DOI: 10.1111/j.1740-8709.2008.00180.x

Original Article

# Dietary behaviour, food and nutrient intake of pregnant women in a rural community in Burkina Faso

**Lieven Fernand Huybregts***, **Dominique Albert Roberfroid**†, **Patrick Wilfried Kolsteren***† **and John Hendrik Van Camp***

**Department of Food Safety and Food Quality, Ghent University, Ghent, Belgium, and †Child Health and Nutrition Unit, Institute of Tropical Medicine of Antwerp, Antwerp, Belgium*

**Abstract**

The aim of this study was to assess potential changes in dietary habits during pregnancy in a rural community in Houndé district, Burkina Faso. In-depth interviews were performed on a random sample of 37 pregnant women in order to analyse specific perceptions and attitudes regarding food consumption during pregnancy. In addition to this, an interactive 24-h recall survey was used to compare the food intake of 218 pregnant and 176 non-pregnant women. The majority of interviewees reported dietary restrictions during pregnancy but no consistent pattern of avoided food types was found. Most of the mentioned 'forbidden' foods were in related to physical discomfort during gestation. Interviewees also admitted to ignoring culturally determined food prohibitions/prescriptions. No differences were observed in food intake, food choice and nutrient intake between the group of pregnant and non-pregnant women. During the third trimester of gestation women did not show any major differences in food and nutrient intake compared with women from the first/second trimester. The mean nutrient intakes were found to be insufficient compared with the recommended daily allowances, especially for pregnant women. In conclusion, pregnant women in this rural area of Burkina Faso do not seem to restrict their diet significantly during pregnancy. The additional nutritional requirements of pregnancy are not accounted for in their dietary practises.

*Keywords:* beliefs, maternal nutrition, pregnancy and nutrition, dietary habits, food intake, rural Burkina Faso.

Correspondence: Patrick Wilfried Kolsteren, Child Health and Nutrition Unit, Institute of Tropical Medicine of Antwerp, Nationalestraat 10, B- 2000 Antwerp, Belgium. E-mail: pkolsteren@itg.be

## Introduction

A number of mainly qualitative studies in developing countries previously suggested that food intake could be deliberately reduced during the course of gestation (Nag *et al.* 1978; Nichter & Nichter 1983; Hutter 1996; Bentley *et al.* 1999). Whether this behaviour is caused by culturally inspired food prohibitions or prescriptions through physiological modifications specific to pregnancy is not fully understood. In a review article, Rush (2000) discussed the widespread belief among women in developing countries that decreased food intake during pregnancy is safer for the mother because a smaller fetus will result in an easy delivery. Such a statement is alarming as maternal nutrition is one of the cornerstones of optimal foetal development and affects newborn and infant health in populations that are deficient in essential nutrients (Ashworth 1998; Bakketeig 1998; Kind *et al.* 2006). However, it is still unclear how beliefs with regard to diet during pregnancy translates into actual dietary behaviours, and how severely it affects dietary food intake. Therefore, the aim of our study was to assess whether pregnant (P) women exhibit a different food and nutrient intake pattern as compared with non-pregnant (NP) women and to explore the existence of specific dietary behaviours related to pregnancy. This study took place in the exploratory phase of a research project aimed to improve maternal nutritional status during pregnancy (Roberfroid *et al.* 2008).

## Material and methods

### Area and subjects

The survey was undertaken in two villages, Koho and Karaba, in the health district of Houndé, province of Tuy, Burkina Faso. The small city of Houndé is located at the highway from the capital Ouagadougou to Bobo-Dioulasso with a population of approximately 40 000 inhabitants. Koho is a widely dispersed village along this highway, at 4 km from Houndé whereas Karaba is a small, more centralized village at 6 km from Houndé. In Koho, the principal ethnic group are the Moore, who is a predominantly Muslim population. The Bwaba form the main ethnic group in Karaba and are mainly Christian. This region has only one rainy season situated between May and October. The harvesting season of the main cereal crops (maize, sorghum and millet) is situated from October to February.

## Study design

### In-depth interviews

In October 2003, a survey with semi-structured questionnaires in the local languages was performed on a random sample of 40 P women. Two Burkina sociologists directed the interviews in Dioula or Mooré. Prompting questions about the main themes of the nutritional knowledge, attitudes and practices of a P woman were used. The interviews were performed at the subject's home, recorded on tape, transcribed and then translated into French by the interviewers. Observations made during the interviews were also reported.

### The interactive 24-h dietary recall

The dietary assessment study was performed in December 2004 over a 4-week period subsequent to the main maize harvest. All P women in the two villages were invited to participate in the survey. Locally trained home visitors sampled conveniently by self-selection an equal number of women who were neither pregnant nor lactating from the same residential quarters of the villages as the P women.

There were two exclusion criteria: the first being outside of the range of childbearing age (15–45 years) and the second being seriously ill and unable to participate in the study. None of the subjects of the in-depth interviews participated in the food-consumption study. One interactive 24-h dietary recall is considered suitable to accurately estimate mean food intakes at group level (Bingham *et al.* 1994; Biro *et al.* 2002). A team of seven local female field workers performed the 24-h dietary recall interviews. All of the fieldworkers had at least 12 years of education and spoke fluently the local languages. They were trained by two nutritionists for 5 days. The validity of their interviews was assessed through standardization procedures before and during the survey.

As people in agricultural communities work regularly throughout the week, we assumed there were no specific days with a different food-consumption pattern. The participants were initially visited before the recall day to inform them about the goals and methods, i.e. to eat separately from other family members with provided utensils (a plate, a cup and two bowls). The 24-h recall interviews took place between 6:30 a.m. and 8:30 a.m. to optimize the recall performance. The length of an interview varied between 20 and 30 min. The 24-h dietary recall consisted of four steps. First, the foods and drinks taken the day before were listed. Second, the quantity of each of the mentioned dishes was estimated using a validated booklet with food photographs of the available staple foods and sauces (Huybregts *et al.* 2008). The utensils provided to the participants were the same as the ones on the food photographs. Foods, like fruits and snacks, which come in discrete units were counted and quantified using a standard weight per food. In a third phase, the respondents were asked to describe the recipes of the composed dishes that were consumed. Last, the interviewer performed a control check using a list with all available ingredients per food group in order to minimize memory lapse of the respondent. If participants were absent on the day of the interview, the interview was rescheduled for another day.

