Received: 15 August 2017 | Revised: 2 October 2017 | Accepted: 3 October 2017

DOI: 10.1111/mcn.12558

WILEY | Maternal & Child Nutrition

SUPPLEMENT ARTICLE

Mother and child nutrition among the Chakhesang tribe in the state of Nagaland, North-East India

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Funding information
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Abstract

Despite the importance of the nutritional status and food systems of Indigenous Peoples, the subject has received very little attention, especially in North-East India. Therefore, a community-based cross-sectional descriptive study was carried out among Chakhesang mothers with children under 5 years of age to evaluate their nutritional status and prevalence of chronic diseases in the context of their dietary habits. From 558 households (HHs), 661 children and 540 mothers were covered using standard anthropometric measurements as well as blood collection for haemoglobin and vitamin A. Data were collected from mothers on HH socio-demographic particulars and infant and young child feeding practices. The results showed that the prevalence of underweight, stunting, and wasting among children <5 years of age was 14%, 22%, and 7%, respectively. The prevalence of anaemia and vitamin A deficiency was 26% and 33% among children <5 years, whereas it was 33% and 26%, respectively, among mothers. Hypertension was observed in 16% of women, whereas diabetes was seen in 0.8%. Approximately 35% and 24% of HHs suffered mild or moderate food insecurity, respectively, which was associated with literacy of the parents, per capita income, and family size. Utilization of the rich agrobiodiversity and wild foods by the Chakhesangs appears to be a strong reason for their better nutritional and health status as compared to the rest of India. Therefore, this Indigenous knowledge and food system must be documented and kept vital, especially in policies and intervention programmes addressing food and nutrition security among the Chakhesangs.

KEYWORDS

biodiversity, Chakhesang tribe, food security, Indigenous food system, nutritional status

> *"Another seasonal activity people look forward to is picking wild mushrooms. During May and June one can see early risers scouring the countryside for the delectable button mushrooms atop anthills, especially after an electric thunderstorm, because that is when they pop out, they say." Mekro, 2014*

1 | INTRODUCTION

North-East India is inhabited by diverse Indigenous populations with distinct cultural, linguistic, religious, and historical backgrounds. Nagaland state in North-East India is home to the various Naga tribes. Phek district (Figure 1), in the state of Nagaland with a population of 163,294 (Census of India, 2011), is inhabited mainly by the Pochurys who speak Pochury and the Chakhesangs who speak either Kezha or Chokri. The Nagas, including the Chakhesangs, were once fierce headhunters, and for the Naga warrior, bringing home the head of the enemy from battle was a matter of pride. Therefore, the main role of men was to protect the women, children, and village from marauding enemies. This role established male dominance in their society and a patriarchal structure, which holds the father to be the head of the family. He is considered the provider of family needs and makes all the major decisions, acts as custodian of the family property, and protects the family. All Naga tribes have nuclear families, and their social organization is patrilineal, patrilocal, and patriarchal. A Chakhesang village is normally divided into clans, or

khels. Marriage among clan members is prohibited and is considered incest, with perpetrators being ostracized from the society.

The land ownership and management systems of the Nagas are unique and different from those of the rest of the country, because local laws have governed their landholding system for generations. More than 88% of land in the state of Nagaland is owned by the people. Land is divided into (a) village lands, set apart for public use, a portion of which is for forest use by the residents of the village and comes under the control of the village council; (b) clan land used only by the clan members; and (c) individual or inherited/acquired land, which is privately owned and can be sold (Saikia, 1987).

The virgin forestlands were reserved for the village and hence have remained sacrosanct from human agricultural activities. According to Chakhesang tradition, the clan owns the land; the line of descent and inheritance is a male prerogative. Women have no natural right to share clan land, nor do they have the right to own ancestral property. However, a woman may receive a share of the family property in exceptional cases, and this land is called *lüna*. This is the portion of land given to the woman, which she and her husband or children could use until her death. After this, it is returned to her male kin.

Cultivable land takes many forms in Nagaland: swidden land, wet terrace fields, agroforestry, and kitchen gardens. Swidden cultivation, commonly known as shifting cultivation, employs a mixed cropping pattern where rice is the dominant crop, followed by maize, millet, Job's tears, yam, pulses, and other vegetables. Wet terrace rice cultivation is traditionally practised on hill slopes with terrace benches,

Key messages

- Providing adequate health care in alignment with unique circumstances of tribal communities of India is essential.
- The broad diversity of wild and cultivated food species available for the Chakhesang population of Phek district, Nagaland, North-East India needs to be profiled nutritionally and capitalized upon with community-based strategies.
- Among Chakhesang women, only 10% had low BMI, and obesity and diabetes were rare, although hypertension (15%) is a concern. Chakhesang young children had less undernutrition, anaemia, and vitamin A deficiency than for the State of Nagaland or for India, and can improve with better complementary feeding using local foods.

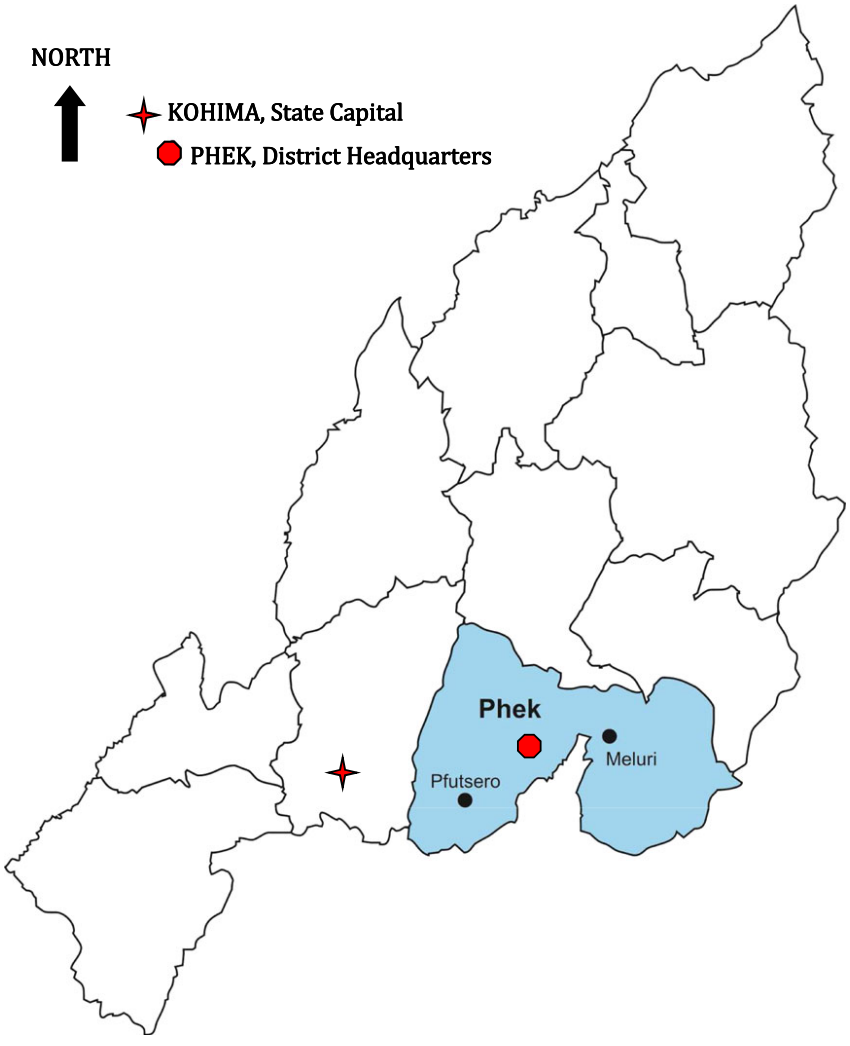

FIGURE 1 Location of Phek district in the state of Nagaland, North-East India

which are irrigated by stream water. Rice is the dominant crop in this system, accounting for 46% of the agricultural produce. However, the share of rice in the total agricultural production of the state, and in terms of area under cultivation, has shown a downward trend. Now, traditional crops like red gram, green gram, Naga dal, beans, peas, and lentils account for only 9% of the gross cropped area. Cultivation of commercial crops such as potato, tea, ginger, and cardamom are on the rise (Singh, Lairenjam, Bharali, Dutta, & Rajkhowa, 2009).

