# Socioeconomic disparity in the diet quality of pregnant women in Northwest China

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## ABSTRACT

**Background and Objectives:** Few studies have described the socioeconomic disparity of dietary quality in Northwest China. The present study aimed to evaluate the diet quality of pregnant women in Shaanxi province of Northwest China by using the Diet Balance Index for Pregnancy (DBI-P) and explored the relationships with socioeconomic status (SES). **Methods and Study Design:** A cross-sectional analysis of data from 7,630 women who were pregnant during 2012-2013 was performed. Dietary intake during the whole pregnancy was assessed by FFQ within 12 months (median, 3 months; 10th-90th percentile, 0-7 months) after delivery. Diet quality evaluated by the DBI-P was related to socioeconomic factors. **Results:** Most women had insufficient consumption of vegetables (72.27%), dairy (89.58%), meat (82.07%), fish and shrimp (92.23%), eggs (62.54%), and dietary variety (97.92%). 67.76% of women had excessive intake of grains, and 87.77% and 69.79% of participants had surplus consumption of edible oil and salt respectively. Women with higher education, occupation and household wealth index (HWI) consumed more vegetables, fruit, dairy, soybean and nuts, meat, fish and shrimp, eggs, edible oil, alcohol and dietary variety but less grains and salt. After adjusting for confounders, education, occupation and HWI were negatively associated with the level of inadequate dietary intake. Conversely, individuals with medium HWI had higher level of excessive dietary intake compared to low HWI groups. **Conclusions:** The diet quality of pregnant women in Northwest China was associated with SES. Socioeconomic disparities in diet quality should be considered when planning nutrition interventions for pregnant women.

**Key Words: pregnant women, diet quality, diet balance index for pregnancy, socioeconomic status, Northwest China**



## INTRODUCTION

Socioeconomic status (SES) plays an important role in health.[1] In high-income countries, a large number of epidemiological studies have suggested that SES is associated with diet quality.[2] As higher SES groups are more likely to follow a healthier diet, dietary may be one of the factors that explains social disparities in health. China is the largest middle-income country in the world, and economic development varies greatly by region, with economic level declining from eastern coastal areas to western areas. In recent years, there have been a few studies related to the social patterns of dietary in China.[3-5] However, such studies were focused in eastern or southern areas, and nutrition epidemiology evidence in Northwest China is scarce.

In general, two methods are used to describe overall diet. The first approach is to identify dietary patterns with statistical techniques such as principal component analysis. Dietary pattern analysis has overcome the methodological limitations of single foods and nutrients and has become increasingly popular as an alternative approach to examine the association between dietary and health outcomes. Another way to assess overall diet quality is to develop a composite quality score of foods and nutrients based on dietary recommendations. Examples include the Diet Quality Index,[6,7] the Healthy Eating Index,[8] and the Diet Diversity Score.[9] Similarly, the Diet Balance Index (DBI) was established for Chinese people, considering the uniqueness of Chinese dietary patterns and habits.[10,11] The DBI consists of six components, and each component has a positive score or a negative score which reflect undernutrition and over-nutrition problems respectively. Moreover, based on the DBI, the Diet Balance Index for Pregnancy (DBI-P) was developed to measure compliance with the nutrition recommendations during pregnancy.[12]

In 2013, a population-based cross-sectional survey was conducted in Shaanxi province of Northwest China to explore the risk factors of adverse pregnancy outcomes, such as birth defects. With the data, the current study aims to evaluate overall diet quality during pregnancy by using the DBI-P and to investigate the associations with SES. To some extent, the findings of the present study can provide some valuable guidance on nutrition intervention.

## MATERIALS AND METHODS

### *Study design and participants*

The study employed data from a cross-sectional survey conducted from August to November 2013 in Shaanxi province of Northwest China. The target population of the survey were women who were pregnant during 2010-2013 and had pregnancy outcomes before they were enrolled. The survey has been described in detail elsewhere.[13-15] Briefly, a stratified multistage random sampling method was adopted to determine the sampling units because of the differences in the distribution and fertility rates of populations between rural and urban areas in the whole province. In the first step, 20 counties and 10 districts were randomly selected from the entire province. In the second step, six townships in the chosen counties, and three streets in the chosen districts were randomly sampled. Next, six villages from each chosen township, and six communities from each chosen street were randomly selected. Subsequently, a random sampling method was adopted to select 30 or 60 women within each sampled village or community respectively. Data for the participants was collected by face-to-face interview using a self-designed structured encoded questionnaire. In total, 30,027 women who were pregnant during 2010-2013 consented to participate in the survey, which had a response rate of 93%. Among the participants, 7,749 women who were pregnant during 2012-2013 and had infants <12 months old were further interviewed to report their diets during pregnancy. 119 participants were excluded from analysis due to multiple gestation (n=87), or incomplete data (n=32). This resulted in a total of 7,630 women for statistical analysis.

The survey was conducted according to the guidelines in the Declaration of Helsinki. All procedures involving human subjects were approved by the ethics review committee of the Xi'an Jiaotong University Health Science Center (No.2012008). All subjects provided written informed consent for their participation in the survey.

