Original Article

Dietary intakes and behaviours in pregnant women of Li ethnicity: a comparison of mountainous and coastal populations in southern China

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The aim of our study was to describe and compare nutritional status and food related behaviours in rural pregnant women of Li ethnicity as they had been divided into mountainous and costal groups by residential area. One hundred and ninety-six randomly selected healthy rural pregnant women of Li ethnicity for the mountainous group (MG), and eighty-two for the coastal group (CG) were recruited. Data were collected via demographic questionnaires, anthropometric measurements, food related behaviour questionnaires, five day dietary diaries and plasma folate tests. The mean (SD) age, years of education, and height of all participants were respectively 25.7 (3.99) years, 7.57 (2.45) years and 155 (5.04) cm, without significant group differences ($p>0.05$). Significant differences were shown in dietary intakes of protein, fat, carbohydrate, dietary fibre, thiamine, vitamin C, folate, potassium, sodium and magnesium between MG and CG ($p<0.05$). The prevalence of plasma folate deficiency differed significantly between groups (3.08% in MG vs 37.8% in CG, $p<0.001$). High prevalence of active or passive smoking (65.1% in MG vs 68.4% in CG), alcohol consumption (13.8% in MG vs 2.6% in CG), and betel quid chewing (19.6% in MG vs 53.9% in CG) were found in all participants. Differences in alcohol consumption and betel quid chewing rates between groups were also significant ($p<0.05$). In general, coastal Li pregnant women have a poorer plane of nutrition than their mountainous counterparts. Therefore, healthy diet and lifestyle education are urgently required and should be emphasised during routine prenatal care.

Key Words: food intake, dietary habits, behaviour, pregnant women, southern China

INTRODUCTION

The Li ethnic group is one of the fifty-five minority ethnic groups in China. They traditionally live in Hainan Island, which is located in the tropical region of China separated from the mainland by the Qiongzhou Strait. Accoding to the 5th National Census in 2000, the total population of Li ethnicity was 1,247,814. Due to centuries of chronic underinvestment, Hainan province is one of the most underdeveloped provinces in China and consequently the Li people have been living in relatively poorer conditions compared with populations in other regions of China. However, since the 1980's Hainan Island has gradually opened its doors to tourism and expanded agriculture and fishing businesses.[1] Various changes in the local people's lifestyles have led to a release from poverty, an overall improvement in living conditions, the meeting of basic human needs and an improvement in primary health care. One South African study confirmed that poverty, malnutrition and chronic household food insecurity are major problems in the informal settlement community.[2] Similar problems may emerge within the Li ethnic population.

Pregnant women have specific needs and require more attention within each ethnic population. An adequate plane of nutrition during pregnancy is essential for optimal fetal growth and development, whereas inadequacy is associated with an increased probability of low birth weight as well as an increased morbidity and mortality.[3] Nutrient requirements for pregnant women are extrapolated from the general adult population, after adjusting for increased needs. Requirements for many nutrients are higher than normal to support fetal growth and pregnancy demands.[4] Studies show that dietary intakes are generally low in pregnant women in China and rural areas of other developing countries.[5-9] Poor nutritional knowledge, poor education, low family income and lower socioeconomic status were the main influencing factors affecting dietary cravings and aversions in pregnancy.[10-13] Those factors could possibly determine food choices and result in poor food intakes.

With regard to assessment methods for dietary intake in pregnant women, 24 hours recall, seven day food

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record/dietary diary and food frequency questionnaire (FFQ) are frequently used. A Vietnamese study showed that FFQ could be applied to regions which have a similar environment, food sources and food habits, with good consideration for validation and modification of some dairy products, depending on dietary patterns in the regions.[14] Whereas, our study would focus on determining the dietary intakes in quantity rather than merely in patterns. Furthermore, women are more likely to change their food habits rapidly and frequently during pregnancy. Based on these reasons, we considered the use of food record/dietary diary method instead of FFQ. A Belgian study showed that a two day food record was able to estimate mean group intakes of iron, calcium and vitamin C and to rank individuals along the distribution of intakes.[15,16] To ensure its accuracy, a five day weighed food record was designed for our study.