The total area of Phek district is 2,026 km^2, with 297 km^2 under very dense forest cover, 675 km^2 under moderate dense cover, and 813 km^2 existing as open forests. Phek is marked by its evergreen subtropical and temperate coniferous forests that support a variety of flora and fauna. With its rich biodiversity, the natural forest of Phek is of vital importance for the sustenance of the local people, whether for timber, non-timber forest products, food, or medicinal plants. Across the world, agrobiodiversity and wild food resources continue to be integral parts of human diet, especially in the case of Indigenous Peoples (Bharucha & Pretty, 2010). The Chakhesangs, due to their specialized understanding of and close association with nature, have over time accumulated a wealth of information on the utilization of the bioresources within their environment. By and large, such knowledge is confined to the community as it is handed down via word of mouth from one generation to the next.

Beginning in the 1900s, the British brought Christianity and their educational system to the region, which undoubtedly changed the Chakhesang way of life; however, the culture, traditions, and mindset of the community have not changed to a large extent, especially among the rural population. In the face of accelerating change in Indigenous Peoples' food systems due to modernization, the study was initiated to understand the contribution of local food biodiversity on the nutrition and health of the Chakhesang People and also to examine the role of gender in the Chakhesang food system.

2 | METHODS

2.1 | Food biodiversity data collection

Focus group discussions on agrobiodiversity with men and women knowledgeable about the foods used by the Chakhesang tribe were conducted in 10 villages, with each group consisting of 8 to 10 respondents. Using free listing, informants were first asked to name all the cultivated and domesticated plant and animal foods according to food groups, starting with cereals and millets and ending with foods sourced from animals. Next, participants were asked to name all of the wild edible plants available in the locality, starting with green leafy vegetables and ending with foods sourced from animals and insects. Information collected included food names (mostly in the local language), the parts of the plant or animal used, seasonality, whether it was still consumed as food, frequency of consumption in season, and therapeutic uses, if any. Wherever available, pictures were taken for recording purposes, and later, specimen samples were collected for scientific identification. The food lists from 10 villages were cross-checked, and the final list created in both the Kezha and Chokri languages. Dietary diversity scores were not calculated due to time and financial constraints.

2.2 | Sample design and sample size estimation for nutritional status evaluations

A community-based cross-sectional descriptive study was carried out by adopting a random sampling procedure. Sample size was calculated using 40% prevalence of stunting among children under the age of 5 years in Nagaland (District Level Household and Facility Survey 2012–13) with 5% precision and 95% confidence interval. A sample size of 564 children was required. Therefore, 600 households (HHs) in the district were targeted for nutritional assessment. The power of the study is 57% based on back power calculation using power and sample size software.

2.3 | Selection of villages and households

Twenty villages were selected by a systematic random sampling procedure from the administrative blocks in the district, and in each village, 30 HHs with at least one index child under 5 years of age were assessed. The first HH was selected randomly after obtaining the list of HHs from the village head and consequent HHs having at least one child under 5 years were covered till the required number was fulfilled in the village. In the case where the required sample size of children was not sufficient in the village, an adjacent village was covered. All the children below 5 years were covered in order to avoid selection bias. Data were collected via pretested and precoded questionnaires by local investigators trained by staff of NIN. Information collected from mothers included socio-economic and demographic circumstances, food security, morbidity, immunizations and supplements, prenatal and antenatal care, and infant and young child feeding practices. Literacy was measured through standard questionnaires that dealt with the level of education of the subject, and income was assessed on the basis of their occupation, agricultural output, and other cash income. Dietary recalls and consumption frequency of selected foods were taken. Although results of the 24-hr dietary recall are not reported here due to incomplete food composition information for the many local and wild food species, preliminary results are indicated in the discussion.

2.4 | Anthropometry

Anthropometric measurements were taken by trained interviewers and standardized within accepted margins of error by the Habicht (1974) criterion. Weight, length of children (<2 years age), and height (children ≥2 years age) were measured. Height of children was measured barefoot using a stadiometer, whereas length was measured using a seca infantometer. Height was taken to the nearest millimetre after ensuring that the child's heel, buttock, shoulder, and the back of the head touched the stadiometer. The child's weight was measured up to the nearest 100 g with minimum clothing using a seca weighing scale. Mid-Upper Arm Circumference (MUAC), a measure of acute malnutrition that uses United Nations Children's Fund tricolour tapes (United Nations Children's Fund, 2009), was also taken. A 1-day

(24 hr) dietary recall survey was conducted on all persons in the HH for every sixth HH (Thimmayamma & Rao, 1969).

2.5 | Haemoglobin estimation

A blood sample (20 μl) was collected by finger prick using a haemoglobin pipette on filter paper (Whatman® #1), and dry blood spot (DBS) samples were prepared. The blood spots were shade dried and transported to NIN for further analysis. The DBS sample was dissolved in a test tube containing 5 ml of Drabkin's solution for 24 hr and analysed using indirect cyanomethaemoglobin method (Sari et al., 2001). The criteria recommended by the World Health Organization (WHO, 2001) were used to diagnose anaemia: a cut-off value of less than 11 g/dl for haemoglobin for 1- to 5-year-old children and pregnant women and less than 12 g/dl for adolescent girls and lactating women was considered anaemic. A cut-off value of less than 12 g/dl was used for the small number of men (n = 47) who were present in the houses at the time of survey and covered for haemoglobin estimation. Smoking is taboo among women in this community and was not determined as a potential confounding factor.

2.6 | Vitamin A estimation

A free-falling drop of blood from a finger prick was collected on a precoded special chromatography filter paper (Whatman® #1) to estimate vitamin A in all children and women covered for anthropometry by the DBS method (Craft et al., 2000). Serum retinol level <20 μg/dl is defined as a public health problem related to vitamin A deficiency (VAD; WHO, 1996). The following cut-off levels were used in the study for determining vitamin A status among children: serum retinol ≥20 μg/dl was considered adequate; <20 μg/dl, marginal; and <10 μg/dl, severe.

2.7 | Hypertension and diabetes

Blood pressure (BP) was measured 3 times in a sitting position using standard android BP apparatus. The average of the last two readings was used. Participants were divided into three categories as per the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure VII classification (Chobanian et al., 2003), where normal BP is defined as systolic <120 mmHg and diastolic <80 mmHg; prehypertension as either systolic BP 120 to 139 mmHg or diastolic BP 80 to 89 mmHg, but not qualifying for hypertension (HTN); and HTN as systolic ≥140 mmHg and diastolic ≥90 mmHg.

2.8 | Household food security evaluation

HH food security was measured using the Food Insecurity Experience Scale (FIES), an international scale developed by the Food and Agriculture Organization (FAO, 2015), under the Voices of the Hungry project using the Rasch model. The assessment is based on the principle that the experience of food insecurity causes predictable reactions and responses that can be captured and measured through surveys and summarized on a scale. FIES consists of eight questions on HH food-related behaviours associated with difficulty in food access due to resource constraints in the preceding 12 months.

2.9 | Quality control

Scientists and technical staff from NIN trained the investigators before carrying out the survey. NIN staff were present with the investigators throughout the study to check the quality of data collected. In every village, quality checks were carried out in subsamples of the population for anthropometric measurement by NIN staff as part of the quality control. Random quality checks were conducted by NIN scientists by revisiting HHs to ensure quality data collection. Databases were developed with range and consistency checks.