A recipe database was compiled including a total of 843 recipes for 88 meals. In order to avoid preparation bias, the recipe collection was compiled using unannounced visits to women of the same villages who were about to prepare a meal.

With a sample size of 216 subjects per group, we had a 90% power to detect a difference equal to the supplementary energy needed for pregnancy, i.e. 1.1 MJ per day (Butte & King. 2005), given an estimated standard deviation of daily energy intake of 3.6 MJ (unpublished observations from a pilot study), a type I error of 5% and a 10% non-response rate.

Verbal consent was obtained from the participants after explaining the goals and methodology of the study by the field workers. The study was approved by the ethics committees of the Centre Muraz, Bobo-Dioulasso, Burkina Faso, and the Institute of Tropical Medicine, Antwerp, Belgium.

## Data analysis

Data from the in-depth interviews were coded using QSR Nudist 6.0 (QSR International, Melbourne, Australia, 2000). Coding was performed by theme corresponding to the interview guide, but also using an iterative method to integrate emerging themes (open coding). An anthropologist and public health scientist (D. R.) performed the coding and analysis of the data to derive substantive significance (Patton 1990). Data obtained from the interviewees were treated as social constructs, i.e. as perceptions, assumptions or belief systems not necessarily as ‘reality’. The transcripts were analysed for the constructs the participants referred to, but also to articulate representations and experiences of food intake during pregnancy.

The quantitative food intake data were entered using Food Processor 8.4.0 (ESHA Research, Salem, OR, USA). For the analysis, average recipes were calculated for each dish. The food composition table of Mali, a neighbouring country with the same Sahelian climatic characteristics, was used to convert the ingredients to their nutrient levels (Barikmo *et al.* 2004). Mean nutrient intakes were expressed as a percentage of the recommended daily allowances (RDA) for P and NP women (FAO & WHO 1994, 2004).

We intended to stratify the analysis by trimesters of gestation to compare dietary consumption between women of different gestational periods. Eventually, the subjects of first and second trimesters were combined because of the limited number of first-trimester subjects.

All statistical analyses were performed with STATA 8.0 (Stata Corp, College Station, TX, USA). As food and energy/nutrient intake values were not normally distributed, we described our data first using crude medians and 25–75th percentiles. In order to compare the association between groups, we also tabulated the differences of the group means with 95% confidence intervals (CI). These differences were adjusted for *age* (covariate) and *village* (fixed effect) in multiple regression models. Age was unbalanced between the NP and P group. The factor village was added into the model to account for the clustering effect. Owing to multiplicity of comparisons, we used $P < 0.001$ (0.05/50) to indicate statistical significance based on the Bonferroni correction.

## Results

### In-depth interviews

In total, 37 P women were interviewed, as three subjects from the initial sample spoke another language rather than Dioula or Mooré.

All but one of the women interviewed admitted to eating less food during pregnancy, as opposed selectively avoiding certain foods. The main motivations reported for this behaviour were a general loss of appetite, nausea and the apparent compression of the stomach by the fetus. The relationship between food intake and the fetus size, and a subsequent difficult delivery, was also mentioned, although by a minority of people ($n = 4$).

When asked about specific food taboos, a wide spectrum of answers was obtained. Most often, the avoidance of specific foods was due to the perceived side effects of these foods: e.g. red pepper 'burns', couscous constipates, dried okra induces vomiting . . . For instance, one woman argued,

> Mango gives you diarrhoea, if you eat some [mango] you will have diarrhoea and your thing [fetus] will be in a bad position. You yourself will wither and your thing [fetus] will stop developing. It's the water of the mango that will make him [fetus] become so. And on the day of the delivery, you can only deliver after emptying the water of the mangos. (19: 520–25).

Two women also reported that it was not advisable to eat oily foods, 'Concerning the food, they say that we shouldn't consume too much fat. (. . .) [if you consume too much fat] your newborn will be covered by a layer of fat which will make him very dirty' (14: 438–40). Despite the apparent variety of restrictions, two groups of food were recurrently cited: 'sweet' food items, like honey and sugar, particularly among Mossi people, and 'cold' or 'cooled down' meals.

Not only a very wide range of foods was mentioned, but also a solid pragmatism in adoption of new habits was noticed: 'Maybe they [food prohibitions] exist, but it's me who doesn't know them' (4: 283). 'Ah, I think not everyone is the same! Some people will certainly not eat them [prohibited foods]; but others they can consume them in discretion. But it's forbidden' (10: 509–511).

When questioned about recommended foods during pregnancy, fruits, dairy products, meat products and fish were often mentioned. Rice and pasta were also mentioned, although many women affirm that because of financial constraints, such foods cannot often be purchased. In addition, the majority of women made reference to a higher recommended intake of 'vitamins' during pregnancy. Some women were able to make the correlation between the small size of newborns and the quality of the diet during pregnancy, especially regarding key foods: 'Some say that it is because of a lack of good nutrition during gestation, when a person does not consume 'rich' foods, the child cannot grow well in the belly' (11: 129–130). 'Fruits like bananas, oranges, etc., milk and meat are good for a big baby . . .' (3: 341).

### The interactive 24-h dietary recall

A total of 432 women were invited to participate in the survey. Thirty-eight (8.8%) did not participate because of refusal (1.4%; 3 P vs. 3 NP) or not being present at several appointments for the interview (7.4; 9 P vs. 23 NP ). A total sample of 394 was retained for analysis which consisted of 218 P and 176 NP. The difference in non-response between P ($n = 12$) and NP ($n = 26$) can be explained by the higher motivation of the P women because they were followed up by the village workers on a regular basis during the preparatory phase of the project. School attendance in both villages was equally low, ranging from 14.8% of the women in Karaba to 17.0% in Koho. While mean age, school attendance, ethnicity and location were comparable between P and NP women, it appeared that the group of NP contained a higher proportion of women older than 35 years (15.9% vs. 7.3%) (Table 1).

