Evaluation of the Nutrient and Energy Adequacy on the Diet of Forest Workers in Brazil

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Abstract

Forest works are carried out, in a big part of Brazil, in a manual or semi-mechanized form. These activities are very exhaustive for workers and result in high-energy expenditure and nutritional requirements. Adequate nutrition is a basic factor for health and the performance of work activities and the daily food intake should be sufficient to attend the metabolic needs of the body. Thus, this study aimed to evaluate the adequacy of the diet provided to forest workers with the requirements of nutrient and energy adequacy recommended by the National Research Council - NRC of the United States of America, being developed with forest workers employees of a paper and cellulose manufacturer. The methods of recall survey and the direct weighing of food were used, since the feeding of workers is performed partly in their home and partly in the company. The calculation of the energy needs of the workers with work activities was based on maximal aerobic capacity. There was a daily intake of 3,067.2 Kcal, compared to a need of 3,600.2 Kcal, indicating the need for changes in the current food scheme, inefficient to attend the nutritional needs of the workers. In relation to nutritional intake, an adequacy superior to 100% was found for some nutrients, such as phosphorus, iron, thiamine, niacin, vitamin B6 and vitamin E, although the intakes of vitamin C, vitamin A, calcium and riboflavin have been presented smaller that the recommended values.

Keywords: feeding, forest work, nutrition, nutritional adequacy

1. Introduction

An adequate diet is a basic factor for health and the performance of work activities. The daily food intake should be sufficient to attend the metabolic needs of the body. The nutritional science recognizes the existence of at least 40 nutrients essential to the human diet, so that the normal body functions are maintained. The basic energy for all these needs is obtained by the degradation of proteins, lipids and carbohydrates.

The action of nutrients in the body occurs in an interrelated manner, so that a nutrient in excess or deficient will affect the use of others (Stipanuk and Caudill, 2012). The energy provided by food is necessary for the maintenance of the processes that sustain life, and it is defined as the capacity to perform work or to produce a change in the matter (Mahan and Escott-Stump, 2005). The work performed by an individual is resulted by the chemical transformation of ingested food into usable energy (Herlihy and Maebius, 2002). Proteins, carbohydrates and lipids provide, on average, 4 kcal/g, 4 kcal/g and 9 Kcal/g, respectively. These nutrients are converted in the body into glucose, fatty acids and amino acids before reaching the cells. Inside the cells, they react with oxygen, forming carbon dioxide and water, liberating energy, which is stored in the form of adenosine triphosphate (ATP) (Nelson and Cox, 2013; Mahan and Escott-Stump, 2005).

Vitamins and minerals do not contain useful energy, but they are essential to act in the activities of the enzymes that participate in the metabolic chain reactions, allowing the release of the energy contained in food molecules and the tissue synthesis (Natow and Heslin, 2004). As food contain different proportions of proteins, carbohydrates, lipids, vitamins and minerals, a balance between the consumption of various types of food should be maintained, so that the metabolic systems can be supplied with the necessary amounts of all nutrients (Guyton and Hall, 2006). Nutritional deficiencies reduce resistance to infections, physical development, learning and work capacity of their carriers (Mahan and Escott-Stump, 2005). The human body, even without performing work or at rest, consumes energy to maintain its vital activities, such as maintaining body temperature, respiration, circulation, among others, which corresponds to the expense of the basal metabolism. This consumption, although it may seem small, is around 1,500 kcal per day, which represents from 50 to 60% of the total consumption of a day, according to Costa and Oliveira (2008). The basal metabolism can vary according to the age, sex, diet, muscle activity, weather and others, according to Douglas (2006) and Gropper and Smith (2012).

Regarding the spending during the work and consequently the energy needs of individuals, it is necessary to know all the movements of the function to be evaluated, the duration of work per shift and number of breaks, in order not to exceed the physical capacity of the worker and serve as basis for the calculation of food needs. Total energy expenditure is achieved by making the sum of the spendings with the basal metabolism, during and after work activities (Astrand *et al.*, 2006). Forest services are performed, in a large part of Brazil, in a manual or semi-mechanized manner. These activities are very exhaustive for workers, due to the intensity of effort expended, which can be aggravated by environmental conditions of work, in addition to adverse factors such as weight of machines and tools, vibration in arms and hands and high noise in the case of chainsaws, earth augers and brush cutters (Souza *et al.*, 2014; Silva *et al.*, 2007; Vosniak *et al.*, 2011). These characteristics result in high energy consumption and a suitable nutrient supply is necessary. Thus, this study had as objective to evaluate the adequacy of the food provided to forest workers with the requirements of adequate energy and nutrients recommended by the National Research Council - NRC of the United States of America (NRC, 1989).