2.10 | Ethical approval

Ethical clearance was given by the Institutional Ethical Committee of NIN. Community consultation and logistics were supported by the Department of Women and Child Development, Government of Nagaland. The objectives and methods of the study were explained to and approved by the community in advance. After explanation of the study, adults provided written, informed consent in the local language for themselves and their children. Wherever required, the consent form was translated with the help of a translator who was present throughout the investigation period. The results of the study were reported to the government for necessary action.

2.11 | Data management and statistical analyses

After the data reached NIN, it was reviewed to check for any inconsistencies after which it was entered in the computer by trained data entry operators to avoid error. Descriptive and statistical analysis was carried out after duly satisfying all data scrutiny procedures with SPSS® for Windows® version 19.0. For continuous variables, *M* and *SD* was calculated, whereas for qualitative variables, prevalence was calculated. Food insecurity was assessed with the FAO Voices of the Hungry HH measure of FIES using the Rasch model (FAO, 2015). Chi-squared tests assessed various dependent and independent variables with statistical significance ($p \leq .05$).

3 | RESULTS

3.1 | Food biodiversity

In all, 614 foods, including those from plant, animal, and insect sources, were recorded. Of these, 377 were found in the wild (Figure 2). Among cereals and millets, there were five varieties of Job's tears; eight maize varieties; 26 millets, including two glutinous varieties; and 95 rice landraces cultivated in swidden and paddy fields, including three glutinous rice, one black rice, and several red rice varieties. Legumes commonly cultivated and used included six rice bean varieties (*Vigna umbellata*), differentiated only by size and colour; three soybeans differentiated by their size; and four varieties of Khollar beans (*Phaseolus vulgaris*).

Leguminous vegetables like common green beans (*P. vulgaris*), green peas (*Pisum sativum*), yardlong beans (*Vigna unguiculata* spp.

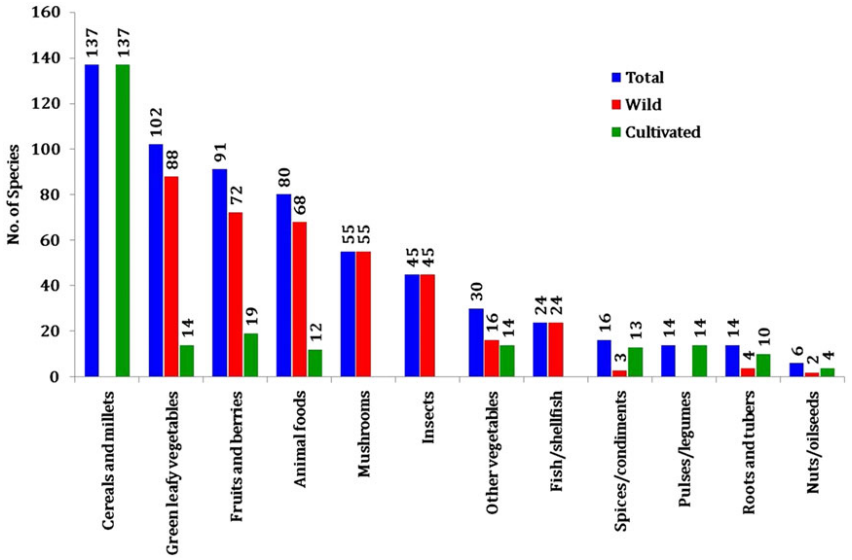

FIGURE 2 Chakhesang's food system

sesquipedalis), sword beans (*Canavalia gladiata*), winged beans (*Psophocarpus tetragonolobus*), broad beans (*Lablab purpureus*), and tree beans (*Parkia roxburghii*) were also grown and used.

Several leafy green vegetables were cultivated, the most common being mustard greens (*Brassica juncea*), cabbage (*Brassica oleracea* var. *capitata*), collard greens (*B. oleracea*), the tender shoots and leaves of chayote (*Sechium edule*), spinach (*Basella rubra*), and passion flower (bell) leaves (*Passiflora edulis*).

The number of leafy vegetables collected from the wild was 87, with the commonly used ones (presented here in local language) being *ghazie* (*Polygonum*), *kutsaga* (*Diplazium esculentum*), *gapre* (*Centella asiatica*), *gatheru* (*Clerodendrum colebrookianum*), *sazu* (*Urtica dioica*), *gakro* (*Athaca rosia*), *mezhunga* (*Zanthoxylum acanthopodium*), and *gapa* (*Plantago*). There was a variety of solanum vegetables, such as *Solanum torvum*, *Solanum indicum*, *Solanum gilo*, and fresh and fermented bamboo shoots from many bamboo species. Tree tomato (*Cyphomandra betacea*) is also a commonly used vegetable unique to the region.

The Chakhesang have their own spices and condiments, including the seed of *mothise* (*Zanthoxylum acanthopodium*), leaves and roots of *gatha* (*Houttuynia cordata*), pericarp of the seed of *tsamhu* (*Rhus semialata*), *thamara* (*Allium chinense*), leaves and roots of *thimere* (*Allium hookeri*), leaves of *khuva* (*Allium tuberosum*), leaves of *dunie* (*Eryngium*), *kotsamithise* or Naga king chilli (*Capsicum chinense*), leaves and flowers of *sawhe* (*Elsholtzia blanda*), and leaves of *nyetsu* (*Ocimum basilicum*).

As many as 74 wild fruits were recorded. Some of those identified included *ciephose* (*Docynia indica*), *tsuhose* (*Phyllanthus emblica*), *tsamhise* (*Rubus ellipticus*), *letuche* (*Pratia begonifolia*), *ziche* (*Debregeasia longifolia*), *chuduse* or *khabuse* (wild ficus), *kazhuche* (*Pyrus pashia*), *tukhrashe* (*Calamus erectus*), *tsakhrose* (*Viburnum foetidum*), *ciephose* (*Docynia indica*), *zhiedeshe* (*Diospyrus kaki*) *nhuche* (*Myrica esculenta*), *kaviche* (*Caudata*), and *mutroho* (*Prunus nepalensis*).

The most commonly consumed wild foods reported in the focus group sessions were leafy green vegetables, followed by fruits. Wild mushrooms were consumed during the wet season between June and September. Fifty-five wild mushroom varieties were collected and consumed, but only three could be identified by scientific name. Perilla seed (*Perilla frutescens*) is a traditional oilseed commonly used by the community. Five varieties of tubers were reported as collected from the wild, with the most widely used being *ruphu* (*Dioscorea bulbifera*) and *muthu* (*Dioscorea deltoidea*).

Many kinds of fish, snails, crabs, and frogs collected either from the paddy fields or river are consumed by the Chakhesang. A number of wild animals, including birds and snakes, are either hunted or trapped and used as food. Insects are another important source of food. Up to 36 species of insect are consumed, including carpenter worm, eri silkworm, beetle larvae, hornet larvae, locust, wild spiders, and bamboo worm.

3.2 | Population coverage particulars

Six hundred sixty-one children under 5 years of age (boys: 338; girls: 328) from 558 HHs were covered for anthropometry. Five hundred forty adult women and 56 adult men were also covered for various investigations. There were 190 mothers with children under 12 months of age and 266 mothers with children between 12 and 35 months of age who were interviewed for infant and young child feeding practices and coverage for immunizations and supplements of iron, folate, and vitamin A. BP and fasting blood sugar was measured for 538 and 511 women, respectively. Dietary survey data were completed for all individuals in 96 HHs.

3.3 | Household socio-economic and demographic summary

Chakhesang families are largely nuclear (97.5%) with an average family size of 5.2. The majority (96.6%) were Christian, and 90% of men as well as 81% of women were literate, with 33% having completed 12th class and above. The major occupation of men was farming or labour (43.2%), whereas 65% of the women were homemakers. The average per capita monthly income was Rs 1,847 (USD 28). Half (50%) of the houses were *kutcha* (constructed of mud/sand or stones with a thatched roof), and a majority (61%) had three or four rooms, whereas 28% had two rooms. All HHs had electricity. Sanitary latrines were present in 90%, and safe drinking water was available to 69% of

HHs. Ninety-eight per cent of HHs had a separate kitchen, and almost all HHs (96%) were using firewood for cooking purposes. About 88% of HHs owned mobile phones, and 29% owned televisions. A majority of the population received rice (82%) and sugar (74%) through the public distribution system (government scheme to ensure food security for the poor); 98% of HHs were using iodized salt with an average iodine content of 7 ppm.