All respondents reported to have eaten cereals (Table 2). The most frequently consumed cereal staple food was maize that was consumed by 89.9% and 87.5% of P and NP women respectively. The most frequently consumed dish was *tô*, a stiff cereal por-

**Table 1.** Sample characteristics of the food consumption survey

| | Non-pregnant | Pregnant |
|---|---|---|
| | *n* (%) | *n* (%) |
| Total number of subjects | 176 | 218 |
| School attendance | | |
| No | 149 (84.7) | 181 (83.0) |
| Yes | 27 (15.3) | 37 (17.0) |
| Village | | |
| Karaba | 59 (33.5) | 76 (34.9) |
| Koho | 117 (66.5) | 142 (65.1) |
| Ethnicity | | |
| Mossi | 102 (58.0) | 114 (52.3) |
| Bwaba | 62 (35.2) | 82 (37.6) |
| Other | 12 (6.8) | 22 (10.1) |
| Age (years)* | 24.0 ± 7.8 | 23.1 ± 6.8 |
| Age categories | | |
| <20 years | 62 (35.2) | 88 (40.4) |
| 21–35 years | 86 (48.9) | 114 (52.3) |
| >35 years | 28 (15.9) | 16 (7.3) |
| Trimester | | |
| First | – | 31 (14.2) |
| Second | – | 95 (43.6) |
| Third | – | 92 (42.2) |

*Mean with standard deviation.

ridge, that was consumed by 98.2% of the respondents, combined with a sauce of dried leaves (67.1% of the subjects) or with a sauce prepared from fresh or dried okra (37.8% of the subjects). P women consumed more roots and tubers than NP women (16.5% vs. 8.5%), although this difference was not statistically significant. Vitamin A-rich fruits and vegetables sources were frequently consumed, ranging from 79.8% of the NP women to 81.3% of the P women. The consumption of this food group was almost exclusively because of the intake of green leafy vegetables like baobab leaves. The consumption of non-vitamin A-rich vegetables consisted mainly of okra and tomato. Fruits were less commonly consumed, ranging from 12.5% of the NP women and 13.8% of the P women, and were mainly lemons and oranges. The group of meat, poultry and fish was consumed by more than half of the respondents (54.6% of the subjects), although it consisted mainly out of dried fish powder (39.6% of the subjects) which was added in small quantities to the dishes. The consumption of eggs was insignificant. Most of the P and NP respondents (71.6% of the subjects) used a source of fat in their dishes. The fats used were mostly shea butter, followed by cottonseed oil and red palm oil. No major differences in the frequency of consuming food groups were found between first/second trimester and third trimester P women except for a slightly higher consumption of milk and dairy products by the group of third-trimester P women (14.1% vs. 7.1%). None of the observed differences were statistically significant.

Table 3 shows the quantitative intake of 10 food groups for P and NP women. The diet was mainly characterized by a high consumption of cereals and to a lesser extent by vitamin A-rich fruits, vegetables, nuts/pulses and fats/oils. The median intake of roots/tubers, dairy products, eggs and meat/poultry/fish was found to be less than 1 g per day. For eggs, roots/tubers and dairy products such low median intake can be explained by the low frequency of food group consumption. For meat/poultry/fish a relatively high frequency is combined with a very low quantitative intake. No substantial differences between the mean food group intakes of P and NP women were noted. Table 4 shows the median intakes of first/second- and third-trimester P women. The only noteworthy difference was a higher mean intake of cereals by P women in the third trimester (+45.2 g; 95% CI [–0.5; 90.9]) which didn't reach statistical significance ($P = 0.052$ with statistical significance set at $P < 0.001$).

The results from Table 5 show that the group of P women from our sample had a similar energy and nutrient intake pattern as the NP women. When comparing the mean nutrient intakes with the RDA, both groups of P and NP women had a deficient intake in micronutrients, particularly for riboflavin, vitamin A and vitamin C. The mean intake here was lower than 25% of the RDA. For the group of P women, the mean intake of all nutrients (excluding zinc, thiamine, phosphorus and energy obtained from fat) was lower than 50% of the RDA. Table 6 describes the median energy and nutrient intakes by trimester of gestation. The reported mean energy intake for third-trimester P women was higher (+0.48 MJ; 95% CI [–0.41; 1.38]) than for first/second-trimester P women although this difference was not statistically significant ($P = 0.29$). In addition, women in later stages of gestation had a lower, but statistically insignificant, calcium intake (–260.8 mg; 95% CI [–513.0; –8.6]) as compared

**Table 2.** Proportions of non-pregnant (NP) and pregnant women (P) that consumed food groups and food items* by period of pregnancy adjusted for the covariate *age* and the fixed effect *village*