### *Dietary data collection*

As previous studies showed that dietary pattern and food types did not change appreciably from early pregnancy to the third trimester,[16,17] and for large epidemiological studies, it is burdensome and expensive to collect dietary data at more than one period during pregnancy,[17] we assessed average dietary intakes during the whole pregnancy at one time in this survey. Participants who have given birth to a child less than 12 months (median, 3 months; 10th-90th percentile, 0-7 months) were asked to complete a FFQ retrospectively. The FFQ during the whole pregnancy was established according to the previously validated FFQ which was designed for pregnant women during the third trimester in northwest China.[18] The FFQ used in this study consisted of 107 food items, including 9 kinds of grains and potatoes; 27 kinds of vegetables; 13 kinds of fruit; 11 kinds of meat and products; 1 kind of eggs; 9 kinds of soybean products and nuts; 3 kinds of dairy and products; 4 kinds of fish, shrimp and shellfish; 6 kinds of fungi and algae food; 8 kinds of alcoholic and non-alcoholic beverages; 11 kinds of sugar, snacks and fast foods; and 5 kinds of edible oil and condiments. The frequency scale of edible oil and condiments was open-ended and was listed as kilograms per month and the number of people who regularly consumed them (children under the age of 12 were converted into one-half of one person). The other 102 food items had a choice of eight frequency categories ranging from 'never or almost never' to 'two or more times per day', and these frequencies were converted to daily equivalent frequencies. Estimates of portion sizes for the 102 food items were recorded as large, medium or small with the assistance of food portion images.[19]

***Dietary Balance Index for Pregnancy***

The Diet Balance Index for Pregnancy (DBI-P) was slightly modified from the Diet Balance Index (DBI) for Chinese pregnant women of three trimesters, based on the Dietary Guidelines[20] and the Dietary Reference Intakes for Chinese people.[21] The details of DBI and DBI-P have been described elsewhere.[12,22,23]

DBI-P consists of six components, including: (i) grains; (ii) vegetables and fruit; (iii) dairy products, soybean products and nuts; (iv) animal food; (v) condiments and alcoholic beverages; and (vi) diet variety. In particular, the diet variety is composed of 12 food groups, including: (i) rice and rice products; (ii) wheat and wheat products; (iii) coarse grains and potatoes; (iv) dark-coloured vegetables; (v) light-coloured vegetables; (vi) fruit; (vii) milk and dairy products; (viii) soybean products and nuts; (ix) red meat and meat products; (x) poultry and game; (xi) fish, shrimp and shellfish; and (xii) eggs.

Vegetables, fruit, dairy products, soybean products and nuts, and dietary variety, which are recommended to be consumed sufficiently by the Dietary Guidelines, have negative scores. In contrast, condiments and alcoholic beverages, which are recommended to be consumed sparingly by the Dietary Guidelines, have positive scores. In addition, grains and animal food, which are recommended to be consumed moderately by the Dietary Guidelines, have both negative and positive scores. A score of 0 for each DBI-P component indicates the recommended intake amounts are met.

Taking into account the nutritional requirements of each stage, the scoring methods of DBI-P in different trimesters are different. In general, in the index, food intake amounts for the same score increase from the first trimester to the third trimester. To evaluate the average diet quality of whole pregnancy, the different ranges of intake amounts for the same score in the three trimesters was averaged. For instance, as 0 points corresponds to the grains intake of 275~300 g, 300~325 g and 350~375 g in the first, second and third trimesters respectively, 0 points were obtained when an average of 308.3 to 333.3 g was consumed during the whole pregnancy. The previous scoring method for the three trimesters and the adjusted scoring method for the whole pregnancy are shown in Table 1.

In the DBI-P, two indicators, the low band score (LBS) and the high band score (HBS), are usually used to reflect dietary quality. The LBS is equal to the sum of the absolute values of all negative scores, reflecting the degree of inadequate dietary intake. The HBS is equal to the sum of the absolute values of all positive scores, reflecting the degree of excessive dietary intake. Both the HBS and the LBS are continuous variables that ranged from 0 to 32 and 0 to 60, respectively. Then, each dietary indicator is divided into five levels: the score of 'no problem' is 0, meaning an excellent dietary intake; the score of 'almost no problem' is less than 20% of the total score, meaning a good dietary intake; the score of 'low level' is between 20% and 40% of the total score, meaning an acceptable dietary intake; the score of 'moderate level' is between 40% and 60% of the total score, meaning a poor dietary intake; the score of 'high level' is more than 60% of the total score, meaning a very poor dietary intake.

***Socioeconomic status***

Income, education and employment status are commonly used to characterize socioeconomic groups. However, due to the lack of accurate income data in epidemiologic surveys, the household wealth index (HWI) constructed from an inventory of household assets or facilities was considered a superior measure of economic status compared to income.[24,25] In this study, HWI was constructed through principal component analysis using five variables of family economic level:[26] housing conditions, type of vehicle, income resources, and type and number of household appliances. The first principal component could explain 48.39% of the total variance and was categorized as tertiles indicating the poor, middle-income and rich households. Maternal education refers to the highest level of education attained. The variable was categorized in three groups: high (senior high school or above), medium (junior high school) and low (illiterate or primary school). Regarding maternal occupation, seven categories were assessed by questionnaire and were grouped into three levels: low occupation level (manual work), medium occupation level (non-manual work), high occupation level (professional work).