3.4 | Anthropometry of children and adults

Anthropometric measurements were taken by trained staff, and only a single measurement was taken. Six hundred sixty-one children aged 0–59 months were covered in the study. There was a homogenous distribution according to sex (51% boys; 49% girls). The prevalence of low birth weight was 7%. The polynomial growth chart based on weight and height for boys and girls from birth to 5 years is given in Figure 3. Data for both weight and height closely follow the WHO standards (Onis, 2006) until around 8 months, when growth begins to lag behind the global standard. With respect to nutritional status of Chakhesang children below 5 years of age, prevalence rates of underweight, stunting, and wasting were 14.4%, 21.6%, and 6.5%, respectively (Figure 4). Mean *z* scores for weight-for-age, height-for-age, and weight-for-height were −0.87, −1.02, and 0.44, respectively. The low prevalence of underweight (4%) and stunting (3%) in children 0–11 months increased to 18% and 32%, respectively, among 36- to 59-month-old children (Figure 5), whereas wasting (6.3%) did not change. Levels of undernutrition were similar among boys and girls. MUAC showed 61% of children under 5 years of age were normal, whereas 1.5% were suffering from acute malnutrition, 9.4% from moderate malnutrition, and 21% at risk of malnutrition. Examination of the children showed that none had any clinical signs of nutritional deficiency, whereas among women, 9% had dental caries and 1.5% had goiter. Nutritional status among adult women is shown in Figure 6. The prevalence of chronic energy deficiency (body mass index [BMI] below 18.5) was 10%, whereas overweight/obesity (BMI ≥ 25) was observed among 12% of women. A majority (78%) of the women had normal BMIs.

3.5 | Prevalence of vitamin A deficiency, anaemia, hypertension, and diabetes

For measurements of VAD, the *M* ± *SD* of serum retinol levels among all children under 5 years of age was 22.88 ± 6.45 μg/dl, slightly higher than the cut-off level of 20 μg/dl (Table 1). VAD was observed in 33% of children, but very few among them had severe VAD. The prevalence of VAD was higher among girls (39.4%) as compared to boys (26.8%). Twenty-six per cent of adults were suffering from VAD.

Besides subclinical VAD, anaemia prevalence among children under 5 years of age was 26.3%. The proportion of children with mild anaemia was 16.4%, and moderate was 9.9%, whereas not a single case of severe anaemia was observed. The prevalence of anaemia among pregnant women was 40.8%, lactating mothers 44.6%, and non-pregnant non-lactating (NPNL) women was 33.1% (Figure 7). Low prevalence of severe cases of anaemia (<7 g/dl) was observed among NPNL (1.8%) and lactating (2.8%) women. Among men, 23.6% suffered from iron deficiency anaemia. Haemoglobin adjustment for altitude has not been made, which is a limitation of the study.

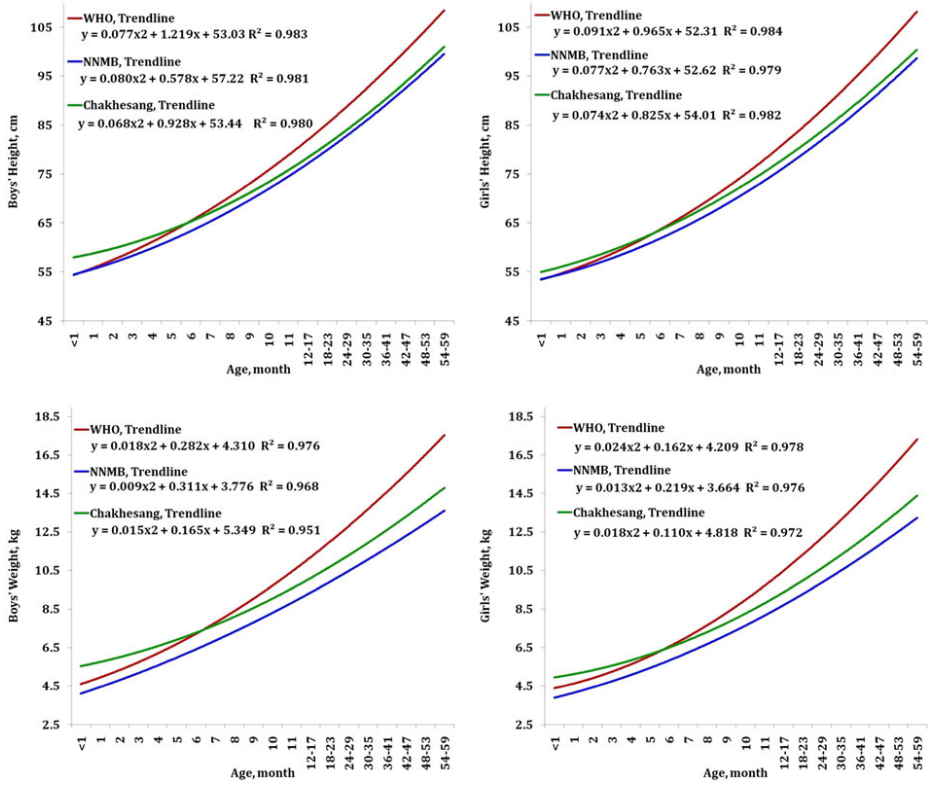

FIGURE 3 Polynomial growth trends in children under 5 years, *n* = 661. NNMB = National Nutrition Monitoring Bureau; WHO = World Health Organization

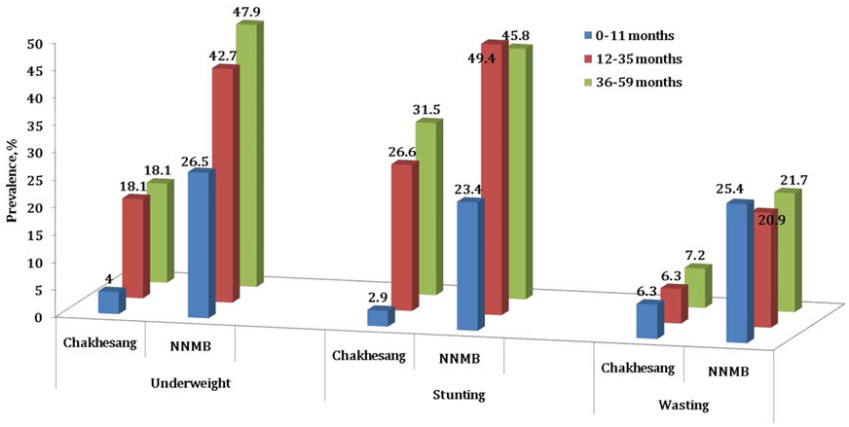

FIGURE 4 Nutritional status of children below 5 years. NNMB = National Nutrition Monitoring Bureau