Folic acid is necessary for cell development and the metabolism of specific biochemical reactions in the body, such as the conversion of homocysteine to methionine. The protective role of folic acid taken during the periconceptual period in reducing the occurrence of neural tube defects (NTD) has been well documented by epidemiological studies, randomized controlled trials and intervention studies.[17] A cross sectional study analyzing red cell folate concentration in women of childbearing age living in three Asian cities, revealed Beijing as the city with the lowest red cell folate concentration.[18] An Indian study reported lack of association between size at birth, and maternal energy and protein intake; but strong associations with folate status and with intakes of foods rich in micronutrients.[19] In addition to dietary intakes and food related behaviour, dietary folate intake and folate deficiency rate in pregnant women of Li ethnicity was one of our study interests.

The overall aim of our study was to compare the nutritional status and some food related behaviours of pregnant women of Li ethnicity living in the mountainous region with those who had emigrated to the coast.

MATERIALS AND METHODS

Subjects

The study field work was conducted over a 14 month period (June 2007 to August 2008) in Hainan Island, China. A lists of the names of all registered pregnant women residing in local rural areas were provided by local Population and Family Planning Commission offices. Eligible subjects were healthy rural pregnant women of Li ethnicity. Two hundred and seventy eight women were randomly selected, stratified by their living areas and recruited as participants. One hundred and ninety-six of them were selected from the central mountainous region; and eighty-two were selected from the east coastal region in the same province. They were respectively classified into the Mountainous Group (MG) and the Coastal Group (CG).The protocol was submitted in accordance with the existing policy for research in the institution and informed consents were obtained from all participants.

Measurements

Field procedures included demographic questionnaire, anthropometric measurement, plasma folate test, as well as a five day dietary diary and food related behaviour questionnaire. Participants were required to fill in a questionnaire including their demographic profile and other information such as stage of pregnancy. Individual interviews were conducted with participants who were illiterate. Afterwards, participants were measured for height and present weight, and weight gain was calculated. Participants were trained to weigh food with provided scales and were required to keep a record of all dietary information in the form of a five day dietary diary. For the purpose of quality control, each participant was required to weigh a bottle of water (210 g) or other items independently by using the provided scale after the training. Blood samples were simultaneously drawn from all participants to analyse their plasma folate level. All blood samples were stored in iceboxes and sent to the laboratory of Hainan Medical College Affiliated Hospital for immediate analysis. Seven days later, dietary diaries were collected and further questionnaires were given, which contained history of active or passive smoking, alcohol consumption, betel quid chewing and other food related behaviours. One plasma sample in the mountainous group was lost due to the tube breaking in the centrifuge. Diaries and food related questionnaires with uncompleted information were excluded. Finally, two hundred and seventy-seven plasma samples (195 in MG, 82 in CG), two hundred and sixty-five dietary diaries and food related questionnaires (189 in MG, 76 in CG) had been successfully collected.

Statistical analyses

Data from dietary diaries were entered into- and automatically computed by 'Food Nutrients Computer, Version 1.6' (Nutrition and Food Safety Institute of China Centre for Disease Control and Prevention, Beijing, China), based on the Chinese Food Composition Tables.[20] The daily intakes of energy, protein, fat, carbohydrate, dietary fibre, vitamins, and minerals intakes, as well as the energy distribution in meals were recorded. Data analyses were performed using Statistical Package for Social Sciences for Windows version 10.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics (frequencies, means and standard deviations), Students' t test, ANOVA and chi-square test were used for comparison. Statistical significance was set at $p<0.05$.

RESULTS

Demographic profile and anthropometry

All participants were from a Li ethnic population aged from 17-35 years, with a mean (SD) of 25.7 (3.99) years. The years of education received for all participants ranged from 0-15 years, the mean (SD) was 7.57 (2.45) years. The mean (SD) for height was 155 (5.04) cm. There were no statistical differences in age, years of education and height between groups. Hence, there was no significant demographic and anthropometric difference between groups.