2. Material and Methods

2.1 Sampling

This study was conducted with forest workers employees of a manufacturer company of paper and cellulose, located within the countryside of the São Paulo State, Brazil. 21% of the total forest workers were randomly selected to compose the number of individuals who significantly represented the total population, by sortition, resulting in a sample of 125 individuals. All employees were informed about the objectives and methodology of the work and signed the Informed and Free Consent Term, therefore in accordance with the Resolution nº 196/1996 of the Research Ethics Committee of the Brazilian Ministry of Health.

2.2 Characterization and Sample Profile

The forest workers selected had at least 6 months of experience in the activities they performed. They had a workday of eight daily hours, with an interval of 1 hour for lunch and a 15-minute break for snack. The values of the main variables of the profile of forest workers were: average age of 33.8 years old; average weight of 67.9 kg, average height of 1.71 m; body mass index of 23.2, indicating that 72.2% had normal weight; rural origin of 75.7% and average schooling of fourth grade of elementary school.

2.3 Food Surveys

To evaluate the amount of food ingested there are different processes: the food balance in the residence, made by checking the food that exist at the beginning of the observation and what is left at the end, discounting scraps and wastage; the recall questionnaire, which consists in annotating all food consumed in the last 24 hours; and the method of direct weighing of food. The methods of recall questionnaire and direct weighing of food were used in this work, since the feeding of workers is performed partly in their home and partly in the company. The food intake at home was determined by food recall questionnaire. Through interviews conducted by a nutritionist of the company, it was asked each worker to recall food ingested in the last 24 hours and quantify the information, referring to capacity measures known as cups, plates, spoons, glasses, trademarks, among others, which were posteriorly converted to weight and volume measurements, grams and milliliters, respectively. Three interviews with each forest worker were performed on consecutive days. In the company the determination of food intake occurred through direct weighing, on which the meals offered to workers had the ingredients used in making the packed lunch weighed separately. Each packed lunch received an adhesive label with information concerning the place, the date and the control number, to be collected after the meal. The scraps of the meal were not discarded by workers and were weighed to thus calculate the liquid intake of each worker. The calculation of the total energy value of the food survey was conducted with the aid of nutritionists and students of the Federal University of Viçosa, Brazil. The Nutrition Support Program (version 1.5), developed by the Centre for Health Informatics of the Medicine School of São Paulo (ANÇÃO *et al.*, 2014) and the table of food composition (FRANCO, 2008) were used to calculate the quantities of nutrients consumed.

2.4 Determination of the Energy Requirement of the Worker

The calculation of the energy requirements of the workers with the work activities was based on maximal aerobic capacity (Astrand *et al.*, 2006). The value found was 4.9 Kcal/min, allowing a maximum workload for an eight-hour workday, of 2,352 Kcal. The extra working energy requirement was estimated for the remaining 16 hours, based on the references of FAO/OMS/ONU (1998), according to Table 1.

Table 1: Extra Work Energy Requirement

Activity	Energy Expenditure (Kcal/h)	Duration (h)	Total Energy Expenditure (Kcal)
Sleep	62.0	7.6	471.2
Go to work by bus (round trip)	102.0	4.0	408.0
Meal and snack	69.0	2.0	138.0
Leisure (watch TV and movies)	96.2	2.4	231.0
Total			1,248.2

Forest workers had a total energy consumption of the non-working activity equal to 1,248.2 kcal, which added to the 2,352.0 Kcal needed to work resulted in total daily energy requirement of 3,600.2 Kcal/day.

3. Results and Discussion

3.1 Total Food and Energy Intake

The diet of forest workers consisted of breakfast, lunch, snack and dinner. Breakfast and dinner are meals made at home. Table 2 presents the characteristics of the workers food intake made at home, with the respective mealtimes.

Table 2: Food Scheme of the Forest Workers at Home

Meal	Food	Amount Ingested			Percentage of Workers who Ingest these Food
		Minimum	Medium	Maximum	
Breakfast	Coffee (ml)	20.0	72.7	150.0	100.0
(4h20 - 5h30)	Bread (g)	50.0	50.0	50.0	12.0
	Margarine (g)	10.0	10.0	10.0	12.0
Dinner	Beans (g)	40.0	150.0	250.0	100.0
(18h30 - 21h30)	Rice (g)	150.0	407.0	750.0	100.0
	Meat (g) [1]	67.5	143.5	300.0	94.0
	Vegetables/Hardwoods [2]	50.0	52.5	60.0	23.0
	Non-hardwoods[3]	30.0	150.0	350.0	52.9
	Vegetable B (g) [4]	50.0	98.0	150.0	23.5
	Vegetable C (g) [5]	50.0	89.0	120.0	41.0
	Coffee (ml)	20.0	86.6	250.0	82.0
	White lightning (ml)	70.0	108.0	280.0	35.0
	Soup (ml) [6]	375.0	412.5	450.0	17.6