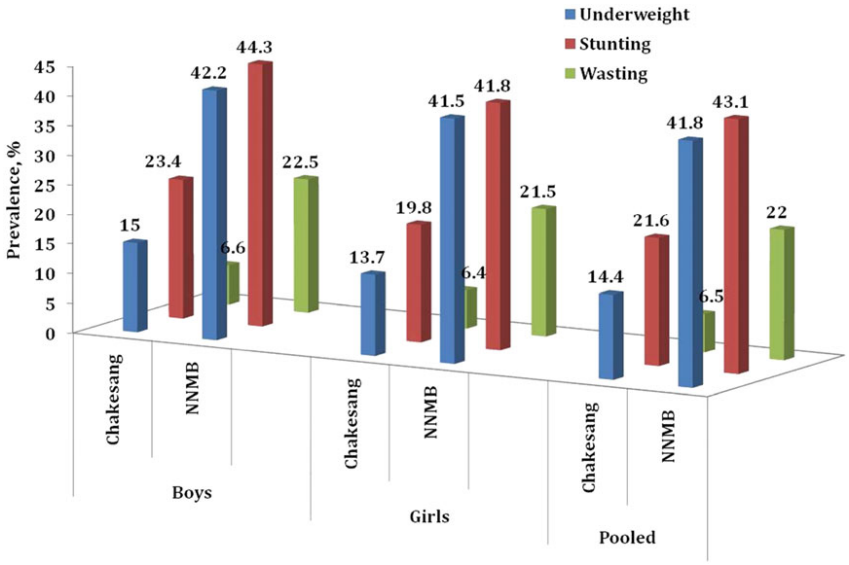

FIGURE 5 Gender-wise nutritional status of children under 5 years. NNMB = National Nutrition Monitoring Bureau

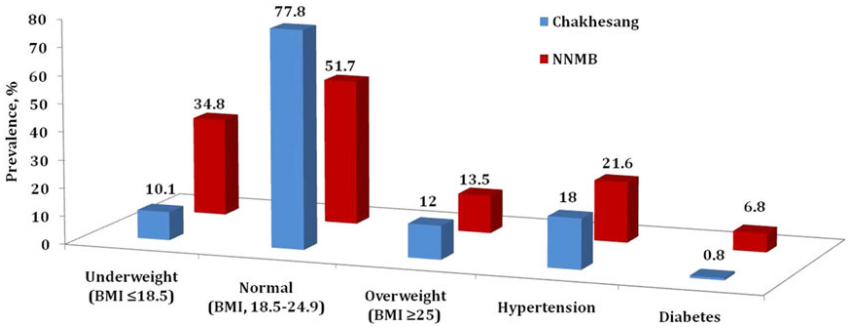

FIGURE 6 Nutritional status of Chakhesang women. Body mass index (BMI) n = 540; hypertension n = 539; and diabetes n = 511. NNMB = National Nutrition Monitoring Bureau

Out of 557 women between the ages of 20–50 years, 5.9% were suffering from HTN, and 9.8% from prehypertension, respectively. The prevalence of diabetes was 0.8% among adult women (Figure 6).

3.6 | Household food insecurity evaluation

Figure 8 depicts the different levels of food insecurity among HHs. It was observed that 41% were food secure, whereas 23% had mild food insecurity and 35% had moderate food insecurity. Severe food security was observed in only 0.05% of the HHs (Figure 8). No significant difference was observed in the prevalence of chronic energy deficiency and overweight/obesity between the food security groups. The prevalence of food insecurity was significantly ($p < .05$) higher among illiterate parents, lower per capita income HHs, and among HHs with a family size over nine members (Table 2). This finding is similar to that of Khasi HHs in Meghalaya, North-East India, as reported in this special issue.

3.7 | Infant and young child feeding practices

About 35% of surveyed mothers initiated breastfeeding within 1 hr of birth and another 50% within 1 to 3 hr of birth. The majority (86%) of the mothers regarded colostrum as important for the newborn, and only about 14% gave a prelacteal feed such as plain or glucose water.

TABLE 1 The prevalence of vitamin A deficiency among Chakhesang tribe

	Serum retinol		
	<20 μg/dl	≥20 μg/dl	Total
1- to 5-year-old children			
Boys	33 (26.8)	90 (73.2)	123
Girls	41 (39.4)	63 (60.6)	104
Total	74 (32.6)	153 (67.4)	227
Adults			
Male	18 (29.5)	43 (70.5)	61
Female	133 (25.4)	390 (74.6)	523
Total	151 (25.9)	433 (74.1)	584

Note. Values in parentheses represent %.

Interviews with mothers revealed that 90% practised exclusive breastfeeding up to 6 months, whereas the other infants received complementary foods on the advice of an auxiliary nurse midwife/elder, or on the mothers' own judgement. After 6 months, 86% of mothers introduced complementary feed to the infants, which was mostly homemade solids or semi-solids prepared with cereals and millets as the base. Complementary feed included various ingredients such as sugar and jaggery, pulses, fruits, fats and oils, eggs, vegetables, roots and tubers, milk, and meat. Cow or buffalo milk was fed to 52% of the infants. About 44% of the mothers reported breastfeeding at least 10 times per day for the young infants, and a majority (57%) continued breastfeeding for more than 2 years. The frequency of breastfeeding decreased after 6 months. For complementary foods, 32% of children were fed by spoon, 24% by hand, whereas 36% ate by themselves. About 64% of children between 24 and 59 months washed their hands with soap before eating. Immunizations were given to 81% of children between 12 and 24 months, but only 31% received at least one dose of vitamin A.

3.8 | Maternal knowledge of diet during pregnancy

About 73% of mothers stated that extra food is needed during pregnancy, and about 62% stated that it was difficult to consume extra food. Fifty per cent of the mothers stated that they consumed extra food during pregnancy, and among them, 13% could access more nutritious food at this time.

4 | DISCUSSION

Traditionally, the division of labour among the Chakhesangs is based on sex and age. HH work, field work, child rearing, and food gathering are considered women's work, whereas hunting, warfare, administration, trade and business, cutting firewood, and clearing the jungle are men's responsibilities. Women gather wild plant foods, whereas hunting and gathering insects are mostly left to men. Usually, women make all major decisions regarding agriculture, but when money is involved, the decision usually lay with the men (personal observation of author T. L.).

4.1 | Food biodiversity

The food free list of the Chakhesangs contains 635 foods, of which 236 are cultivated. Many of the wild foods were not identified scientifically, making it difficult to analyse dietary recall data. Vast diversity was observed within the traditional crops, which included 137 cereals and millets, and 97 fruit and vegetable crops grown in paddy fields, *jhum* (shifting cultivation) fields, and home gardens. Many of these wild foods are collected from natural and semi-natural vegetation and still form a significant portion of the total food basket for HHs. The collection by Chakhesangs of wild species, including small snakehead fish, water beetle, apple snail, and other insects is an example of an overlooked but important contribution to daily protein requirements. In Cambodia, wild fish in and around paddy fields have been reported to contribute up to 70% to the local population's protein intake (Guttman, 1999). Bush meat and fish have been reported to provide 20% of protein in at least 60 developing countries (Bennet & Robinson, 2000). Although wild foods cannot entirely bridge the existing supply and demand gaps, without them, these gaps would be much larger. Food collected from the wild has always provided dietary diversity and acted as a safety net in times of scarcity and uncertainty for Indigenous Peoples

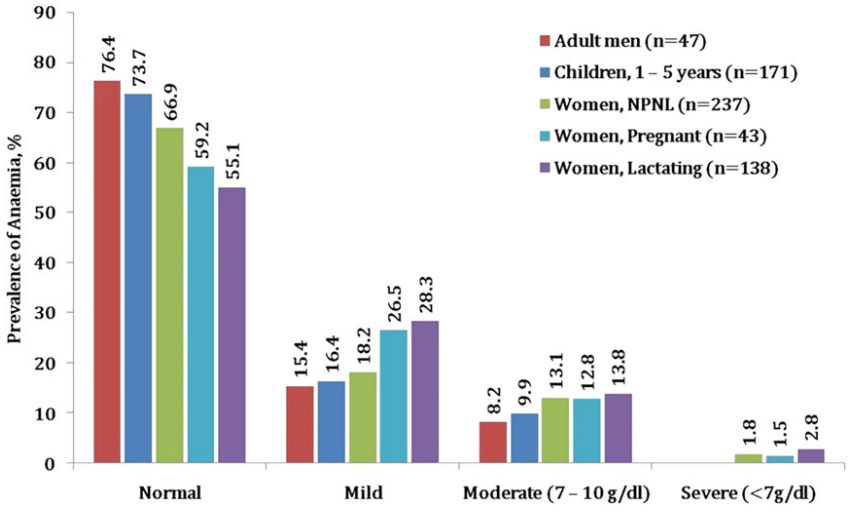

FIGURE 7 Prevalence of anaemia in different physiological age groups. NPNL = non-pregnant non-lactating

