 9.52%. IDA prevalence was lowest at 5.16%, given a need to assess other etiologies of anemia. Intakes of many important micronutrients were severely inadequate, suggesting imbalance diet patterns of participants. Vitamin D was the most inadequate micronutrient intake with 99.6% of women consumed less than recommendation. Logistic models showed that older women and those who had more than 2 children had higher risk of calcium deficiency. Women with lower education were more likely to had IDA. The deficiencies of vitamins A, E and iron intakes varied with age. People who were overweight - obese were at lower risk of folate intake deficiency compared with underweight women. The risk of ID in participants with inadequate vitamin A intake was lower than those with adequate intake. Because micronutrients can only be derived from the diet, there is a need to tailor food patterns to provide a balanced diet for this population. Some associations between dietary micronutrient intakes and micronutrient status require further studies to make more accurate assessments. Our findings may be useful for future nutrition intervention policies and programs in reducing the prevalence of

MNDs, focusing on women concerning their working status.

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