| | NP | P | *P* value†,‡ | Trimester 1/2 | Trimester 3 | *P* value†,‡ |
|---|---|---|---|---|---|---|
| | *n* (%) | *n* (%) | | *n* (%) | *n* (%) | |
| Total subjects per group | 176 | 218 | | 126 | 92 | |
| Cereals | 176 (100.0) | 218 (100.0) | 1.00 | 126 (100.0) | 92 (100.0) | 1.00 |
| Maize | 154 (87.5) | 196 (89.9) | | 115 (91.3) | 81 (88.0) | |
| Rice | 45 (25.6) | 53 (24.3) | | 31(24.6) | 22 (23.9) | |
| Millet | 26 (14.8) | 45 (20.6) | | 21 (16.7) | 24 (26.1) | |
| Wheat | 20 (11.4) | 30 (13.8) | | 15 (11.9) | 15 (16.3) | |
| White sorghum | 21 (11.9) | 17 (7.8) | | 9 (7.1) | 8 (8.7) | |
| Red sorghum | 6 (3.4) | 11 (5.0) | | 6 (4.8) | 5 (5.4) | |
| Roots and tubers | 15 (8.5) | 36 (16.5) | 0.035 | 22 (17.5) | 14 (15.2) | 0.75 |
| Sweet potato | 8 (4.5) | 20 (9.2) | | 11 (8.7) | 9 (9.8) | |
| Yam | 5 (2.8) | 16 (7.3) | | 12 (9.5) | 4 (4.3) | |
| Nuts and pulses | 99 (56.3) | 128 (58.7) | 0.62 | 75 (59.5) | 53 (57.6) | 0.71 |
| Peanuts | 55 (31.3) | 67 (30.7) | | 41 (32.5) | 26 (28.3) | |
| Cowpeas | 49 (27.8) | 53 (24.3) | | 33 (26.2) | 20 (21.7) | |
| Cotton seed | 12 (6.8) | 15 (6.9) | | 11 (8.7) | 4 (4.3) | |
| Vitamin A-rich fruits and vegetables | 143 (81.3) | 174 (79.8) | 0.58 | 99 (78.6) | 75 (81.5) | 0.90 |
| Baobab leaves | 76 (43.2) | 93 (42.7) | | 55 (43.7) | 38 (41.3) | |
| Cowpea leaves | 34 (19.3) | 42 (19.3) | | 18 (14.3) | 24 (26.1) | |
| Bush okra leaves | 29 (16.5) | 37 (17.0) | | 24 (19.0) | 13 (14.1) | |
| Kapok tree flowers | 22 (12.5) | 31 (14.2) | | 17 (13.5) | 14 (15.2) | |
| Sorrel leaves | 23 (13.1) | 26 (11.9) | | 17 (13.5) | 9 (9.8) | |
| Other vegetables | 114 (64.8) | 141 (64.7) | 0.83 | 80 (63.5) | 61 (66.3) | 0.73 |
| Okra | 64 (36.4) | 87 (39.9) | | 44 (34.9) | 43 (46.7) | |
| Tomato | 48 (27.3) | 50 (22.9) | | 33 (26.2) | 17 (18.5) | |
| Onion | 26 (14.8) | 29 (13.3) | | 18 (14.3) | 11 (12.0) | |
| Cabbage | 11 (6.3) | 10 (4.6) | | 4 (3.2) | 6 (6.5) | |
| Other fruits | 22 (12.5) | 30 (13.8) | 0.65 | 15 (11.9) | 15 (16.3) | 0.38 |
| Lemon | 9 (5.1) | 14 (6.4) | | 9 (7.1) | 5 (5.4) | |
| Orange | 11 (6.3) | 12 (5.5) | | 8 (6.3) | 4 (4.3) | |
| Meat/poultry/fish products | 100 (56.8) | 115 (52.8) | 0.34 | 62 (49.2) | 53 (57.6) | 0.25 |
| Dried fish | 71 (40.3) | 85 (39.0) | | 47 (37.3) | 38 (41.3) | |
| Chicken | 13 (7.4) | 13 (6.0) | | 7 (5.6) | 6 (6.5) | |
| Sheep and goat | 14 (8.0) | 11 (5.0) | | 7 (5.6) | 4 (4.3) | |
| Pork | 10 (5.7) | 5 (2.3) | | 4 (3.2) | 1 (1.1) | |
| Eggs | 0 (0.0) | 1 (0.5) | – | 1 (0.8) | 0 (0.0) | – |
| Milk and dairy products | 15 (8.5) | 22 (10.1) | 0.48 | 9 (7.1) | 13 (14.1) | 0.088 |
| Fresh cow's milk | 9 (5.1) | 13 (6.0) | | 6 (4.8) | 7 (7.6) | |
| Edible fats and oils | 124 (70.5) | 158 (72.5) | 0.82 | 94 (74.6) | 64 (69.6) | 0.45 |
| Shea butter | 83 (47.2) | 98 (45.0) | | 67 (53.2) | 31 (33.7) | |
| Cotton seed oil | 38 (21.6) | 45 (20.6) | | 25 (19.8) | 20 (21.7) | |
| Red palm oil | 20 (11.4) | 29 (13.3) | | 10 (7.9) | 19 (20.7) | |

*Only food items that were consumed by at least 5% of a group are reported. †Multiple logistical regression adjusted for the covariate *age* and the fixed effect *village*. ‡Statistical significance is achieved at $P < 0.001$ (Bonferroni correction for multiplicity).

with P women in the early or in the middle stages of gestation.

## Discussion

The in-depth interviews highlighted the existence of a wide spectrum of food beliefs during pregnancy. In addition, a recurring claim that food intake is reduced during gestation was noted. However, contrary to our expectations that food and energy intake would increase during gestation to cover the increased nutritional requirements of pregnancy, the results from the dietary assessment study indicated no significant

**Table 3.** Crude median daily food group consumption and adjusted difference of mean food group consumption between non-pregnant (NP) and pregnant women (P)

| Food group | NP ($n = 176$) | | P ($n = 218$) | | Difference of means* | CI† | P value‡ |
|---|---|---|---|---|---|---|---|
| | Median (g) | ($P_{25}$; $P_{75}$) (g) | Median (g) | ($P_{25}$; $P_{75}$) (g) | | | |
| Cereals | 438.0 | (336.9; 566.7) | 442.4 | (349.3; 554.6) | 2.3 | [–32.2; 36.8] | 0.90 |
| Roots and tubers | 0 | (0; 1.5) | 0 | (0; 2.5) | 15.7 | [0.4; 30.9] | 0.045 |
| Nuts and pulses | 33.1 | (8.8; 91.0) | 32.9 | (9.4; 92.9) | –4.8 | [–17.9; 8.3] | 0.47 |
| Vitamin A-rich fruits and vegetables | 35.4 | (9.6; 90.9) | 25.7 | (9.8; 78.9) | –7.3 | [–20.8; 6.2] | 0.29 |
| Other vegetables | 10.1 | (2.4; 24.6) | 14.2 | (2.2; 29.3) | 2.5 | [–2.5; 7.4] | 0.33 |
| Other fruits§ | – | – | – | – | 1.4 | [–7.1; 9.9] | 0.75 |
| Meat/poultry/fish | 0.37 | (0; 27.51) | 0.33 | (0; 1.28) | –4.4 | [–14.4; 5.7] | 0.40 |
| Eggs§,¶ | – | – | – | – | – | – | – |
| Milk and dairy products§ | – | – | – | – | 5.2 | [–13.0; 23.4] | 0.58 |
| Edible fats and oils | 7.7 | (4.1; 14.4) | 8.7 | (3.8; 15.9) | 1.0 | [–1.0; 3.1] | 0.33 |

*Model-based difference of the means (P) – (NP), adjusted for the covariate *age* and the fixed effect *village*. †Model-based 95% confidence intervals (CI) adjusted for the covariate *age* and the fixed effect *village*. ‡Model-based adjusted for the covariate *age* and the fixed effect *village*; statistical significance is achieved at $P < 0.001$ (Bonferroni correction for multiplicity). §Medians and 25th and 75th percentiles are only presented if the at least 75% of sample consumed the food group. ¶The analysis of eggs was omitted because only one person consumed eggs.

