Original Article

Nutritional status of pregnant women in Northeast Thailand

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A comparative study on the nutritional status of primiparous and multiparous women in the first trimester of pregnancy was conducted in the northeastern province of Thailand, Khon Kaen, to investigate differences in protein-energy-malnutrition, iron deficiency anaemia, vitamin A deficiency and carotenoid status between both parity groups. 94 subjects were recruited at first attendance of antenatal clinic. Data about weight, height, haemoglobin and haematocrit were obtained from hospital records. Anthropometric measurements of mid-upper arm circumference and triceps skinfold were done on a sub sample. Retinol, carotenoids and α-tocopherol were analysed using a reversed-phase high-performance liquid chromatography method. Ferritin, transthyretin and retinol-binding protein were determined by enzyme–linked immunosorbent assay. Primiparous women showed lower body mass index, mid-upper arm circumference, corrected arm muscle area (P <0.001) as well as lower retinol, cholesterol and triceps skinfold (P <0.05). After adjusting for age and socio-economical status the significant difference persisted for all parameters but triceps skinfold. No significant differences of α-tocopherol, serum proteins, carotenoids and iron indices could be observed, even though a tendency to higher values for ferritin, haemoglobin and haematocrit was shown in multiparous women. Prevalence of protein-energy-malnutrition (body mass index <18.5 kg/m^2) in the primiparous group was significantly higher compared to the multiparous group (P<0.05). Prevalence of protein-energy-malnutrition, iron deficiency anaemia and vitamin A deficiency were 15.1%, 6.3 % and 3.3%, respectively, in the total study population. No differences between parity groups could be observed for prevalence of iron deficiency anaemia and vitamin A deficiency.

Key Words: nutritional status, pregnancy, vitamin A, iron, carotenoids.

Introduction

Adequate nutritional status of expectant mothers is essential for their health and pregnancy outcomes. Due to increased nutritional requirements pregnancy is a critical period for meeting the body's demand for macro- and micronutrients. Thus, anaemia and vitamin A deficiency (VAD) are highly prevalent nutrient deficiencies encountered in pregnant women, affecting 53.8 million (55.8 %) and 7.2 million (6.8 %) on a global scale, respectively.[1,2] Both deficiencies have been shown to result in serious health consequences including increased morbidity and mortality of both mother and child.[3]

In addition, the prevalence of teenage pregnancy is still high in most developing countries, 33% on average, reaching from 8% in East Asia to 55% in West Africa.[4] These approximately 15 million women worldwide, who are physically immature and still in a state of growth, face even more difficulties in meeting their nutritional requirements. Among them malnutrition, maternal morbidity and adverse effects on pregnancy outcomes, e.g. low birth weight babies, were shown to be more prevalent.[5,6] Reported prevalence of teenage pregnancy in Thailand decreased from 28.7% in 1996[7] to 12.9% in 2001.[8] Considering the high percentage of young pregnant women in Southeast Asia, this study was undertaken to compare the nutritional status of first trimester primiparous and multiparous pregnant women in a poor settings in Northeast-Thailand and to describe the extent of protein-energy-malnutrition (PEM), iron deficiency anaemia (IDA) and vitamin A deficiency (VAD) as well as the carotenoid status.

Subjects and Methods

Study population

The study was conducted in Khon Kaen Province in the

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north-eastern part of Thailand. 94 pregnant women in the first trimester, primiparous (pregnant for the first time) and multiparous, were recruited from three district hospitals and four health centres from February to June 2003 following the first attendance of antenatal clinics. Pregnant women exceeding the 12th week of pregnancy, women receiving vitamin and/or iron supplements and women suffering from infections within the last two weeks before attending were excluded from the study. All women signed informed consent forms before partici-pating in the study. Ethics committee approval was obtained from the ethical committee of the Faculty of Associated Medical Sciences, Khon Kaen University, Thailand.

Questionnaire and sample collection

After obtaining informed consent, subjects were interviewed about socio-economic characteristics and personal and pregnancy history. Data about weight, height, gestation age, haemoglobin and haematocrit were obtained from hospital records. Subsequently, anthropometric data and blood samples were collected. Blood were drawn from the subjects arm. One part was placed in Eppendorf cups prepared with the anticoagulant EDTA, transported on ice to the Khon Kaen University campus and stored at –80°C until analysis. The other part was centrifuged to obtain serum samples, placed in opaque Eppendorf cups to protect from light and transported on ice to be stored at –80°C at Khon Kaen University campus. Samples were transferred to Germany by air on dry ice and stored at –80°C until further analysis, which was performed within six months after blood collection. This is a time span and storage temperature at which analytes have been reported to remain stable.[9]