***Potential confounders***

Factors that have been found to affect dietary quality or intakes in previous studies were considered as potential confounders[14,22,27] and were adjusted in multivariate analysis. Childbearing age (years) was computed from the maternal birthday and the child's birthday. Childbearing season was defined based on the child's birth month: March-May was classified as spring; June-August as summer; September-November as autumn; and December-February as winter. The mothers were considered as primipara if they reported 'no previous pregnancy' before this pregnancy. Geographically, Shaanxi province was divided into three regions: northern, middle and southern, with climate and lifestyle varying significantly across the three regions. In addition, urbanity was categorized as urban or rural.

### *Statistical analysis*

Initially, the mean and standard deviation (SD) were used to describe continuous variables, while count and proportions were used to describe categorical variables. Linear regression was adapted to derive the p-value for trend in the score of DBI-P components across three socioeconomic levels. Because of the adoption of the cluster sampling method in this survey, multilevel models were constructed to analyse the relationships between diet quality and SES. After running empty models, we observed the intra-class correlation was 0.08 ($p$<0.001) for the levels of LBS and 0.07 ($p$<0.001) for the levels of HBS at the county (district) level. Thus, the simplified 2-level generalized linear mixed models with a random intercept at the county (district) level was used to estimate the associations between the levels of LBS and HBS and socioeconomic factors. Then, three models were established one by one: with no adjustment separately (model 1); with adjustments for three socioeconomic factors together (model 2); and with adjustments for three socioeconomic factors together plus potential factors, including geography, urbanity, primipara, childbearing age and season (model 3). Childbearing age in years was introduced as a continuous variable and all other factors were included as categorical variables in the mixed models. Data were entered into Epidata version 3.1 (EpiData Association, Denmark) by double entry, and SAS version 9.4 (SAS Institute Inc., Cary, NC) was used for the data analysis. All reported p-values were 2-tailed, and the criteria for statistical significance was a $p$-value of <0.05.

## RESULTS

The characteristics of the participants are shown in Table 2. About half (54.47%) of the women were from central Shaanxi geographically, and 76.70% lived in rural areas. The mean ± SD of childbearing age of women was 26.64±4.59, and more than 36.99% were educated beyond junior high school, and 77.58% had a low occupation level. Amongst the mothers, the average gravidity was 1.50±0.50. Childbearing season was slightly higher during spring and winter than during autumn and summer.

Table 3 shows the distribution of the DBI-P components. Excessive grains intake was common, with 67.76% of pregnant women having a positive score. In contrast, inadequate intake of vegetables, meat and eggs were common, with more than half of pregnant women scoring in the negative range. Approximately 90% of women had insufficient consumption of certain food subgroups including dairy, fish and shrimp. Dietary variety was also below recommended levels, with almost all (97.92%) of the pregnant women having negative scores. For condiments and alcoholic beverages, 69.79% of pregnant women had a moderate or severe surplus of salt, and 87.77% of women consumed excessive edible oil. Alcohol consumption scores were good for most of the sample, with 98.05% of pregnant women not drinking at all. The distribution of dietary quality indicators is shown in Table 4. Almost all participants had a certain degree of inadequate and excessive intake, with a score of more than 0 in both the LBS (99.62%) and the HBS (98.32%).

We compared the score of DBI-P components across SES subgroups (Table 5). HWI was negatively associated with grains intake. Increasing educational, occupational and HWI levels were associated with increasing consumption of vegetables, fruit, dairy, soybean and nuts, meat, fish and shrimp, eggs and dietary variety. Pregnant women with higher education and HWI consumed more edible oil, while those with higher education and occupation consumed less salt. In addition, there was a positive linear correlation between alcohol intake with educational and HWI levels.

Associations between the levels of LBS and HBS and socioeconomic factors are shown in Table 6 and Table 7. Regarding the levels of LBS, in the unadjusted univariate analysis (model 1), the results show an inverse association between the levels of LBS with education, occupation and HWI. However, in the model with all three socioeconomic factors together (model 2), the associations between the levels of LBS with SES were partly attenuated, and the effect for medium vs. low education became not significant ($p$=0.10). Similar associations were observed after adjusting for covariates (including geography, urbanity, primipara, childbearing age and season) (model 3). Regarding the levels of HBS, only HWI showed a significant positive association with the levels of HBS in all three models, with medium HWI individuals having a higher level of HBS compared to low HWI individuals (OR=1.16; 95% CI 1.04, 1.29 (model 3)). Adjustment for other socioeconomic factors (model 2) and potential factors (model 3) modified risk but did not result in meaningful changes in the estimates of the effect of socioeconomic factors on the levels of HBS.