The mean height (cm) and weight gain (kg) between groupers in different gestation stage are reported in Table 1. No significant height difference was found. The weight gain differences between groups within first, second or third trimesters were not significant either.

Table 1. Height and weight gain differences between groupers in different gestation stages (mean±SD)

Gestation stage		Mountainous Group	Coastal Group	*p* value
	n	13	7	
1st trimester	Height(cm)	155±3.91	156±3.81	ns
	Weight gain(kg)	1.29±4.25	2.61±3.71	ns
	n	64	33	
2nd trimester	height(cm)	156±5.82	157±6.78	ns
	Weight gain(kg)	5.28±2.37	4.82±4.29	ns
	n	119	42	
3rd trimester	Height(cm)	155±5.19	155±5.09	ns
	Weight gain(kg)	9.11±5.18	10.18±6.72	ns

Table 2. Daily energy and nutrient intakes in different groups (mean±SD)

	Mountainous Group (*n*=189)	Coastal Group (*n*=76)	*p* value	Chinese RNI/AI
Energy (kcal)	2149±388	2143±317	ns	2300 †
Protein (g)	72.9±19.8	83.8±20.6	<0.001	80 †
Fat (g)	75.9±22.4	56.4±16.1	<0.001	65 ‡
Carbohydrate (g)	295±76.6	325±57.2	<0.05	345 ‡
Dietary fibre (g)	16.4±31.5	9.09±3.43	<0.05	30
Vitamin A (μg RE)	780±608	814±604	ns	900 §
Thiamine (mg)	0.98±0.38	0.80±0.41	<0.001	1.5
Riboflavin (mg)	1.41±1.97	1.05±0.35	ns	1.7
Vitamin C (mg)	134±80.9	97.8±56.2	<0.001	130 §
Folate (μg DFE)	369±65.1	286±61.1	<0.001	600
Niacin (mg NE)	31.7±12.7	31.4±8.47	ns	15
Vitamin E (mg α-TE)	20.8±59.1	12.7±6.57	ns	14
Fe (mg)	27.6±10.4	28.2±8.46	ns	25 §
Ca (mg)	586±370	619±421	ns	1000 §
P (mg)	1309±449	13439±2939	ns	700
K (mg)	2575±1034	2117±721	<0.001	2500
Na (mg)	4897±2070	3749±1101	<0.001	2200
Mg (mg)	400±129	370±79.1	<0.05	400
Zn (mg)	15.5±5.02	15.8±3.77	ns	16.5 §
Se (μg)	76.7±32.3	85.8±33.2	<0.05	50
Cu (mg)	2.54±2.03	1.65±0.56	<0.001	2.0 ¶
Mn (mg)	7.84±2.76	7.86±2.15	ns	3.5 ¶

RNI: Reference Nutrient Intake, AI: Adequate Intake, RE, retinol equivalent; DFE, Dietary Folate Equivalent; NE, Niacin Equivalent; α-TE, α-TocopherоI equivdents; ns, not significant

† reference for 2nd trimester pregnant women with Physical Activity Level (PAL)=1.56

‡ calculated by reference percentage of Energy Intake (EI): 15% EI from protein, 25% EI from fat, 60% EI from carbohydrate (CHO). 1g protein=4kcal EI, 1g fat=9kcal EI, 1g CHO=4kcal EI

§ reference for 2nd trimester pregnant women

¶ No reference value for pregnancy. AI for adult aged 18~49 was taken.

Plasma folate level

Six (3.08%) participants in MG and thirty one (37.8%) in CG were diagnosed with folate deficiency (plasma folate level below 3 ng/mL). There was a significant difference between the two groups as indicated by chi-square test results (χ^2=60.2, p<0.001).