Anthropometrics and sample analysis

Measurement of triceps skinfold (TSF) and mid-upper arm circumference (MUAC) were performed on a sub sample using Harpenden skinfold calliper (Holtain Ltd. Crymych, UK) and commercially available tape measure. Both measurements were done in triplicate to the nearest 0,1 mm and 0,1 cm for TSF and MUAC, respectively. Body mass index (BMI) and corrected arm muscle area (cAMA) were calculated. [10]

Blood samples were analysed for ferritin, retinol-binding protein and transthyretin (TTR) using enzyme–linked immunosorbent assay (ELISA) according to the standard procedures in our laboratory.[11] Retinol, carotenoids (lutein, zeaxanthin, α-carotene, β-carotene, β-cryptoxanthin, lycopene) and α-tocopherol were determined by a reversed-phase high-performance liquid chromatography method as described previously.[11] Total protein and cholesterol were analysed using BCA method[12] and cholesterol oxidase assay method (Infinity™ Cholesterol, Thermo Trace, Australia).

Statistics

Data was analysed by statistical program SPSS 10.0 for Windows (SPSS Inc., Chicago, USA). Statistical comparison between the results for primiparous and multiparous women was carried out with a parametric method (t-test) and nonparametric method (Mann-Whitney U-test). Probability values below 0.05 were considered significant.

Results

94 pregnant participants, ranging in age from 15 to 41 years, 51 of whom were primiparous and 43 multiparous (38 second pregnancy, three third pregnancy, two fourth pregnancy) were enrolled in the study. General characteristics of the study population are shown in Table 1. 19.4% of the study population were below 20 years of age. All of them were in the primiparous group. Most of the study population were house wives or engaged in farming activities. 43.8% of the women lived below the official poverty line of Khon Kaen Province (885 Baht/month, 1 US$ = 42 Baht).[13]

Table 1. General characteristics of the study population, means ± standard deviation.

Variable	Study population $N = 94$
Age < 20 years (%)	19.4
Gestational age (month)	10.2 ± 1.8
Income per capita (Baht)	1435 ± 1329
Below poverty line (%) †	43.8

† Income < 885 Baht per month/capita

Table 2 shows the means of age, height, weight, BMI, MUAC, TSF and cAMA for primiparous and multiparous women. All parameters except height showed a significant difference between parity groups. Primiparous women were found to have lower values compared to multiparous. BMI and MUAC in multiparous women were on average 3.4 kg/m^2 and 2.6 cm higher, respectively. After adjusting for age and socio-economic status the significant difference persisted for all parameters but TSF. The analysis of blood samples revealed no significant differences in blood parameters between the primiparous and multiparous group, except for serum retinol (Table 3). However, a tendency for higher values for multiparous women was observed.

The prevalence for PEM by BMI, MUAC and cAMA in primiparous women was significantly higher compared to multiparous ones (Table 4). None of the women in the multiparous group showed a BMI below 18.5 kg/m^2. No differences in prevalence of IDA and VAD were found between both study groups, although a slightly lower

Table 2. Anthropometrical characteristics of pregnant women according to parity, means ± standard deviation.

	Primipara $N = 51$	Multipara $N = 43$	*P*-value
Age (years)	23.1 ± 5.2	29.3 ± 4.9	0,000
Weight (kg)	48.8 ± 6.9	57.2 ± 11.1	0.006
Height (cm)	154.2 ± 0.5	154.7 ± 0.6	0.684
BMI (kg/m$^{2)}$	20.5 ± 2.6	23.9 ± 4.6	0.000
MUAC (cm) †	24.1 ± 2.4	26.7 ± 2.9	0.000
TSF (mm) †	13.9 ± 4.4	16.3 ± 4.2	0.016
cAMA (cm^2) †	24.6 ± 4.9	30.9 ± 7.7	0.000

† Sub sample: $N = 37$ for Primipara, $N = 37$ for Multipara

Table 3. Serum proteins, vitamins and iron parameter of pregnant women according to parity, means ± standard deviation.

	Primipara *N* = 51	Multipara *N* = 43	*P*-value
Total protein (g/l)	57.5 ± 1.6	57.0 ± 1.4	0.194
Transthyretin (µmol/l)	5.0 ± 1.1	5.5 ± 1.6	0.126
RBP (µmol/l)	1.038 ± 0.252	1.138 ± 0.400	0.168
RBP/TTR ratio	0.21 ± 0.07	0.22 ± 0.10	0.518
Retinol (µmol/l)	1.15 ± 0.24	1.29 ± 0.32	0.025
α-Tocopherol (µmol/l)	17.04 ± 4.29	17.13 ± 4.65	0.923
Haemoglobin (g/l)	117.4 ± 11.2	118.5 ± 10.1	0.663
Haematocrit (%)	37.4 ± 2.9	37.8 ± 2.8	0.552
Ferritin (µg/l) †	60.6 ± 67.9	85.3 ± 87.8	0.202

† *N* = 37 for Primipara, *N* = 29 for Multipara

Table 4. Prevalence of malnutrition in pregnant women according to parity, in percent.