## DISCUSSION

The dietary quality of pregnant women in Shaanxi province of Northwest China was evaluated by the DBI-P in this study. Our results show that both inadequate and excessive food intake were prevalent among pregnant women, and diet quality was shown to be influenced by SES, which was characterized by occupation, education and HWI.

This study found that among pregnant women in Shaanxi province, insufficient intakes of vegetables, dairy, meat, fish and shrimp, eggs and dietary variety were common, while the proportion of excessive intake of grains, edible oil and salt was high, especially that of oil

(87.77%). In general, our results are similar with other epidemiological studies that have assessed dietary quality using the DBI since it was established in 2005.[22,23,28,29] These findings suggest that an unbalanced diet structure should be considered when developing nutritional intervention programs in China. In addition, our results indicate that the diet quality of the pregnant women in Shaanxi province of Northwest China was far from optimal, with almost all participants having a score of more than 0 for the LBS (99.62%) and the HBS (98.32%). The low level of adherence to dietary recommendations during pregnancy we observed is also consistent with previous studies in New Zealand,[30] Canada[31] and Australia.[32]

Despite subtle differences existed between three socioeconomic indicators, we found some disparities in dietary intakes on the whole. Pregnant women with higher SES had more consumption of vegetables, fruit, dairy, soybean and nuts, meat, fish and shrimp, eggs, edible oil, alcohol and dietary variety, and had less consumption of grains and salt. The ongoing China health and nutrition survey showed that China's food consumption patterns have changed dramatically since 1991, with a decreased consumption of coarse grains and legumes and an increased intake of edible oil and animal-source foods.[33] This result supports the hypothesis that nutrition transition possibly occurs first in high-SES individuals.[34]

To date, there is little evidence that SES and the indicators of diet quality, LBS and HBS, are related. Using 2002 National Nutrition and Health Survey data, among 28,320 adults aged from 18 to 59 years, He et al. founded a negative association between household income and educational level with LBS but a positive association between household income level with HBS.[35] Similarly, the dietary data of 2,748 rural residents aged 18-80 in Hanzhong of Shaanxi province was collected with a semi-quantitative FFQ in 2010 and evaluated using the DBI. Liu et al. reported a decrease in the risk of inadequate intake with higher HWI and educational level and a non-significant increase in the risk of excessive intake with higher HWI.[36] In terms of overall inadequate intake, our study is in line with previous research. However, in regard to HBS, which reflects the overall excessive intake of grains, meat, eggs, and condiments and alcoholic beverages, our result is not entirely consistent with others. We found that pregnant women from middle-income families, rather than from rich families, had higher levels of HBS compared with poor individuals. Not surprisingly, rich people consumed more meat, eggs, edible oil and alcohol but less grains (Table 5). The difference among these studies may be partly attributed to variations in the dietary pattern of the population studied. The diet in Northwest China has less diversity and wheat products such as noodles, dumplings and steamed bread account for a large proportion of the dietary intake.[37] On the other hand, as women have paid more attention to nutrition, dietary patterns during pregnancy have changed to some extent.

In our study, it appears that education, occupation and HWI influence diet quality independently, as associations were only slightly attenuated by mutual adjustment. A probable explanation is that each index measures a different aspect of socioeconomic position and has a different mechanism through which SES could have an independent effect on dietary habits. Educational level is related to nutrition knowledge and cooking skills, which then influence dietary habits.[38] Occupation determines the social network, which can also greatly influence health behaviours.[39] In general, food price is positively correlated with food quality, and nutrient-dense diets are associated with higher costs.[40,41] As food price is an important factor of food choice, economic level determines the quality of diet that individuals have access to.

Evidence from epidemiological studies have shown that balanced dietary structure and appropriate nutrient intake during pregnancy are vital for maternal and infant outcomes (Fig.1). Exposure to excessive energy will lead to maternal obesity[42] and is associated with a series of adverse outcomes, including gestational diabetes, preeclampsia, delivery problems, high birth weight and offspring insulin resistance.[43] In contrast, restricted intake of energy or protein or a specific micronutrient (e.g., folate, iron, calcium, zinc, vitamin D) can retard fetal growth and development and increase the risk of birth defects.[44] Furthermore, both obesity and smaller body size at birth are associated with increased risk of developing non-communicable diseases in adulthood.[45] Based on this survey, our team previously reported a socioeconomic inequality in birth outcomes with a negative association between HWI and low birth weight but a positive association between HWI and macrosomia.[13] Our findings appear to imply that maternal nutrition mediate the link between SES and adverse birth outcomes. We will focus on the impact of dietary quality during pregnancy on maternal and child outcomes in the future.

Some methodological weaknesses in our study should be acknowledged. First, as previous research has indicated that there are minimal changes in dietary patterns and variety during pregnancy,[16,17] the FFQ used in this study was established based on the previously validated FFQ that was designed for pregnant women during the third trimester in Northwest China. However, the validity and reliability test of the FFQ throughout pregnancy was not conducted in the study population. Second, in the present survey, participants were asked to recall dietary intakes during pregnancy at 0-12 months (median, 3 months; 10th-90th percentile, 0-7 months) after delivery. Although detailed supporting materials such as food portion images and calendars were used to collect data, we cannot rule out recall bias. Third, we assessed average dietary intakes during the whole pregnancy at one time for the sake of convenience and economy in large epidemiological studies.[17] Even though trained investigators reminded participants to take into account physical symptoms such as nausea and food aversions when reporting the average dietary intake throughout the pregnancy, it is still difficult to exclude measurement errors.