[1] Meat: beef, pork, fish, chicken, sausage and viscera.
[2] Vegetable and Hardwoods: lettuce, kale and cabbage.
[3] Non-hardwoods: aubergine, onion, red pepper, cucumber and tomato.
[4] Vegetable B: carrot and chayote.
[5] Vegetable C: english potato.
[6] Soup ingested replacing dinner, or with it.

The company offers the employees two meals: lunch and snack. Table 3 presents the characteristics of the workers food intake made in the company. Most forest workers ingest only coffee for breakfast, which is nutritionally incorrect, because it is the first meal of the day and due to the large physical wear propitiated by the physical activity they perform, besides the requirement of constant attention and concentration. Thus, the ideal would be an ingestion of a snack before the beginning of the workday (Rampersaud *et al.*, 2005). The household consumption of vegetables is very low. This fact, along with the lack of consumption of fruits, milk and dairy products, constitutes an unbalanced diet, which helps to propitiate the appearance of several nutritional deficiencies (Whitney, 1996). The inclusion of green in the diet is indispensable, due to the nutrients that provide: fiber, vitamins and minerals (Natow and Heslin, 2004). Thus, these foods should be added to the workers diet and offered by the companies at lunch. The supply of juice would also help to partially solve the dietary deficiency of fruits and raw green, besides helping in the workers hydration who lose a lot of liquid and salts through sweat.

Wastage was observed due to the high offer of food offered at lunch. This meal weighs on average 1,022 g and the workers ingest around 775 g, which corresponds to 75.8% of the amount offered, considering only rice, beans, meat and garnish, that are the menu items ingested by all commensals. Considering that lunch is their main meal of the day and it is offered after hours of fasting, the worker tries to eat the largest amount of food possible.

It's known that the number of meals served to the employee in the company is an important factor in his production. Fractionation of the daily diet, with the inclusion of a snack before starting work and in the afternoon, is useful because it increases the worker productivity when compared to the individual who starts his activities in fasting, besides not taking him to an excessive food intake in the main meals of the day, which are lunch and dinner, thus avoiding the postprandial lassitude (Wells et al., 1997).

Table 3: Food Scheme of the Forest Workers in the Company, with the Average Amounts of Offered and Ingested Food

Meal/ Time	Food	Average Amounts Offered (g)	Average Amounts Ingested (g)	Percentage of the Food Consumed
Lunch	Beans	250.0	170.0	68.0
(11 at 12 hours)	Rice	494.0	376.0	76.1
	Meat [1]	118.0	105.3	89.2
	Garnish[2]	160.0	123.6	77.3
	Dessert [3]	50.0	29.4	58.8
Snack	French bread	50.0	50.0	100.0
(15 at 15h15)	Margarine	10.0	10.0	100.0
	Mortadella	50.0	50.0	100.0

[1] Meat: beef, pork, fish, chicken and sausage
[2] Garnish: manioc flour, breaded and fried banana, crumbed aubergine, braised onion, braised kale, fried egg, pasta
[3] Dessert: industrialized sweets

Table 4 shows the distribution of the energy intake during the day. The company offers 1,767.7 Kcal at lunch, which corresponds to 49.1% of total energy value (TEV) recommended and 57.6% of total energy intake. However, as the workers do not ingest all the food, the energy intake of lunch is 1,431.4 Kcal, which corresponds to 46.7% of the daily energy intake and 39.7% of the ideal energy amount that is 3,600.2 Kcal/day.

Table 4: Amount of Offered and Ingested Nutrients in the Company and at Home and Respective Daily Recommended Amounts for the Workers

Amounts	Kcal	Proteins (g)	Lipids (g)	Carbohydrates (g)
Recommended for the day	3,600.2	90.0 - 135.0	120.0	495.0 - 540.0
Offered at lunch	1,767.7	67.0	67.5	223.1
Consumed at lunch	1,431.4	55.5	58.2	171.4
Consumed at snack	305.5	8.4	15.1	34.0
Leftover at lunch (offered - ingested)	336.3	11.5	9.0	51.7
Household intake				
Breakfast	92.4	1.9	2.4	15.8
Dinner	1,237.9	47.6	43.5	164.0
Total Intake	**3,067.2**	**113.4**	**119.2**	**385.2**

3.2 Daily Energy Requirements of the Forest Worker

The forest worker had a total energy expenditure in the eight hours of work activities of 2,352.0 Kcal and in the sixteen hours of non-work activities of 1,248.2 Kcal, which resulted in a total daily energy requirement of 3,600.2 Kcal. Table 5 shows the percentage distribution of daily energy intake on meals made by forest workers.