	Primipara *N* = 51	Multipara *N* = 43	*P*-value
BMI < 18,5 (kg/m^2) †	25.5	0	0.001
MUAC < 23 (cm) §	25.0	2.7	0.010
cAMA < 21,6 (cm^2) §	27.5	5.4	0.032
IDA †	7.3	4.9	0.632
VAD ‡	3.9	2.5	0.550

† Ferritin and haemoglobin below cut-off 12µg/l and 110g/l, respectively; ‡ Serum retinol < 0,7 µmol/l; § Subsample: *N* = 37 for Primipara, *N* = 37 for Multipara

Table 5. Serum carotenoids in µmol/l (µmol/g cholesterol) and cholesterol in mmol/l of pregnant women according to parity, means ± standard deviation

	Primipara *N* = 51	Multipara *N* = 43	*P*-value
Carotenoids			
Lutein	0.297 ± 0.146	0.326 ± 0.169	0.391
	(0.074 ± 0.037)	(0.072 ± 0.034)	0.740
Zeaxanthin	0.030 ± 0.012	0.034 ± 0.053	0.562
	(0.007 ± 0.003)	(0.008 ± 0.013)	0.788
β-Cryptoxanthin	0.154 ± 0.099	0.124 ± 0.071	0.115
	(0.038 ± 0.022)	(0.027 ± 0.016)	0.018
α-Carotene	0.035 ± 0.019	0.037 ± 0.021	0.632
	(0.009 ± 0.004)	(0.008 ± 0.004)	0.679
β-Carotene	0.272 ± 0.142	0.325 ± 0.372	0.366
	(0.069 ± 0.043)	(0.073 ± 0.091)	0.804
Lycopene	0.040 ± 0.037	0.037 ± 0.050	0.708
	(0.010 ± 0.008)	(0.008 ± 0.009)	0.332
Cholesterol	4.11 ± 0.85	4.59 ± 0.76	0.009

prevalence could be seen for multiparous women in the study. Prevalence of PEM (BMI <18.5 kg/m^2), IDA (ferritin <12µg/l and haemoglobin <110g/l) and VAD (serum retinol <0.7 µmol/l) in the total study population were 15.1%, 6.3% and 3.3%, respectively. Table 5 shows mean serum carotenoids and cholesterol concentrations in the study population. Except for cholesterol, no differences between both parity groups could be observed.

Discussion

Early marriage with subsequent childbearing is still widespread in developing countries. The consequences of this practice with regards to the nutrition and health of the mother and her offspring have been covered extensively.[4,14,15] There are few studies, however, which focus on the influence of parity on the nutritional status of pregnant women. In Bangladesh lower serum vitamin A levels in primiparous lactating women were observed compared with multiparous ones[16], while studies in England and Brazil found a positive correlation between parity and BMI or body weight.[17,18] However, there has been no study addressing this question with regard to the influence of parity on nutritional status.

We studied the nutritional status of pregnant women in the first trimester in the north-eastern province of Thailand, Khon Kaen. In our study population 19.4% of participants were pregnant before the age of 20. Thus, the trend of increasing the age at first birth, which started some 30 years ago after the introduction of the Family Planning Program in Thailand, could not be confirmed in our study. Compared with published data from the UN[8] the observed prevalence of teenage pregnancy was almost double. A correlation between poverty and early pregnancy has also been shown elsewhere.[19,20] Thus, the high prevalence of poverty in our study population, to which the aftermath of the economic crisis in 1997 might have contributed, could explain the higher number of early pregnancies.

The anthropometric measurements BMI, MUAC, cAMA and TSF as well as the blood parameters cholesterol and serum vitamin A (retinol) for primiparous women showed significantly lower values compared with multiparous women. The difference persisted even after adjusting for age and socio-economic status in BMI, MUAC and cAMA. In addition, PEM was more prevalent in the primiparous group. Our findings are consistent with other publications which correlate increasing parity with higher BMI or body weight, triglyceride levels and diabetes.[17,21-23] Rodrigues and Da Costa observed a lower energy consumption, waist-hip-ratio and percent body fat in women with lower parity.[17] A possible explanation for our findings could be a lower energy consumption of primiparous women as suggested by Rodrigues and Da Costa. Unfortunately, it was not possible to collect data on food intake.