The strength of this study is the stratified multistage random sampling method and therefore, our findings can be generalized to all of Shaanxi province. A further advantage is that with three socioeconomic indicators of education, occupation and HWI, the social disparities in diet quality were described fully in our study. Moreover, when exploring the association between SES and the degrees of inadequate and excessive intake, we adjusted our analysis for most known variables that are plausibly associated with diet quality[14,22,27] and the association remained consistent.

### *Conclusion*

In summary, our study shows that, as evaluated by the DBI-P, the diet quality of pregnant women in Northwest China was associated with SES. While lower SES groups were more likely to have inadequate intake, the more affluent population was at risk of over-nutrition. Socioeconomic disparities in the dietary quality should be considered for public health interventions aiming to prevent adverse pregnancy outcomes.



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## CONFLICT OF INTEREST AND FUNDING DISCLOSURE

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**Table 1.** Scoring method of Diet Balance Index for three trimesters and for the whole pregnancy†

| Components | Subgroups | Score range | Scoring method | | | |
|---|---|---|---|---|---|---|
| | | | In the first trimester | In the second trimester | In the third trimester | During the whole pregnancy |
| Grains | Grains | (-12)-(12) | 0 g=-12, (275~300) g=0, >575 g=12 | <25 g=-12, (300~325) g=0, >600 g=12 | <75 g=-12, (350~375) g=0, >650 g=12 | <33.3 g=-12, (308.3~333.3) g=0, >608.3 g=12 |
| Vegetables and fruit | Vegetables | (-6)-(0) | 0 g=-6, ≥400 g=0 | | | 0 g=-6, ≥400 g=0 |
| | Fruit | (-6)-(0) | 0 g=-6, ≥150 g=0 | 0 g=-6, ≥300 g=0 | | 0 g=-6, ≥250 g=0 |
| Dairy, soybean and nuts | Dairy | (-6)-(0) | 0 g=-6, ≥300 g=0 | 0 g=-6, ≥400 g=0 | | 0 g=-6, ≥366.7 g=0 |
| | Soybean and nuts | (-6)-(0) | 0 g=-6, ≥40 g=0 | 0 g=-6, ≥50 g=0 | | 0 g=-6, ≥46.7 g=0 |
| Animal food | Meat | (-4)-(4) | 0 g=-4, (45~60) g=0, >105 g=4 | 0 g=-4, (60~80) g=0, >140 g=4 | | 0 g=-4, (55~73.3) g=0, >128.3 g=4 |
| | Fish and shrimp | (-4)-(0) | <5 g=-4, ≥50 g=0 | 0 g=-4, ≥75 g=0 | | 0 g=-4, ≥66.7 g=0 |
| | Eggs | (-4)-(4) | 0 g=-4, (45~60) g=0, >105 g=4 | | | 0 g=-4, (45~60) g=0, >105 g=4 |
| Condiments and alcohol | Edible oil | (0)-(4) | ≤17.5 g=0, (17.5~24.5) g=1, (24.5~31.5) g=2, (31.5~38.5) g=3, >38.5 g=4 | ≤22.5 g=0, (22.5~29.5) g=1, (29.5~36.5) g=2, (36.5~43.5) g=3, >43.5 g=4 | | ≤20.8g=0, (20.8~27.8) g=1, (27.8~34.8) g=2, (34.8~41.8) g=3, >41.8 g=4 |
| | Salt | (0)-(4) | <6 g=0, 6-8 g=1, 8-10 g=2, 10-12 g=3, >12=4 g | | | <6 g=0, 6-8 g=1, 8-10 g=2, 10-12 g=3, >12=4 g. |
| | Alcohol | (0)-(4) | 0 g=0, 1-15 g=1, 15-30=2, 30-45 g=3, >45 g=4 | | | 0 g=0, 1-15 g=1, 15-30=2, 30-45 g=3, >45 g=4. |
| Dietary variety | Dietary variety | (-12)-(0) | Score is 0 when intake amount of each food group is more than 25 g, otherwise score is 1. | | | Score is 0 when intake amount of each food group is more than 25 g, otherwise score is 1. |

†Taking a food intake of 2000 kcal energy as an example.