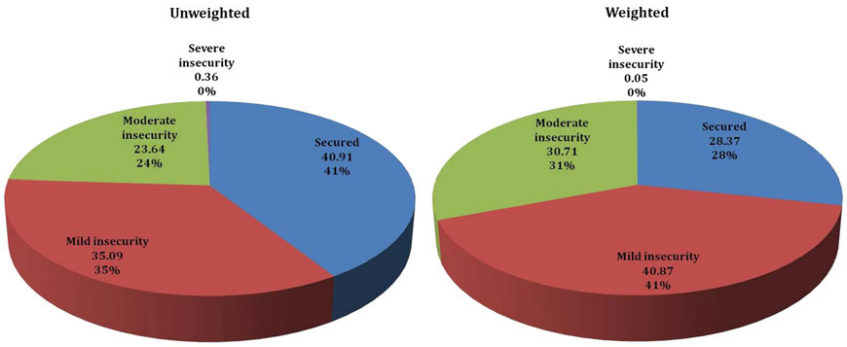

FIGURE 8 Food insecurity status among Chakhesang households (n = 537)

TABLE 2 Associations of food insecurity with women's nutritional status and socio-demographic variables in percentage

		Women, BMI		
	n HH	CED	Normal	Overweight
Food insecurity				
Secured	214	9.8	79.9	10.3
Mild insecurity	192	10.9	75.0	14.1
Moderate insecurity	131	9.9	77.9	12.2
		Food insecurity		
		Secured	Mild insecurity	Moderate insecurity
Literacy status				
Illiterate	88	26.1	43.2	30.7
Literate	449	42.5	34.3	23.2
Per capita income				
1st quartile	134	26.1	33.6	40.3
2nd quartile	135	29.6	42.2	28.1
3rd quartile	133	36.8	41.4	21.8
4th quartile	135	66.7	25.9	7.4
Family size				
1–4	233	45.9	32.2	21.9
5–8	281	35.9	36.3	27.8
≥9	23	26.1	65.2	8.7

Note. BMI = body mass index; CED = chronic energy deficiency; HH = household.

(Colfer, Sheil, & Kishi, 2006; McSweeney, 2004; Powell et al., 1997; Vinceti, Eyzaguirre, & Johns, 2008). Currently, only 36% of the HHs reported eating one or more wild foods more than 3 times a week as recorded through food frequency questionnaires, which suggests that, despite its dietary contribution, the frequency of wild food consumption may be declining.

4.2 | Anthromometry

The BMI of mothers showed that only 10% had low BMI (<18.5), indicative of energy deficiency, whereas 78% had normal BMI. Studies have reported that a child's nutritional status is correlated with the mother's health as measured by BMI (Das & Sahoo, 2011; Subramanian, Ackerson, & Smith, 2010). Following this logic, it is assumed that the 78% of the Chakhesang mothers with normal BMI were producing sufficient quantity and adequate quality of breast milk for optimum child growth. This is exemplified by the low rate of undernutrition observed among children less than 6 months of age. However, child undernutrition began to increase steadily after the child had passed 6 months of age. Transition from breast milk to complementary food of poor quality or diminished quantity may be one of the factors that explains this. This could be further aggravated by delayed or early initiation of complementary feeding and frequency and quality of complementary feeding, compounded with infection.

The National Family Health Survey-4, conducted by the central government every 10 years, reported 14%, 28%, and 9% prevalence of underweight, stunting, and wasting, respectively, in Phek district, which is comparable to findings of this study. Comparatively, Chakhesang children have lower levels of child undernutrition than reported for the State of Nagaland generally. Indeed, the Chakhesang mother and child are doing much better than the national average, where the prevalence of underweight, stunting, and wasting among children under 5 years of age is 35.7%, 38.4%, and 28.5%, respectively (National Family Health Survey-4, 2015-16). This is also supported by the lower infant mortality and morbidity rate among the Chakhesangs. Family plays an important role in Chakhesang society, as it is the source of Indigenous knowledge and social values among all Naga tribes in general (personal observation of author T. L.). Perhaps it is also the traditional division of labour that gives the mother more time to take care of the infant, which in turn contributes to the comparatively lower magnitude of child undernutrition.

Most Chakhesang HHs are still using firewood, which should be replaced by clean cooking fuel, as the link between firewood use and respiratory diseases is well established (Po, FitzGerald, & Carlsten, 2011). This will not only improve the health and nutrition of the population but also reduce the time and effort of women, who traditionally gather and carry firewood.

MUAC showed that 1.5% of children were in the severe malnutrition category. Severe underweight (3.5%) and severe stunting (6.5%) were also observed among children, indicating that there is a segment of very poor Chakhesang families who require government support in terms of food aid and health care. During the survey period, these children were immediately referred to the primary health centre for treatment according to standard procedures. The low levels of severe malnutrition among children are indicative that a majority of children are receiving good food and growing well.

4.3 | Health issues

About one third of the children had low levels of serum retinol indicative of VAD. Though the Chakhesang community consumes ample green leafy vegetables along with wild and cultivated fruits, a young child is unlikely to consume sufficient dietary sources of β carotene to satisfy their vitamin A needs from vegetables and fruits alone. Further, the conversion of β carotene from plant foods is highly variable among foods ranging from 8 to 45 μg (De Pee, West, Permaesih, Martuti, & Hautvast, 1998; West, Eilander, & Van Lieshout, 2002). This may be compounded by the fact that the low intake of oils and fat among the Chakhesangs (dietary intake data not presented here) would hamper absorption and bioavailability of fat-soluble vitamins.

Anaemia is a well-known health occurrence in developing countries and has a multifaceted aetiology wherever it occurs that is indicative of multi-micronutrient deficiency (Jamieson & Kuhnlein, 2008; Jamieson, Kuhnlein, Weiler, & Egeland, 2013). Prevalence of anaemia among children below 5 years of age at the Indian national level was 51% (Stevens et al., 2013), much higher than in this study (26.3%). Anaemia prevalence among adult men (23.6%), NPNL women (33.1%), pregnant women (40.8%), and lactating women (44.9%) was much lower than compared to the rural Indian population as a whole (National Nutrition Monitoring Bureau, 2012). Studies have shown that consumption of animal products, including those from wild animals, is associated with significantly higher haemoglobin concentration (Golden, Fernald, Brashares, Rasolofoniaina, & Kremen, 2011; Neumann et al., 2003). From the preliminary dietary intake data, it appears that protein intake among the Chakhesang was adequate (data not presented here). Food sourced from animals, including that from wildlife and insects, is another likely reason for the much lower prevalence of anaemia in the community. These results confirm the benefits of the Indigenous Peoples' food systems.

Obesity, which is one of the major risks leading to the development of HTN, was low among Chakhesang women. However, prevalence of HTN was 15%, which is a matter of concern. Salt intake among the Chakhesangs was 8.3 g/day. Excess dietary sodium predisposes one to high BP (Meneton, Jeunemaitre, de Wardener, & Macgregor, 2005; He, Marrero, & Macgregor, 2008), and several studies have shown the benefit of reducing salt intake on BP at community levels (Forte, Miguel, Miguel, De Padua, & Rose, 1989; Tian et al., 1995; Staessen et al., 1988; Cutler, Follmann, & Allender, 1997; Graudal, Galløe, & Garred, 1998). Perhaps reducing the current salt intake to the recommended level of less than 5 g/day will reduce HTN among members of the Chakhesang tribe.