Daily oil and table salt consumptions

The mean (SD) daily oil and table salt consumptions were respectively 25.1 (5.85) g and 9.14 (3.42) g for all participants. Oil consumption was close to the Chinese Reference Value of 25 g/day for adults over 18 years.[21] However, table salt consumption was 152% of the reference value, which is only 6g/day for adults over 18 years of age.[21]

The mean (SD) daily oil consumptions were 25.6 (5.69) g in the MG and 23.7 (6.06) g in the CG. The mean (SD) table salt consumptions were 9.78 (3.47) g in the MG and 7.56 (2.72) g in the CG. Significant statistical differences were found both in daily oil and table salt consumptions between the groups (p< 0.05). The mountainous group had much higher oil and table salt consumptions than the CG.

Daily dietary energy and nutrient intakes

Daily intakes of energy, protein, fat, carbohydrate, dietary fibre, as well as vitamins and minerals; and the corresponding Chinese Reference Nutrient Intake (RNI)/ Adequate Intake (AI) values are listed in Table 2.[21] Differences between groups were analysed by independent t-test.

In Table 2, nutrients that met the Chinese References in both groups were niacin, iron, phosphorus, sodium, selenium, and manganese. Nutrients that met the Chinese References only in the MG were fat, vitamin C, vitamin E, potassium, magnesium, and copper. Protein was the only nutrient that met the Chinese References in the CG but not in the MG. Vegetables formed the main part of the

Table 3. Questions and answers of food related behaviours in rural Li pregnant women, n (%)

Questions	Mountainous Group (n=189)		Coastal Group (n=76)		*p* value
	Yes	No	Yes	No	
Demand for nutrition counselling or instruction from professionals	143 (75.7)	46 (24.3)	58 (76.3)	18 (23.7)	ns
Willingness to change present unhealthy food habits	152 (80.4)	37 (19.6)	63 (82.9)	13 (17.1)	ns
Food prohibition during pregnancy	118 (62.4)	71 (37.6)	41 (53.9)	35 (46.1)	ns
Physical activities in late pregnancy	132 (69.8)	57 (30.2)	55 (72.4)	21 (27.6)	ns
Smoking during pregnancy (active or passive)	123 (65.1)	66 (34.9)	52 (68.4)	24 (31.6)	ns
Alcohol consumption during pregnancy	26 (13.8)	163 (86.2)	2 (2.63)	74 (97.4)	<0.05
Betel quid chewing during pregnancy	37 (19.6)	152 (80.4)	41 (53.9)	35 (46.1)	<0.001
Prenatal examination more than one time	169 (89.4)	20 (10.6)	70 (92.1)	6 (7.89)	ns

MG population's diet; whilst the CG population more frequently consumed food derived from animals. Folate intake was remarkably low in both groups and did not even meet the current recommended amount to reduce the risk of neural tube defects in pregnancy (400 μg DFE (Dietary Folate Equivalent)).

Food related behaviours

Results of food related behaviours in the MG and the CG are reported in Table 3 and were analysed by Chi-square test. Table 3 shows significant group differences in habits of alcohol consumption and betel quid chewing during pregnancy. Mountainous group had higher alcohol intake than the CG. Coastal group had higher betel quid chewing rate than the MG. Drinking home-made rice wine is a tradition in the Li population from the mountainous region. Whereas, the habit of betel quid chewing is prevalent in the coastal region in Hainan Island, as it is in Taiwan and other South and Southeast Asian countries.[22,23]

There were no significant differences found between the groups in terms of: demand for nutrition counselling or instruction from professionals, willingness to change present unhealthy habits, physical activities in late pregnancy, active or passive smoking in pregnancy and prenatal examination history.

Although no significant group difference was found in food prohibitions during pregnancy, food prohibition rate was generally high in both groups and food prohibitions were rather popular and common in populations of Li ethnicity. For the open-ended question of "what are the food prohibitions in pregnancy?", most frequent answers were hot and spicy food (78.11%), cigarettes and alcohol (56.23%), coffee or tea (9.43%), and some special fruits (7.92%).