**Table 2.** Baseline characteristics of the participants in Shaanxi province of Northwest China

| | n | % |
|---|---|---|
| Childbearing age | | |
| <25 | 2,850 | 37.35 |
| 25~29 | 3,048 | 39.95 |
| ≥30 | 1,732 | 22.70 |
| Education | | |
| Illiterate or primary school | 702 | 9.20 |
| Junior high school | 4,106 | 53.81 |
| Senior high school or above | 2,822 | 36.99 |
| Occupation | | |
| Manual work | 5,919 | 77.58 |
| Non-manual work | 1,370 | 17.96 |
| Professional work | 341 | 4.47 |
| Childbearing season | | |
| Spring | 2,200 | 28.83 |
| Summer | 1,728 | 22.65 |
| Autumn | 1,697 | 22.24 |
| Winter | 2,005 | 26.28 |
| Urbanity | | |
| Rural | 5,852 | 76.70 |
| Urban | 1,778 | 23.30 |
| Geography | | |
| North | 1,250 | 16.38 |
| Central | 4,156 | 54.47 |
| South | 2,224 | 29.15 |
| Gravidity[†] | | |
| 1 | 3,786 | 49.63 |
| ≥2 | 3,843 | 50.37 |

[†]Gravidity was missing for 1 participant.

**Table 3.** Distribution of Diet Balance Index for Pregnancy components among pregnant women in Shaanxi province of Northwest China

| | Score | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (-12)-(-11) | (-10)-(-9) | (-8)-(-7) | (-6)-(-5) | (-4)-(-3) | (-2)-(-1) | 0 | (1)-(2) | (3)-(4) | (5)-(6) | (7)-(8) | (9)-(10) | (11)-(12) |
| Grains | 0.84 | 1.24 | 3.01 | 4.95 | 7.27 | 9.62 | 5.31 | 11.99 | 12.39 | 11.41 | 9.90 | 6.36 | 15.71 |
| Vegetables and fruit | | | | | | | | | | | | | |
| Vegetables | | | | 11.99 | 33.92 | 26.36 | 27.73 | | | | | | |
| Fruit | | | | 3.07 | 8.48 | 9.66 | 78.79 | | | | | | |
| Dairy, soybean and nuts | | | | | | | | | | | | | |
| Dairy | | | | 45.5 | 26.39 | 17.69 | 10.42 | | | | | | |
| Soybean and nuts | | | | 11.13 | 17.77 | 16.55 | 54.55 | | | | | | |
| Animal food | | | | | | | | | | | | | |
| Meat | | | | | 51.13 | 30.94 | 6.38 | 5.68 | 5.87 | | | | |
| Fish and shrimp | | | | | 81.44 | 10.79 | 7.77 | | | | | | |
| Eggs | | | | | 38.55 | 23.99 | 25.83 | 3.99 | 7.64 | | | | |
| Condiments and alcohol | | | | | | | | | | | | | |
| Edible oil | | | | | | | 12.23 | 18.15 | 69.62 | | | | |
| Salt | | | | | | | 30.21 | 49.62 | 20.17 | | | | |
| Alcohol | | | | | | | 98.05 | 1.94 | 0.01 | | | | |
| Dietary variety | 0.13 | 1.57 | 8.43 | 28.13 | 41.69 | 17.97 | 2.08 | | | | | | |

**Table 4.** Distribution of diet quality indictors among pregnant women in Shaanxi province of Northwest China

| | Level | | | | |
|---|---|---|---|---|---|
| Indictor | No problem | Almost no problem | Low level | Moderate level | High level |
| Low band score (%)† | 0.38 | 22.99 | 49.15 | 23.55 | 3.93 |
| High band score (%)‡ | 1.68 | 35.82 | 37.12 | 23.79 | 1.60 |

†The low band score is equal to the sum of the absolute values of all negative scores, reflecting the degree of inadequate dietary intake.
‡The high band score is equal to the sum of the absolute values of all positive scores, reflecting the degree of excessive dietary intake.

**Table 5.** Comparison of the score of Diet Balance Index for Pregnancy components by socioeconomic subgroups among pregnant women in Shaanxi province of Northwest China