Type 2 diabetes has been recognized as a significant public health problem in India, and the growing prevalence among children and youth has emerged as a public health concern. Interestingly, the prevalence of diabetes (glucose intolerance) among adult Chakhesang women in this study was only 0.8%, much lower than 6%, the average rate among women in 10 states of India (National Nutrition Monitoring Bureau, 2012). As diabetes prevalence continues to rise in the country, prevention of the disease has become an increasingly important goal of the government. Availability and access to wild foods from farms and forests appears to provide dietary diversification and helps to explain the better nutritional status of the Chakhesang mother and child (personal observation of author T. L.). The focus group information revealed that the Chakhesang have used the biodiversity in and around their fields and forests to supplement their foods, providing much needed dietary diversity, as observed in many Indigenous populations around the world (Grivetti & Ogle, 2000).

4.4 | Local food diversity

Ethnobotanical surveys of wild plants indicate that more than 12,500 species have been used as human food at some stage in human history (Rapoport & Drausal, 2001). However, Prescott-Allen and Prescott-Allen (1990) have argued that this list is deceptively short, because it comes from global and commercial production data. The documented uses of over 200 species among different Indigenous communities have been reported (Kuhnlein, Erasmus, & Spigelski, 2009). Over 600 plant species have been recorded in India as having food value (Rathore, 2009). Some 1,069 species of wild mushrooms are consumed worldwide as important sources of protein and income (Boa, 2004). DeFoliart (1992) has recorded over 1,000 species of edible insects used around the world. Even small surveys yield surprisingly high numbers of species used in the food system. In North-East Thailand, wild foods are deliberately propagated (High & Shackleton, 2000; Harris & Mohammed, 2003). Thus, there is no easy distinction between wild and cultivated foods, which exist in a continuum ranging from entirely wild to semi-domesticated (Harris, 1989). The enormous list of foods used by the Chakhesangs needs complete scientific identification, evaluation of nutritional value, use, and consumption, and a study of their subsequent impact on human health and nutrition.

With the focus on education, children are now spending more time in school, reducing opportunities to learn about wild foods. This will ultimately lead to erosion of traditional knowledge of food biodiversity. Agricultural development programmes that encourage the cultivation and sale of commercial vegetables are gaining popularity, driven by the farmers' need for money to meet their needs. The government policy of discouraging *jhum* cultivation to "protect" the ecosystem and the public distribution system, which provides subsidized rice and sugar is, in a way, reducing physical activity and fuelling dietary diversity loss. Government policies and the need to increase income could, in the long run, undercut the sustainable food system that has been practised by the Chakhesangs for centuries. This will ultimately affect food choices and lead to dietary simplification, having a negative impact on their health (Kuhnlein, Erasmus, & Spigelski, 2009; Popkin, 2001; Popkin & Gordon-Larsen, 2004).

The FAO recognizes that "nutrition and biodiversity converge to a common path leading to food security and sustainable development" and that "wild species and intraspecies biodiversity have key roles in global nutrition security" (FAO, 2011). In light of this study, where food biodiversity appears to be key to the better nutritional health of the Chakhesangs as compared to the rest of the country, Indigenous knowledge of food biodiversity, which affects food choices, should be preserved. It is known that many of the wild foods are of good nutritional quality, with many beneficial attributes. Therefore, comprehensive food composition data is the first step to bringing about recognition of wild foods for nutritional security (Vinceti et al., 2008). This should be followed by identification of potential foods for agricultural

development and conservation policies. The Chakhesang food system can be a model of Indigenous knowledge to prevent dietary simplification and its negative impact on human health.

ACKNOWLEDGMENTS

We would like to express our sincere thanks to The Indigenous Partnership for Agrobiodiversity and Food Sovereignty (TIP), Indigenous Peoples' International Centre for Policy Research and Education (TEBTEBBA), and North East Slow Food and Agrobiodiversity Society (NESFAS) for funding support and cooperation during the study. We are grateful to the Department of Women and Child Development, Government of Nagaland, Kohima, for their support through their various Integrated Child Development Services networks in carrying out this study. Our earnest thanks go to the entire project staff for their commitment and sincere efforts in completing data collection. We are extremely grateful to the Chakhesang community, especially mothers of young children, for their unstinting cooperation. Without their participation, the study would not have been completed successfully.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONTRIBUTIONS

TL was the study coordinator and, along with HVK and PR, conceptualized the research, study parameters, and reviewed the manuscript. BK was responsible for the data related to food biodiversity and the associated questionnaire. IIM was involved in the study design, recruitment, training of project staff, execution of survey, data analysis, and report writing. SK was involved in the training and anthropometric data collection as well as the diet survey, whereas VK was involved in the study design, sampling, training, and data analysis.

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REFERENCES

Bennet, E. L., & Robinson, J. G. (2000). Hunting of wildlife in tropical forests, implications for biodiversity and forest peoples. Washington, DC: World Bank. Environment Dept. Paper No. 76.

Bharucha, Z., & Pretty, J. (2010). The roles and values of wild foods in agricultural systems. *Philosophical Transactions of the Royal Society B*, *365*, 2913–2926.

Boa, E. (2004). Wild edible fungi: A global overview of their use and importance to people. *Series on Non-Wood Forest Products*, Forestry Department, Rome, Italy: FAO. No. 17.

Census of India 2011. New Delhi: Registrar General & Census Commissioner of India. http://censusindia.gov.in/

Chobanian, A. V., Bakris, G. L., Black, H. R., Cushman, W. C., Green, L. A., Izzo, J. L., & Wright, J. T. (2003). Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension*, *42*(6), 1206–1252.

Colfer, C. J. P., Sheil, D., & Kishi, M. (2006). Forests and human health: Assessing the evidence. Occasional, CIFOR Paper No. 45.

Craft, N. E., Haitema, T., Brindle, L. K., Yamini, S., Humphrey, J. H., & West, K. P. (2000). Retinol analysis in dried blood spots by HPLC. *The Journal of Nutrition*, *130*(4), 882–885.

Cutler, J. A., Follmann, D., & Allender, P. S. (1997). Randomized trials of sodium reduction: An overview. *The American Journal of Clinical Nutrition*, *65*(2), 643S–651S.

Das, S., & Sahoo, H. (2011). An investigation into factors affecting child undernutrition in Madhya Pradesh. *Anthropologist*, *13*(3), 227–233.

De Pee, S., West, C. E., Permaesih, D., Martuti, S., & Hautvast, J. G. (1998). Orange fruit is more effective than are dark-green, leafy vegetables in increasing serum concentrations of retinol and beta-carotene in schoolchildren in Indonesia. *The American Journal of Clinical Nutrition*, *68*(5), 1058–1067.

DeFoliart (1992). Insects as human food. *Crop Protection*, *11*, 395–399.

Food and Agriculture Organization (2011). Biodiversity for food and agriculture: Contributing to food security and sustainability in a changing world, Food and Agriculture Organization of the United Nations, Rome.

Food and Agriculture Organization (2015). Voices of the Hungry. Food Insecurity Experience Scale. Retrieved from http://www.fao.org/in-action/voices-of-the-hungry/en/#.V3P1SY-cG70

Forte, J. G., Miguel, J. M., Miguel, M. J., De Padua, F., & Rose, G. (1989). Salt and blood pressure: A community trial. *Journal of Human Hypertension*, *3*(3), 179–184.

Golden, C. D., Fernald, L. C. H., Brashares, J. S., Rasolofoniaina, B. J. R., & Kremen, C. (2011). Benefits of wildlife consumption to child nutrition in a biodiversity hotspot. *PNAS*, *49*, 19635–19656.

Graudal, N. A., Galløe, A. M., & Garred, P. (1998). Effects of sodium restriction on blood pressure, renin, aldosterone, catecholamines, cholesterols, and triglyceride: A meta-analysis. *JAMA*, *279*(17), 1383–1391.

Grivetti, L. E., & Ogle, B. M. (2000). Value of traditional foods in meeting macro- and micronutrient needs: The wild plant connection. *Nutrition Research Reviews*, *13*, 31–46.