DISCUSSION

Dietary intakes and nutritional status

The mean weight gain was generally low at every stage of pregnancy when compared to other study result in China.[24] Weight gain during pregnancy less than 10 kg or low maternal weight was reported as an attributable risk factor for low birth weight (LBW).[25,26] Low weight gain or low BMI during pregnancy was attributed to chronic energy deficiency.[27] Our result showed both the MG and CG populations had lower energy intake than the Chinese reference value although there was no significant difference between groups. Unlike the increasing concern in developed countries of having large babies, LBW babies are more common in developing countries.[25,26] To control the prevalence of LBW babies, energy intake in pregnant women must be increased.

Besides energy intake, intake of some nutrients in both groups did not meet the Chinese reference intake values, such as carbohydrate, dietary fibre, vitamin A, thiamine, riboflavin, calcium and zinc. Therefore, the overall nutritional status in pregnant women of Li ethnicity is poor regardless of region.

Attention should also be paid to the differences between the groups. Participants in the CG had higher protein and selenium intakes, whereas those in the MG had higher intakes of table salt, dietary fibre, thiamine, vitamin C, folate, and potassium. Meanwhile, group differences were also found in some food related behaviours. The CG had lower alcohol consumption but higher use of betel nuts. Our results indicated that pregnant women of Li ethnicity were willing to take advantages of local food. Li pregnant women in coastal regions showed the tendency of consuming fewer vegetables with more animal foods, which led to relatively higher protein intake. However, one of the adverse consequences is the high prevalence of folate deficiency (37.8%) in the CG, which was close to the plasma folate deficiency frequencies (44%-50%) reported in the high prevalence areas of northern China.[28,29] Another related Chinese study also showed that a marked insufficient intake of folic acid might be an important risk factor for the high prevalence of birth defects in those regions.[30] For the prevention of NTD, it is recommended that a woman of childbearing age consume foods that result in a daily folate intake of 400 μg DFE; however, the average dietary folate intake without fortification is only half that amount.[31] Since folic acid fortification has not been implemented in rural China yet, folate deficiency is more prevalent in regions with lower intakes of fresh fruit and vegetables, such as in the coastal region of Hainan Island.

Food related behaviours

Findings of interest on food related behaviours were: high prevalence of all participants suffering from active or passive smoking (65.1% in MG, 68.4% in CG) and a high rate of betel quid chewing, especially in coastal Li pregnant women (53.9%). The rate of exposure to smoke in our study was close to those reported in Taiwan, Lublin, India and Saudi Arabia;[32-35] and much higher than those reported in Poland (8.1% for active smoking, 25.5% for passive smoking).[36,37] The rate of betel quid chewing in

Li pregnant women is much higher than that reported in the Taiwanese aboriginal population (6.3% in women).[22] Betel quid chewing rate in the MG was found to be triple of that found in Taiwan, whereas the rate in the CG was 8.6 times that of Taiwan. Another Taiwanese study showed women chewing Betel quid had a lower cessation rate (27.5% in men, 12.7% in women).[38] This result may indicate that Li females are less likely to cease chewing during pregnancy, and our study result supported it.

Regular exposure to smoke in pregnancy significantly increases the rate of having a LBW- or small for gestational age (SGA) infant, as well as other several adverse pregnancy outcomes.[49-41] With regards to betel quid chewing, a series of Taiwanese studies have produced strong evidence for adverse effects on a number of birth outcomes, including the sex ratio at birth, lower birth weight and reduced birth length.[42-44] In addition to the effects on babies, betel quid chewing is also a risk factor for some chronic conditions in mothers. Oral diseases including oral submucous fibrosis (OSF), oral leukoplakia (OL) and oral cancer are strongly association with betel quid chewing.[45-47] A higher risk of cirrhosis was also associated with longer duration of betel quid chewing and greater amount of betel quid consumed.[48]