| | Education† | | | | Occupation‡ | | | | HWI | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Low | Medium | High | *p* for trend§ | Low | Medium | High | *p* for trend§ | Low | Medium | High | *p* for trend§ |
| Grains | 3.45 (5.63) | 3.34 (5.72) | 3.32 (6.02) | 0.60 | 3.34 (5.78) | 3.32 (5.99) | 3.52 (5.81) | 0.58 | 3.73 (5.75) | 3.60 (5.78) | 2.71 (5.88) | <0.001 |
| Vegetables | -2.32 (1.80) | -2.29 (1.77) | -2.02 (1.75) | <0.001 | -2.26 (1.77) | -1.97 (1.75) | -1.91 (1.73) | <0.001 | -2.32 (1.77) | -2.17 (1.77) | -2.09 (1.76) | <0.001 |
| Fruit | -0.84 (1.54) | -0.65 (1.38) | -0.45 (1.16) | <0.001 | -0.64 (1.36) | -0.45 (1.18) | -0.42 (1.17) | <0.01 | -0.67 (1.40) | -0.58 (1.30) | -0.53 (1.26) | <0.001 |
| Dairy | -4.50 (1.70) | -3.95 (1.84) | -3.14 (1.96) | <0.001 | -3.88 (1.88) | -3.16 (1.96) | -2.89 (1.96) | <0.001 | -3.96 (1.86) | -3.74 (1.91) | -3.41 (1.97) | <0.001 |
| Soybean and nuts | -1.79 (1.99) | -1.58 (1.91) | -1.16 (1.73) | <0.001 | -1.52 (1.89) | -1.23 (1.79) | -1.04 (1.66) | <0.001 | -1.58 (1.94) | -1.42 (1.85) | -1.33 (1.79) | <0.001 |
| Meat | -2.19 (1.82) | -1.91 (1.86) | -1.56 (1.95) | <0.001 | -1.88 (1.87) | -1.57 (2.01) | -1.45 (1.90) | <0.001 | -2.05 (1.81) | -1.84 (1.86) | -1.53 (2.00) | <0.001 |
| Fish and shrimp | -3.28 (0.91) | -3.05 (1.02) | -2.64 (1.20) | <0.001 | -3.02 (1.04) | 2.60 (1.23) | -2.50 (1.25) | <0.001 | -3.09 (1.02) | -2.93 (1.08) | -2.74 (1.17) | <0.001 |
| Eggs | -1.67 (2.20) | -1.58 (2.11) | -1.13 (2.03) | <0.001 | -1.50 (2.11) | -1.23 (2.10) | -0.87 (1.96) | <0.001 | -1.60 (2.00) | -1.39 (2.10) | -1.27 (2.19) | <0.001 |
| Edible oil | 2.60 (1.47) | 2.79 (1.36) | 2.73 (1.34) | <0.05 | 2.77 (1.37) | 2.72 (1.34) | 2.62 (1.33) | 0.055 | 2.66 (1.39) | 2.79 (1.33) | 2.81 (1.37) | <0.001 |
| Salt | 1.70 (1.38) | 1.71 (1.36) | 1.58 (1.30) | <0.05 | 1.69 (1.35) | 1.62 (1.35) | 1.38 (1.22) | <0.001 | 1.64 (1.36) | 1.71 (1.34) | 1.64 (1.33) | 0.857 |
| Alcohol | 0.01 (0.11) | 0.02 (0.16) | 0.02 (0.16) | <0.05 | 0.02 (0.14) | 0.03 (0.20) | 0.02 (0.13) | 0.924 | 0.01 (0.13) | 0.02 (0.15) | 0.03 (0.18) | <0.01 |
| Dietary variety | -4.61 (1.84) | -4.31 (1.87) | -3.58 (1.86) | <0.001 | -4.22 (1.88) | -3.59 (1.88) | -3.28 (1.86) | <0.001 | -4.32 (1.90) | -4.06 (1.90) | -3.82 (1.87) | <0.001 |

HWI: household wealth index.
Values are given as the mean value (standard deviation).
†The education category was defined as follows: low (illiterate or primary school); medium (junior high school); or high (senior high school or above).
‡The occupation category was defined as follows: low (manual work); medium (non-manual work); or high (professional work).
§*p* for trend was obtained from linear regression.

**Table 6.** Association between socioeconomic factors and score of Diet Balance Index among pregnant women in Shaanxi province of Northwest China[†]

| | Model 1[‡] | | | Model 2[§] | | | Model 3[¶] | | |
|---|---|---|---|---|---|---|---|---|---|
| | OR | 95% CI | *p*-value | OR | 95% CI | *p*-value | OR | 95% CI | *p*-value |
| Low band score | | | | | | | | | |
| Education[††] | | | | | | | | | |
| Low | Ref. | | | Ref. | | | Ref. | | |
| Medium | 0.85 | 0.73, 0.99 | <0.05 | 0.88 | 0.75, 1.03 | 0.10 | 0.86 | 0.74, 1.01 | 0.07 |
| High | 0.51 | 0.43, 0.60 | <0.001 | 0.57 | 0.48, 0.67 | <0.001 | 0.58 | 0.49, 0.69 | <0.001 |
| Occupation[‡‡] | | | | | | | | | |
| Low | Ref. | | | Ref. | | | Ref. | | |
| Medium | 0.71 | 0.63, 0.80 | <0.001 | 0.81 | 0.72, 0.91 | <0.001 | 0.82 | 0.73, 0.93 | <0.001 |
| High | 0.55 | 0.45, 0.69 | <0.001 | 0.76 | 0.61, 0.94 | <0.05 | 0.80 | 0.64, 1.00 | <0.05 |
| HWI | | | | | | | | | |
| Low | Ref. | | | Ref. | | | Ref. | | |
| Medium | 0.82 | 0.74, 0.92 | <0.001 | 0.86 | 0.77, 0.96 | <0.05 | 0.86 | 0.77, 0.95 | <0.05 |
| High | 0.72 | 0.65, 0.81 | <0.001 | 0.80 | 0.72, 0.89 | <0.001 | 0.79 | 0.71, 0.89 | <0.001 |
| High band score | | | | | | | | | |
| Education[††] | | | | | | | | | |
| Low | Ref. | | | Ref. | | | Ref. | | |
| Medium | 0.97 | 0.83, 1.13 | 0.68 | 0.96 | 0.82, 1.12 | 0.60 | 1.04 | 0.89, 1.22 | 0.58 |
| High | 0.95 | 0.80, 1.11 | 0.50 | 0.93 | 0.79, 1.10 | 0.41 | 1.05 | 0.88, 1.24 | 0.61 |
| Occupation[‡‡] | | | | | | | | | |
| Low | Ref. | | | Ref. | | | Ref. | | |
| Medium | 1.06 | 0.95, 1.19 | 0.28 | 1.08 | 0.96, 1.21 | 0.22 | 1.08 | 0.96, 1.22 | 0.19 |
| High | 0.95 | 0.77, 1.17 | 0.65 | 0.98 | 0.79, 1.21 | 0.83 | 0.93 | 0.75, 1.16 | 0.54 |
| HWI | | | | | | | | | |
| Low | Ref. | | | Ref. | | | Ref. | | |
| Medium | 1.15 | 1.03, 1.27 | <0.05 | 1.15 | 1.04, 1.28 | <0.05 | 1.16 | 1.04, 1.29 | <0.05 |
| High | 1.00 | 0.90, 1.11 | 1.00 | 1.00 | 0.90, 1.12 | 0.95 | 1.03 | 0.92, 1.15 | 0.66 |