Guttman, H. (1999). Rice field fisheries—A resource for Cambodia. *Naga ICLARM Quart*, *22*, 11–15.

Habicht, J. P. (1974). Standardization of quantitative epidemiological methods in the field. *Boletin de La Oficina Sanitaria Panamericana. Pan American Sanitary Bureau*, *76*(5), 375–384.

Harris, D. R. (1989). An evolutionary continuum of people–plant interaction. In D. R. Harris, & G. C. Hillman (Eds.), *Foraging and farming: The evolution of plant exploitation* (pp. 11–26). London, UK: Unwin Hymanpp.

Harris, F. M. A., & Mohammed, S. (2003). Relying on nature: Wild foods in Northern Nigeria. *Ambio*, *32*, 24–29.

He, F. J., Marrero, N. M., & Macgregor, G. A. (2008). Salt and blood pressure in children and adolescents. *Journal of Human Hypertension*, *22*(1), 4–11.

High, C., & Shackleton, C. M. (2000). The comparative value of wild and domestic plants in home gardens of a South African rural village. *Agroforestry Systems*, *48*, 141–156. https://doi.org/10.1023/A:1006247614579

Jamieson, J. A., & Kuhnlein, H. V. (2008). The paradox of anemia with high meat intake: A review of the multifactorial etiology of anemia in the Inuit of North America. *Nutrition Reviews*, *66*(5), 256–271.

Jamieson, J. A., Kuhnlein, H. V., Weiler, H. A., & Egeland, G. M. (2013). Higher *n*3-fatty acid status is associated with lower risk of iron depletion among food insecure Canadian Inuit women. *BMC Public Health*, *13*(1), 289.

Kuhnlein, H. V., Erasmus, B., & Spigelski, D. (2009). Indigenous peoples' food systems: The many dimensions of culture, diversity and environment for nutrition and health. Rome: United Nations Food and Agriculture Organization, pp. 339.

McSweeney, K. (2004). Forest product sale as natural insurance: The effects of household characteristics and the nature of shock in eastern Honduras. *Society and Natural Resources*, *17*(1), 39–56.

Mekro, V. (2014). *The fragile ecosystem of Nagaland*. Kohima: Barkweaver Publications.

Meneton, P., Jeunemaitre, X., de Wardener, H. E., & Macgregor, G. A. (2005). Links between dietary salt intake, renal salt handling, blood pressure, and cardiovascular diseases. *Physiological Reviews*, *85*(2), 679–715.

Neumann, C. G., Bwibo, N. O., Murphy, S. P., Sigman, M., Whaley, S., Allen, L. H., … Demment, M. W., (2003). Animal source foods improve dietary quality, micronutrient status, growth and cognitive function in Kenyan school children: Background, study design and baseline findings. *The Journal of Nutrition*, *133*(11, Suppl 2), 3941S–3949S.

National Family Health Survey-4 (2015–16). International Institute for Population Sciences. Ministry of Health and Family Welfare, Government of India.

National Nutrition Monitoring Bureau (2012). Diet and nutritional status of rural population, prevalence of hypertension, and diabetes among adults and infants and young child feeding practices. Report of third repeat survey (2011–2012).National Nutrition Monitoring Bureau, National Institute of Nutrition, Indian Council of Medical Research (Hyderabad).

Onis, M. (2006). WHO child growth standards based on length/height, weight and age. *Acta Paediatrica*, *95*(S450), 76–85.

World Health Organization (2001). Iron deficiency anaemia: Assessment, prevention and control: A guide for programme managers.

World Health Organization (1996). *Indicators for assessing vitamin A deficiency and their application in monitoring and evaluating intervention programs*. Geneva: Switzerland.

Po, J. Y. T., FitzGerald, J. M., & Carlsten, C. (2011). Respiratory disease associated with solid biomass fuel exposure in rural women and children: Systematic review and meta-analysis. *Thorax*, *66*, 232–239.

Popkin, B. M. (2001). Nutrition in transition: The changing global nutrition challenge. *Asia Pacific Journal of Clinical Nutrition*, *10*(Suppl), S13–S18.

Popkin, B. M., & Gordon-Larsen, P. (2004). The nutrition transition: Worldwide obesity dynamics and their determinants. *International Journal of Obesity and Related Metabolic Disorders*, *28*(Suppl 3), S2–S9.

Powell, B., Watts, J., Boucard, A., Urech, Z., Feintrenie, L., Lyimo, E., … Price, L. L. (1997). Wild plant food in agricultural environments. *Human Organization*, *56*, 209–221.

Prescott-Allen, R., & Prescott-Allen, C. (1990). How many plants feed the word? *Conservation Biology*, *4*(4), 365–374.

Rapoport, E. H., & Drausal, B. S. (2001). Edible plants. En:. In S. Levin (Ed.), *Encyclopedia of biodiversity* (Vol. II) (pp. 375–382).

Rathore, M. (2009). Nutrient content of important fruit trees from arid zone of Rajasthan. *Journal of Horticulture and Forestry*, *1*, 103–108.

Saikia, J. (1987). Land relations in Nagaland. Land Relations in Northeast India. New Delhi: Peoples Publishing House, 202–207.

Sari, M., de Pee, S., Martini, E., Herman, S., Bloem, M. W., & Yip, R. (2001). Estimating the prevalence of anaemia: A comparison of three methods. *Bulletin of the World Health Organization*, *79*(6), 506–511.

Singh, R. K., Lairenjam, C., Bharali, R., Dutta, P. R., & Rajkhowa, C. (2009). Resource inventory of district Phek—Nagaland, Krishi Vigyan Kendra —NRC on Mithun Porba, Phek, Nagaland.

Staessen, J., Bulpitt, C. J., Fagard, R., Joossens, J. V., Lijnen, P., & Amery, A. (1988). Salt intake and blood pressure in the general population: A controlled intervention trial in two towns. *Journal of Hypertension*, *6*(12), 965–973.

Stevens, G. A., Finucane, M. M., De-Regil, L. M., Paciorek, C. J., Flaxman, S. R., Branca, F., & Group, N.I.M.S. (2013). Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: A systematic analysis of population-representative data. *The Lancet Global Health*, *1*(1), e16–e25.

Subramanian, S. V., Ackerson, L. K., & Smith, G. D. (2010). Parental BMI and childhood undernutrition in India: An assessment of intrauterine influence. *Pediatrics*, *126*(3), e663–e671.

Thimmayamma, B. V. S., & Rao, D. H. (1969). A comparative study of the oral questionnaire method with actual observation of the dietary intake of pre-school children. *Indian Journal of Nutrition and Dietetics*, *6*, 177–181.

Tian, H. G., Guo, Z. Y., Hu, G., Yu, S. J., Sun, W., Pietinen, P., & Nissinen, A. (1995). Changes in sodium intake and blood pressure in a community-based intervention project in China. *Journal of Human Hypertension*, *9*(12),959–968.

United Nations Children's Fund (2009). Retrieved from http://www.unicef.org/supply/files/Mid_Upper_Arm_Circumference_Measuring_Tapes.pdf

Vinceti, B., Eyzaguirre, P., & Johns, T. (2008). The nutritional role of forest plant foods for rural communities (chapter 4). In C. J. P. Colfer (Ed.), *Human health and forests: A global overview of issues, practice and policy*. London, UK: Earthscan.

West, C. E., Eilander, A., & Van Lieshout, M. (2002). Consequences of revised estimates of carotenoid bioefficacy for dietary control of vitamin A deficiency in developing countries. *The Journal of Nutrition*, *132*(9), 2920S–2926S.

PHOTOGRAPHIC SECTION

See Photographic section – Chakhesang

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How to cite this article: Longvah T, Khutsoh B, Meshram II, et al. Mother and child nutrition among the Chakhesang tribe in the state of Nagaland, North-East India. *Matern Child Nutr*. 2017;13(S3):e12558. https://doi.org/10.1111/mcn.12558