In general, the traditions of some food prohibitions and physical activities in late pregnancy were preserved in the Li population regardless of region. From the answers to some open-ended questions, we found local people believed that less physical activities caused difficulties in delivery, large babies and a longer pregnancy. Rural women believe that eating rabbit may cause harelip in the newborn baby, so rabbit meat is one of the food prohibitions during pregnancy. Such traditional beliefs are passed down from previous generations. However, many participants now receive information from multiple sources; for example: television, radio, newspaper and magazines, and even via internet. As a result, possible conflicts between tradition and modern ideas may have occurred, and the participants may have realized that some of those traditions were not evidence based. Consequently, the demand for nutrition counselling or instruction from professionals was high in both groups (75.7% in MG, 76.3% in CG); rate of willingness to change present unhealthy habits was also extremely high (80.4% in MG, 82.9% in CG).

Another finding was the remarkablely high rate of prenatal examination (89.4%in MG, 92.1% in CG) in rural Li pregnant women. On the one hand, as mentioned above, harmful food related habits were prevalent in Li pregnant women; on the other, they expressed a positive attitude and demand for nutrition and health, as well as a willingness to change their present unhealthy habits. This may have resulted from increased opportunities by the health workers to communicate with pregnant women in hospitals or clinics compared to before. Health education has been proved to improve nutrient intake and a change of behaviour in pregnant women.[49-51] Prenatal care from health professionals should be more active to promote further nutrition education, as well as monitoring pregnant women's health status.

In general, our research found that dietary energy and nutrient intakes were low, and prevalence of harmful food related habits such as alcohol consumption, smoking and betel quid chewing was relatively high in all rural Li pregnant women. Prevalence of folate deficiency was high in the coastal region. In conclusion, Li pregnant women in the coastal region have a generally poorer nutritional status when compared to those in mountainous region. Based on our findings; nutrition and health education, dietary advice on the harmful effects of alcohol, betel quid and cigarettes use during pregnancy are required and should be emphasised during routine prenatal care.

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AUTHOR DISCLOSURES

No conflict of interest exists for any author.

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Original Article

Dietary intakes and behaviours in pregnant women of Li ethnicity: a comparison of mountainous and coastal populations in southern China

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中國南方黎族孕妇的膳食摄入和饮食行为：山區和沿海住民的比較

本课题研究了黎族农村孕妇的营养状况和饮食相关行为。为着重研究其居住地区间的差异，随机抽取 278 名健康黎族农村孕妇为调查对象，其中 196 名来自山区(MG)，82 名来自沿海(CG)。对调查结果进行了描述性研究和组间对比分析。调查内容包括收集人口学资料、进行人体测量、饮食相关行为问卷调查、5 日膳食摄入記錄和血清叶酸水平测定。全体调查对象的平均年龄为 25.7 (3.99)岁，平均受教育年限为 7.57 (2.45)年，平均身高为 155 (5.04)厘米，两组间差异无统计学意义（p>0.05）。但是山区组和沿海组的蛋白质、脂肪、碳水化合物、膳食纤维、维生素 B_1、维生素 C、叶酸、钾、钠和镁的膳食摄入量差异有统计学意义（p<0.05）。山区组的血清叶酸缺乏率为 3.08%，而沿海组为 37.8%，两组间有顯著差异（p<0.001）。两组调查对象中，不良饮食相关行为发生率均高，山区组的主动或被动吸烟率为 65.1%，沿海组为 68.4%；山区组的饮酒率为 13.8%，沿海组为 2.6%，两组间差异有统计学意义（p<0.05）；19.6%的山区组调查对象有嚼槟榔习惯，而 53.9% 的沿海组调查对象有此习惯，两组间差异有统计学意义（p<0.05）。总之，本研究发现居住在沿海地区的黎族农村孕妇总体营养状况较山区孕妇差。建议加强黎族农村孕妇的孕期保健工作，应对其开展有关合理膳食、健康生活方式等内容的宣教活动。

關鍵字：食物攝取、膳食習慣、行为、孕妇、中國南方