Lower blood values for total protein, transthyretin, retinol-binding protein, haemoglobin, haematocrit and ferritin, in the primiparous group compared to the multiparous group were observed. However, the difference did

not reach the level of significance (P>0.05). Also, IDA and VAD tended to be more prevalent in primiparous women though not significantly. These slightly lower values might be explained by the high number of women younger than 20 years in the primiparous group. As reported by Dreyfuss *et al.,* (2000) parity seems to have no effect on the prevalence of anaemia.[24] However, we suggest a connection between age and the occurrence of anaemia since other studies have reported that young women (<18 or <20 years) showed a higher tendency to be anaemic.[25, 26]

Primiparous women showed significantly lower serum vitamin A concentrations than multiparous women. The same association was shown by Ahmed *et al.,* (2002) in lactating women in a poor urban setting.[16] However, the authors conclude that the age rather than the parity was the causative factor for this finding. Another report revealed a 1.7 times higher risk for VAD in younger women compared to older ones.[27] Also, no correlation between parity and serum vitamin A levels could be found by Panpanich *et al.,* (2003) in women during lactation in rural Thailand. Thus, as the parity effect disappeared after adjusting for age we assume our findings were due to the age difference between the two groups.

The prevalence of PEM in the total study population ranged from 14.3 to 16.9% depending on the indicator, which is in agreement with data released from the WHO.[28] Prevalence data for VAD in pregnant women in Thailand is scarce. However, the mean serum vitamin A level in our study showed to be slightly lower compared with two studies undertaken in Bangkok by Phuapradit *et al.,* with 1.21 µmol/l versus 1.31 µmol/l and 1.56 µmol/l.[29,30] Unpublished data from these studies observed 1.5% VAD in pregnant Thai women. These differences between our observation on VAD (3.3%) and the ones of Phuaradit *et al.,* are possibly due to the different study areas and income groups which were examined.

IDA was prevalent with 6.3% among all study participants which is a much lower value than the national average for Thailand (11.9%). This is probably due to defining IDA only as a haematocrit below 33% so there is a difficulty in comparing with our findings. Sethawanich *et al.,* (1998) however, described a similar low prevalence of IDA in pregnant Thai women.[31] Serum carotenoid concentrations between parity groups showed no differences. There is a great variability in serum carotenoid concentrations between different populations worldwide mainly depending on the carotenoid availability and thus the dietary intake. As a consequence, values for lutein for example vary from 0.27 µmol/l in US-American women to 0.69 µmol/l in Japanese women.[32] In addition, a varying seasonal food supply has been shown to alter serum carotenoid concentrations within the same population.[33] Lutein and β-carotene were the most prevalent carotenoids in the serum of study participants. Compared to a German reference group of non-pregnant women (data unpublished), Thai women showed two times higher serum lutein values. On the other hand, lycopene, cantha-xanthin and β-carotene reached just 27%, 38% and 41% of the German reference group. These variations in carotenoid supply among Western and Asian populations had been already described by us and others.[34,35] The high intake of green leafy vegetable rich in lutein and zeaxanthin in Asian communities might be cause for this finding.[34]

Conclusion

In our study we showed that the nutritional status of primiparous pregnant women was suboptimal with regard to BMI, MUAC and cAMA compared to multiparous women. All these indicators however, were shown to be age-independent. No significant differences could be observed in micronutrient status between both study groups, except for serum vitamin A. However, a tendency for a marginally better micronutrient status in multiparous women could be seen, although again due to the effect of age than parity. The mild to moderate prevalence of malnutrition found in this study population points to the need for nutritional interventions to reduce these deficiencies.

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Original Article

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泰国东北部孕妇的营养状况

本研究是对泰国东北部 Khon Kaen 的初产妇和经产妇怀孕前三个月的营养状况进行对比研究，调查两组人群的蛋白能量型营养失调，缺铁性贫血，维生素 A 缺乏和类胡萝卜素状况的差别。94 个试验者在第一次产前门诊时就参加本实验。从医院病例卡中获得了试验者的体重，身高，血红蛋白和红细胞比容的数据。人体测量法测量试验人员上臂围和三头肌皮褶厚度。维生素 A，类胡萝卜素，维生素 E 用反相高效液相色谱分析。铁蛋白、前清蛋白和视黄醇结合蛋白由酶联免疫分析。结果显示初产妇组身体质量指数、上臂围、校正的臂肌面积显著降低(P <0.001)，维生素 A,胆固醇和三头肌皮褶厚度也显著降低(P <0.05)。在校正年龄和社会经济条件后，除了三头肌皮褶厚度，上述其他参数仍旧有显著差别。尽管经产妇组铁蛋白、血红蛋白和红细胞比容有升高趋势，但是维生素 E，血清蛋白，类胡萝卜素和铁指标却没有显著差别。初产妇组蛋白能量型营养失调（身体质量指数小于<18.5 kg/m^2）显著高于经产妇组(P<0.05)。总试验者中蛋白能量型营养失调，缺铁性贫血和维生素 A 缺乏者分别 15.1%, 6.3 % and 3.3%。两组之间的缺铁性缺血和维生素 A 缺乏无差别。

关键词：营养状况、怀孕、维生素A、铁、类胡萝卜素。