**Table 4.** Crude median daily food group consumption and adjusted difference of mean food group consumption between pregnant women of trimester 1/2 and trimester 3 of gestation

| Food group | Trimester 1/2 ($n = 126$) | | Trimester 3 ($n = 92$) | | Difference of means* | CI† | P value‡ |
|---|---|---|---|---|---|---|---|
| | Median (g) | ($P_{25}$; $P_{75}$) (g) | Median (g) | ($P_{25}$; $P_{75}$) (g) | | | |
| Cereals | 430.4 | (345.0; 538.1) | 458.2 | (361.3; 622.2) | 45.2 | [–0.5; 90.9] | 0.052 |
| Roots and tubers | 0 | (0.0; 3.0) | 0 | (0.0; 2.9) | –5.9 | [–31.0; 19.2] | 0.64 |
| Nuts and pulses | 34.6 | (8.7; 101.4) | 31.7 | (9.5; 91.0) | –3.3 | [–20.7; 14.0] | 0.71 |
| Vitamin A rich Fruits and Vegetables | 32.2 | (9.8; 91.9) | 24.8 | (7.8; 74.8) | –10.5 | [–28.4; 7.4] | 0.27 |
| Other vegetables | 16.9 | (2.2; 31.8) | 14.1 | (2.7; 28.1) | –2.3 | [–9.4; 4.8] | 0.53 |
| Other fruits§ | – | – | – | – | 2.5 | [–9.7; 14.7] | 0.69 |
| Meat/poultry/fish | 0.33 | (0.0; 5.62) | 0.33 | (0.0; 1.14) | 1.2 | [–13.1; 15.6] | 0.87 |
| Eggs§,¶ | – | – | – | – | – | – | – |
| Milk and dairy products§ | – | – | – | – | –2.3 | [–30.9; 26.3] | 0.87 |
| Edible fats and oils | 9.1 | (4.0; 18.4) | 9.0 | (3.4; 15.6) | –0.5 | [–3.7; 2.6] | 0.74 |

*Model-based difference of the means (trimester 1/2) – (trimester 3) adjusted for the covariate *age* and the fixed effect *village*. †Model-based 95% confidence intervals (CI) adjusted for the covariate *age* and the fixed effect *village*. ‡Model-based adjusted for the covariate *age* and the fixed effect *village*; statistical significance is achieved at $P < 0.001$ (Bonferroni correction for multiplicity). §Medians and 25th and 75th percentiles are only presented if the at least 75% of sample consumed the food group. ¶The analysis of eggs was omitted because only one person consumed eggs.

differences in food and energy intake between the group of P and NP women.

Several factors may be responsible for the change in food-consumption pattern during pregnancy. First, because of beliefs held about certain foods, the consumption of these foods may be encouraged or discouraged during pregnancy. Second, an overall reduction in food consumption during pregnancy may be observed. This phenomenon of *eating down* has been reported in other studies (Nag 1994; Choudhry 1997; Christian *et al.* 2006). In our study, in-depth interviews offered conflicting views. On one hand, the majority of the interviewees reported diet restrictions during pregnancy. Most of the 'forbidden' foods were mentioned in relation to physical discomfort during gestation. This is consistent with a study in South India which identified the subjective health state of P women as the main reason for food reduction during

**Table 5.** Crude median energy/nutrient intake and adjusted difference of mean energy/nutrient intake between non-pregnant (NP) and pregnant women (P)

| Nutrient and energy | NP ($n = 176$) | | | P ($n = 218$) | | | Difference of means[§] | CI[¶] | $P$ value** |
|---|---|---|---|---|---|---|---|---|---|
| | Median | ($P_{25}$; $P_{75}$)* | %RDA[†] | Median | ($P_{25}$; $P_{75}$)* | %RDA[‡] | | | |
| Energy | | | | | | | | | |
| kcal | 1994 | (1623; 2633) | | 2096 | (1645; 2642) | | 8.2 | [–147.8; 164.2] | 0.92 |
| MJ | 8.3 | (6.8; 11.0) | | 8.8 | (6.9; 11.1) | | 0.034 | [–0.618; 0.687] | – |
| Fat (g) | 30.3 | (17.1; 42.8) | | 27.9 | (16.4; 46.6) | | 1.1 | [–3.6; 5.9] | 0.61 |
| Protein (g) | 58.9 | (45.3; 78.8) | | 60.3 | (45.7; 76.5) | | 0.56 | [–5.29; 6.42] | 0.85 |
| % energy from fat | 12.7 | (8.6; 17.4) | 84.9[††] | 12.7 | (8.0; 17.8) | 63.5[††] | –0.03 | [–1.40; 1.35] | 0.97 |
| % energy from protein | 11.7 | (9.9; 13.1) | | 11.0 | (9.8; 13.3) | | –0.11 | [–0.66; 0.44] | 0.71 |
| Thiamine (mg) | 0.75 | (0.51; 1.16) | 68.2 | 0.81 | (0.54; 1.12) | 57.9 | –0.05 | [–0.14; 0.04] | 0.30 |
| Riboflavin (mg) | 0.24 | (0.14; 0.39) | 21.8 | 0.22 | (0.13; 0.38) | 15.7 | 0.002 | [–0.052; 0.055] | 0.96 |
| Niacin (mg) | 7.7 | (5.3; 11.1) | 55.0 | 7.3 | (5.2; 10.0) | 40.6 | –0.6 | [–1.6; 0.4] | 0.21 |
| Vitamin $B_6$ (mg) | 0.87 | (0.63; 1.20) | 66.9 | 0.84 | (0.64; 1.10) | 44.2 | 0.02 | [–0.76; 0.80] | 0.97 |
| Folate (μg) | 215.4 | (139.5; 345.9) | 53.9 | 217.5 | (149.1; 336.2) | 36.3 | 0.81 | [–31.62; 33.23] | 0.96 |
| Vitamin A (μg) | 123.0 | (65.5; 226.0) | 24.6 | 117.6 | (58.5; 238.2) | 14.7 | 18.8 | [–21.5; 59.1] | 0.36 |
| Vitamin C (mg) | 9.7 | (5.3; 19.7) | 21.6 | 10.7 | (5.8; 22.9) | 19.5 | 4.4 | [–2.0; 10.7] | 0.18 |
| Calcium (mg) | 458.6 | (257.5; 878.2) | 45.9 | 493.9 | (281.2; 908.3) | 41.2 | 93.5 | [–74.4; 261.3] | 0.27 |
| Phosphorus (mg) | 834.0 | (640.7; 1099.1) | 119.1 | 838.8 | (638.8; 1135.9) | 119.8 | 28.6 | [–54.9; 112.1] | 0.50 |
| Iron (mg) | 38.0 | (24.9; 50.6) | 64.6 | 39.9 | (27.1; 54.7) | 21.0 | 3.6 | [–1.5; 8.8] | 0.17 |
| Zinc (mg) | 12.6 | (9.4; 16.9) | 128.6 | 13.0 | (10.1; 16.1) | 65.0 | 0.22 | [–0.98; 1.42] | 0.72 |