Ref.: referent category; HWI: household wealth index.
[†]The low band score is equal to the sum of the absolute values of all negative scores, reflecting the degree of inadequate dietary intake.
[‡]Model 1 was the unadjusted model.
[§]Model 2 was adjusted for three socioeconomic factors together.
[¶]Model 3 was adjusted for three socioeconomic factors together plus potential factors, including geography, urbanity, primipara, childbearing age and season.
[††]The education category was defined as follows: low (illiterate or primary school); medium (junior high school); or high (senior high school or above).
[‡‡]The occupation category was defined as follows: low (manual work); medium (non-manual work); or high (professional work).

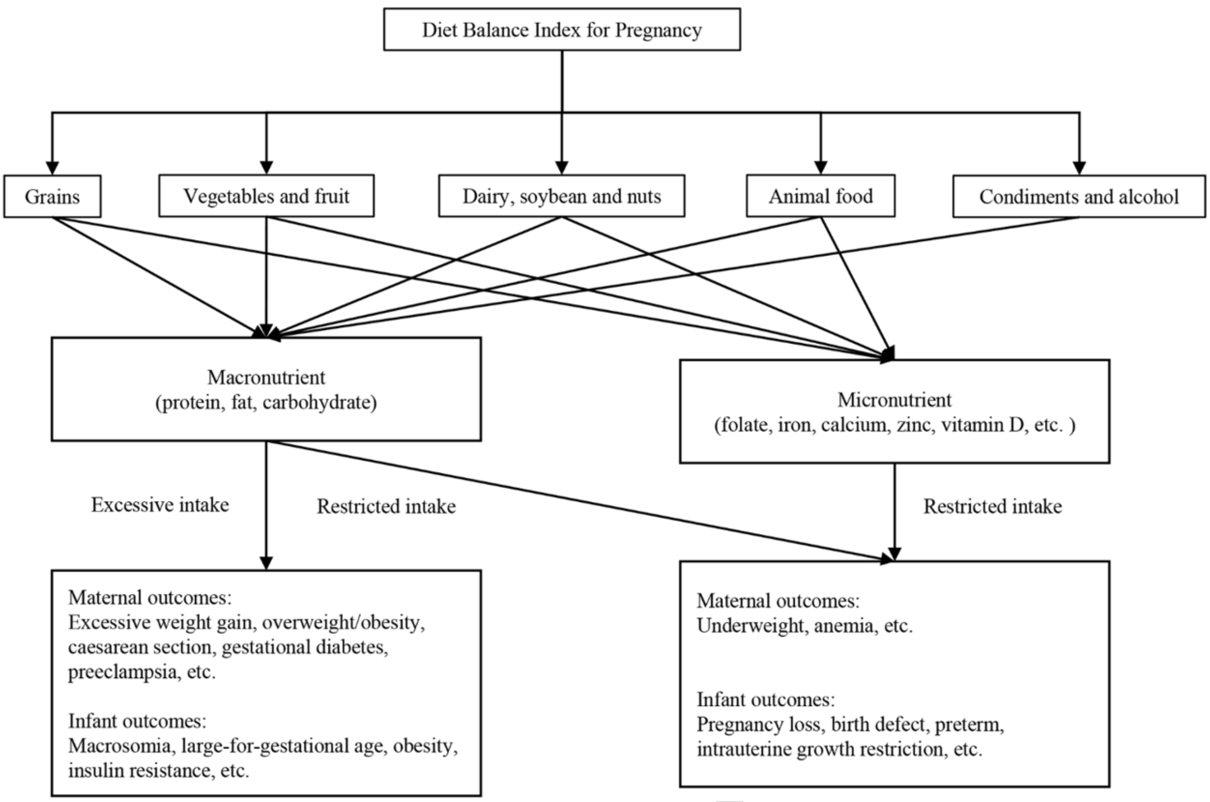


**Figure 1.** Maternal nutrition during pregnancy and maternal and infant outcomes.