*25th and 75th percentiles. [†]%RDA = median intake/RDA × 100, recommended daily allowances for adults (FAO & WHO 2004). [‡]%RDA = median intake/RDA × 100, recommended daily allowances during pregnancy (FAO & WHO 2004). [§]Model-based difference of the means (P) – (NP), adjusted for the covariate *age* and the fixed effect *village*. [¶]Model-based 95% Confidence Intervals adjusted for the covariate *age* and the fixed effect *village*. **Model-based adjusted for the covariate *age* and the fixed effect *village*; statistical significance is achieved at $P < 0.001$ (Bonferroni correction for multiplicity). [††]Recommended minimal intakes of fat for adults and pregnant women are 15% and 20% of the total energy intake respectively (FAO & WHO 1994).

pregnancy (Hutter 1996). In addition, an in-depth study in Nepal highlighted seasonal availability and financial limitations, but also personal aversion and lack of appetite as contributing factors to the *eating down* during pregnancy (Christian *et al.* 2006). On the other hand, no consistent pattern of avoided food types was achieved except for sugared and 'cooled down' foods. It is noteworthy that sugared and cool food categories were also consistently reported in other studies. Among Mossi, sugared foods are considered the food of bush spirits (Bonnet 1988), while 'cooled down' foods could be considered a threat because the pregnancy is related to a state of excessive body warmth (Manderson 1987; Pool 1987).

Interviewees also reported coping strategies and displayed pragmatism in adopting new food habits. These findings are in agreement with those of a qualitative study in rural Nigeria, where it was reported that women mentioned the existence of cultural food taboos but added that they generally do not intend to follow them (Ene-Obong *et al.* 2001). A few studies from developing countries, mainly Asia, document that pregnancy does not seem to be a time for special food prohibitions or prescriptions (Gittelsohn *et al.* 1997; Gittelsohn & Vastine 2003; Christian *et al.* 2006). Another noteworthy point in the interviews was the knowledge women had of certain nutrients recommended during pregnancy. The term 'vitamin', which refers to the iron and folic acid tablets, was strikingly widespread in this rural, mostly illiterate, community. The knowledge of this word by the local population is probably due to the nutritional education efforts of the local health services. Finally, a complex picture emerged from the analysis: P women in this rural community are confronted with antinomic recommendations from their elders (mainly their mothers-in-law) and from the health services, and have to draw their own conclusions amidst patchy information. Similar findings were reported for a Gourmantché population in northern Burkina (Avril 2003). On the

**Table 6.** Crude median energy/nutrient intake and adjusted difference of mean energy/nutrient intake between pregnant women of trimester 1/2 and trimester 3 of gestation

| Nutrient and energy | Trimester 1/2 ($n = 126$) | | Trimester 3 ($n = 92$) | | Difference of means† | CI‡ | $P$ value§ |
|---|---|---|---|---|---|---|---|
| | Median | ($P_{25}$; $P_{75}$)* | Median | ($P_{25}$; $P_{75}$)* | | | |
| Energy | | | | | | | |
| kcal | 2050 | (1632; 2653) | 2153 | (1676; 2698) | 115.9 | [–97.6; 329.4] | 0.29 |
| MJ | 8.6 | (6.8; 11.1) | 9.0 | (7.0; 11.3) | 0.48 | [–0.41; 1.38] | – |
| Fat (g) | 31.2 | (17.1; 47.5) | 27.0 | (15.4; 46.5) | –0.84 | [–8.0; 6.3] | 0.82 |
| Protein (g) | 60.5 | (44.8; 76.8) | 61.2 | (46.5; 77.8) | –0.87 | [–9.5; 7.8] | 0.84 |
| % energy from fat | 13.9 | (8.4; 18.3) | 11.3 | (7.0; 16.3) | –1.23 | [–3.1; 0.6] | 0.19 |
| % energy from protein | 11.4 | (9.9; 13.5) | 10.7 | (9.7; 13.0) | –0.63 | [–1.45; 0.18] | 0.13 |
| Thiamine (mg) | 0.85 | (0.53; 1.1) | 0.81 | (0.57; 1.1) | –0.005 | [–0.118; 0.113] | 0.94 |
| Riboflavin (mg) | 0.20 | (0.13; 0.34) | 0.25 | (0.14; 0.5) | 0.073 | [–0.003; 0.151] | 0.06 |
| Niacin (mg) | 7.3 | (5.2; 10.0) | 7.8 | (5.5; 10.3) | 0.96 | [–0.40; 2.33] | 0.17 |
| Vitamin $B_6$ (mg) | 0.84 | (0.63; 1.14) | 0.88 | (0.68; 1.26) | 0.80 | [–0.46; 2.06] | 0.21 |
| Folate (µg) | 234.7 | (152.1; 367.5) | 217.2 | (150.3; 316.9) | –37.4 | [–81.3; 6.5] | 0.09 |
| Vitamin A (µg) | 118.9 | (60.5; 249.6) | 117.6 | (53.8; 242.3) | –5.1 | [–65.6; 55.5] | 0.87 |
| Vitamin C (mg) | 11.0 | (5.7; 21.2) | 10.4 | (6.1; 28.4) | –0.62 | [–10.21; 8.98] | 0.90 |
| Calcium (mg) | 574.3 | (335.3; 1081.5) | 468.6 | (231.0; 708.5) | –260.8 | [–513.0; –8.6] | 0.043 |
| Phosphorus (mg) | 839.7 | (616.9; 1135.7) | 852.1 | (670.7; 1180.7) | 17.5 | [–102.7; 137.7] | 0.78 |
| Iron (mg) | 40.6 | (28.9; 57.7) | 40.1 | (25.4; 54.6) | –3.8 | [–11.4; 3.8] | 0.33 |
| Zinc (mg) | 13.1 | (10.1; 16.2) | 13.3 | (10.4; 16.6) | –0.69 | [–2.37; 0.99] | 0.42 |

*25th and 75th percentiles. †Model-based difference of the means (trimester 3) – (trimester 1/2), adjusted for the covariate *age* and fixed effect *village*. ‡Model-based 95% confidence intervals (CI) adjusted for the covariate *age* and fixed effect *village*. §Model-based adjusted for covariate *age* and the fixed effect *village*; statistical significance is achieved at $P < 0.001$ (Bonferroni correction for multiplicity).

basis of such findings, we hypothesize that contradictory recommendations cancel each other out, and lead to insignificant changes in food intake during pregnancy.

A strength of our study was to combine a qualitative and quantitative research in the same region. Quite consistently, the results from the dietary assessment showed that P women do not eat very differently from NP women. Our results do not allow us to conclude that the previously reported *eating down* attitude is responsible for significant changes in food and nutrient intakes. There were also no obvious differences in the intake of specific foods, except for a slightly, but statistically insignificant, increased consumption of roots and tubers, and this is consistent with the wide and variable array of prohibited foods reported by interviewees. These results are in agreement with previous studies which failed to show an important influence of pregnancy on food-consumption patterns (Tuazon *et al.* 1987; Dufour *et al.* 1999). An exception to this is a study in South India by Hutter (1996) which reports a reduced energy intake over the pregnancy duration, but only for women with a body mass index higher than 18.5 $kg/m^{-2}$.

Third-trimester P women had a slightly higher energy intake and lower calcium intake, which can be related to a higher cereal intake and a lower intake of calcium-rich dairy products and green leafy vegetables respectively. However, it cannot be excluded that these differences were obtained due to chance because of statistical insignificance. Moreover, these results contradict the information obtained from the in-depth interviews where interviewees declared to increase the intake of nutrient-dense foods like dairy products during pregnancy. The food-consumption survey revealed that both P and NP women consumed a very monotonous cereal-based diet which resulted in very poor micronutrient intake. When comparing our results with a previous food consumption study organized in the North East of Burkina Faso by Savy *et al.* (2006) we found a more frequent consumption of fats and oils and fruits. This difference can be explained by the difference in climatic zone. The present study was situated in a more humid region with the high presence of cotton (*Gossypium hirsutum*) and Shea butter trees (*Vitellaria paradoxa*). A reasonable portion of the interviewed women were consuming the food group of meat/poultry/fish, but the average portion size was insignificant. This can be explained by the presence of dried powdered fish that was included under this food group and was only used as a condiment. Savy *et al.* (2006) showed a comparable proportion of women consuming this food group, but in their study portion sizes were not accounted for. A comparison of the mean nutrient intakes with the RDA showed that the women of our sample women were mainly deficient for all nutrients except zinc (only NP) and phosphorus (P and NP). The intake values for vitamins A and C were extremely low. The survey was performed during the dry season when green leafy vegetables are only available in dried form (after being stored for several months with possibly substantial losses of heat labile vitamins). As these green leafy vegetables appear to be the most important source for the sample, it can be suggested that this season forms the worst case for vitamins A and C intake. Overall, the results obtained for energy intake did not show a chronically energy-deficient population. However, it must be added that the present survey was organized at the end of the harvesting season when cereal availability is high and market prices are traditionally low. Furthermore, a national annual food security report of 2005 showed that the Tuy province was one of the least food insecure provinces with an estimated cereal production of 218% of the population's energy requirement (Kaboré *et al.* 2008).

Our study presents some potential limitations which should be considered when interpreting the results. First, the study power was set to prove a difference of 1.1-MJ daily intake between P and NP women. So a true smaller difference could have been missed. The clinical significance of such a smaller difference is however not obvious. Second, the differential misreporting of food intake between groups could have biased the results. Information on the influence of pregnancy on misreporting during the 24-h dietary recall is scarce. However, in Indonesia it was found that P women in rural areas were not systematically under reporting (Winkvist *et al.* 2002). For this study we used food photographs to estimate food portions, and a previous validation study showed that pregnancy status was not a significant determinant of the capacity to estimate portion size (Huybregts *et al.* 2008). Third, this study was cross-sectional instead of longitudinal, consequently undetermined intrasubject variance was incorporated in the group comparison. In addition, this survey was limited to the post-harvest season. Although seasonality is believed to have profound effects on the diet and nutritional status in Burkina Faso (Savy *et al.* 2006), it is unlikely that seasonality would modify a potential dietary difference in P women. A fourth potential limitation was the use of one 24-h dietary recall. This method allows accurate estimations of group mean intakes of foods and nutrients, which was the aim of this study. However, it does not allow us to report the proportion of the evaluated groups that were deficient for a particular nutrient, even though this method classifies individuals to the same extent within the distribution as with food-frequency questionnaires (Bingham *et al.* 1994).

In conclusion, P women in this rural area of Burkina Faso do not seem to restrict their diet significantly during pregnancy. The additional nutritional burden of pregnancy is not accounted for in their dietary practises. To address the absence of an increased energy intake and the poor micronutrient intake during pregnancy, the implementation and careful evaluation of innovative interventions is warranted. Such interventions should combine the promotion of good nutrition during pregnancy and the provision of an energy-dense food supplement fortified with micronutrients.

## Acknowledgements

This study was made possible through the financial support of the Flemish Interuniversity Council (VLIR). Our gratitude goes to the field team of the project and the many collaborators of this study. Special thanks go to Jean-Pascal Ki, Virginie Koudougbo and Awa Ouattara for assisting in the supervision of the study.

## Source of funding

This research project was funded through an Own Initiatives grant of the Flemish Interuniversity Council (VLIR) with no role in study design, data collection, data analysis or writing of the report.

## Conflicts of interest

We declare that we have no conflict of interest.

**Key messages**

- Pregnant women have a diet that does not differ from non pregnant women in rural Burkina Faso.
- Although it is often mentioned that food taboos exist during pregnancy, neither the qualitative nor the food intake study could demontrate a clear and consistent food taboo pattern.

## References

Ashworth A. (1998) Effects of intrauterine growth retardation on mortality and morbidity in infants and young children. *European Journal of Clinical Nutrition* **52**, S34–S42.

Avril N. (2003) *Alimentation et Santé de Grossesse en Milieu Rural Burkinabé; Perceptions et Contraintes Socio-culturelles*. Université de Montpellier II: Montpellier, France.

Bakketeig L.S. (1998) Current growth standards, definitions, diagnosis and classification of fetal growth retardation. *European Journal of Clinical Nutrition* **52**, S1–S4.

Barikmo I., Ouattara F. & Oshaug A. (2004) *Food Composition Table for Mali*. Akershus University College: Oslo.

Bentley G.R., Aunger R., Harringan A.M., Jenike M., Bailey R.C. & Ellison P.T., *et al.* (1999) Women's strategies to alleviate nutritional stress in a rural African society. *Social Science & Medicine* **48**, 149–162.

Bingham S.A., Gill C., Welch A., Day K., Cassidy A., Khaw K.T., *et al.* (1994) Comparison of dietary assessment methods in nutritional epidemiology – weighed records v. 24-h recalls, food-frequency questionnaires and estimated-diet records. *British Journal of Nutrition* **72**, 619–643.

Biro G., Hulshof K.F.A.M., Ovesen L. & Cruz J.A. (2002) Selection of methodology to assess food intake. *European Journal of Clinical Nutrition* **56**, S25–S32.

Bonnet D. (1988) *Corps Biologique, Corps Social. Procréation de Maladies de l'Enfant en Pays Mossi*. ORSTOM: Paris.

Butte N.F. & King J.C. (2005) Energy requirements during pregnancy and lactation. *Public Health Nutrition* **8**, 1010–1027.

Choudhry U.K. (1997) Traditional practices of women from India: pregnancy, childbirth, and newborn care. *Journal of Obstetric, Gynecologic, and Neonatal Nursing* **26**, 533–539.

Christian P., Srihari S.B., Thorne-Lyman A., Khatry S.K., LeClerq S.C. & Shrestha S.R. (2006) Eating down in pregnancy: exploring food-related beliefs and practices of pregnancy in rural Nepal. *Ecology of Food and Nutrition* **45**, 253–278.

Dufour D.L., Reina J.C. & Spurr G.B. (1999) Food and macronutrient intake of economically disadvantaged pregnant women in Columbia. *American Journal of Human Biology* **11**, 753–762.

Ene-Obong H.N., Enugu G.I. & Uwaegbute A.C. (2001) Determinants of health and nutritional status of rural Nigerian women. *Journal of Health Population and Nutrition* **19**, 320–330.

FAO & WHO (1994) *Fats and Oils in Human Nutrition*. Report of a joint FAO/WHO Expert Consultation paper no. 57. Food and Agriculture Organization of the United Nations: Rome..

FAO & WHO (2004) *Vitamin and Mineral Requirements in Human Nutrition*, 2nd edn. Report of a joint FAO/WHO Expert Consultation. Food and Agriculture Organization of the United Nations: Rome.

Gittelsohn J. & Vastine A.E. (2003) Sociocultural and household factors impacting on the selection, allocation and consumption of animal source foods: current knowledge and application. *Journal of Nutrition* **133**, 4036S–4041S.

Gittelsohn J., Thapa M. & Landman L.T. (1997) Cultural factors, caloric intake and micronutrient sufficiency in rural Nepali households. *Social Science & Medicine* **44**, 1739–1749.

Hutter I. (1996) Reduction of food intake during pregnancy in rural South India. *Tropical Medicine & International Health* **1**, 399–405.

Huybregts L., Roberfroid D., Lachat C., Van Camp J. & Kolsteren P. (2008) Validity of photographs for food portion estimation in a rural West African setting. *Public Health Nutrition* **11**, 581–587.

Kaboré M., Ouedraogo D., Zoungrana M., Zoungrana B. & Kienou B. (2008) *Dimension Alimentaire de la Pauvreté au Burkina Faso*. Ministère de l'agriculture, de l'hydraulique et des ressources halieutiques: Ouagadougou, Burkina Faso.

Kind K.L., Moore V.M. & Davies M.J. (2006) Diet around conception and during pregnancy – effects on fetal and neonatal outcomes. *Reproductive Biomedicine Online* **12**, 532–541.

Manderson L. (1987) Hot-cold food and medical theories: overview and introduction. *Social Sciences & Medicine* **25**, 329–330.

Nag M. (1994) Beliefs and practices about food during pregnancy. Implications for maternal nutrition. *Economic and Political Weekly* **10**, 2427–2238.

Nag M., White B. & Peet R.C. (1978) An anthropological approach to the study of the economic value of children in Java and Nepal. *Current Anthropology* **19**, 293–306.

Nichter M. & Nichter M. (1983) The ethnophysiology and folk dietetics of pregnancy – a case-study from South-India. *Human Organization* **42**, 235–246.

Patton M.Q. (1990) *Qualitative Evaluation and Research Methods*. Sage Publications: Beverly Hills, CA.

Pool R. (1987) Hot and cold as an explanatory model: the example of Bharuch district in Gujarat, India. *Social Sciences & Medicine* **25**, 389–399.

Roberfroid D., Huybregts L., Lanou H., Henry M.C., Meda N., Menten J., *et al.* (2008) Effects of maternal multiple micronutrient supplementation on fetal growth: a double-blind, randomized controlled trial in rural Burkina Faso. *American Journal of Clinical Nutrition* **88**, 1330–1340.

Rush D. (2000) Nutrition and maternal mortality in the developing world. *American Journal of Clinical Nutrition* **72**, 212S–240S.

Savy M., Martin-Prevel Y., Traissac P., Eymard-Duvernay S. & Delpeuch F. (2006) Dietary diversity scores and nutritional status of women change during the seasonal food shortage in rural Burkina Faso. *Journal of Nutrition* **136**, 2625–2632.

Tuazon M.A.G., Hautvast J.G.A.J., Vanraaij J.M.A. & Barba C.V.C. (1987) Energy-requirements of pregnancy in the Philippines. *Lancet* **2**, 1129–1131.

Winkvist A., Persson V. & Hartini T.N.S. (2002) Underreporting of energy intake is less common among pregnant women in Indonesia. *Public Health Nutrition* **5**, 523–529.