Table 5: Percentage Distribution of the Daily Energy Intake

Place of the Intake	Meal	Percentage of the Total Energy Intake (Kcal)
At the company	Lunch	46.7
	Snack	10.0
At home	Breakfast	3.0
	Dinner	40.3
Total		**100.0**

According to Couto (1996), the total energy value should be distributed in accordance with Table 6, between the meals of the day. Lunch offered, on average, 46.7% of the total energy received during the day, which represented 6.7% beyond the recommended.

The snack provided 10.0% of the total energy, which according to Couto (1996) should be only 5%, which would correspond to 153.4 Kcal. In case they were receiving the necessary 3,600.2 Kcal, 5% would correspond to 180.0 Kcal.

Table 6: Total Energy Value (TEV) Distributed Among the Meals of the Day

Meal	Percentage of TEV	Amount of Kcal
At breakfast	20 a 25%	720.0 Kcal
At the morning snack	5%	180. 0 Kcal
At lunch	40%	1,440.1 Kcal
At afternoon snack	5%	180.0 Kcal
At dinner	20 a 30%	1,080.1 Kcal
Total		**3,600.2 Kcal**

Breakfast provided only 3.0% and dinner of the workers 40.3% of the total energy, that according to the references should be from 20 to 25% and 20 to 30%, respectively. These values point to the need for changes in the current food scheme.

3.3 Daily Intake of Nutrients

The daily energy intake of forest workers is found in Table 7.

Table 7: Daily Intake of Forest Workers and Adequacy in Accordance with the Recommendations of NRC (1989)

Nutrients	Average Intake	Kcal Provided	Daily Average Recommendation	Standard Deviation	Percentage of TEV	Percentage of Adequacy
Total Energy Value (TEV) (Kcal)	3,067.2		3,600.2	445.1	85.0	85.0
Protein (g)	113.4	453.6	10-15% of TEV	-	14.8	100.0
Lipids (g)	119.2	1,072.8	25-30% of TEV	-	35.0	116.7
Carbohydrates (g)	385.2	1,540.8	55% of TEV	266.6	50.2	91.2

The total energy intake is below what is considered ideal, as noted in Table 4. This energy deficit implies a reduction of body weight, which can lead to malnutrition, or reduced productivity, to spare the body (Stipanuk and Caudill, 2012). A deficit of about 533.1 kcal in energy intake in relation to the recommended amount was found. Protein intake has the purpose of providing to the body the essential amino acids for protein synthesis (Gropper and Smith, 2012). This requirement can be is supplied with 1g/kg of weight/day. Thus, the average requirement is around 67.9 g of protein for each worker and thus, the amount of protein provided presents an adequacy of 167.0%. According to NRC (1989), the amount of protein ingested should not exceed the value of 2 g per Kg of weight, which corresponds to 135 g of protein/day, the maximum amount to be offered in the diet, since the average weight of the worker is 67.9 Kg. The average protein intake found was 113.4 g, which corresponds to 14.8% of the TEV, thus being adequate both in grams and in percentage of TEV, according to NRC recommendations. The ideal lipids intake should be between 25 to 30% of total energy value ingested (Lawrence, 2013). For diets of 3,600.2 Kcal, this percentage would correspond to the range of 100 to 120 g of lipids. It was observed that the TEV is above the recommended and that lipids are contributing with 35% of it. The TEV must be increased, not the amount of lipids, so that its contribution is reduced to the recommended levels of 30% of TEV. An increase of food with low lipid content would raise the TEV, and at the same time would place the percentage of lipids in the ideal range, without it being necessary to exclude any food.

Carbohydrates account for 50.2% of TEV. Due to the fact that TEV is below the amount needed and that both protein and lipids should not have their intakes increased, the recommended is that food with higher percentage of carbohydrates included. The carbohydrate could be added by a snack in the morning, time detected to have the highest deficit in terms of food intake. In Table 8 the average daily intake of some minerals and some vitamins and its adequacy due to the recommended values by the NRC (1989) is presented. The calcium found in the diet represents only 57.2% of the daily requirement of the worker, which is based on a loss of 200 to 250 mg/day and absorption of 30 to 40% (NRC, 1989). Forest workers present a loss of 15 to 20 mg/day of calcium through sweat, in consequence of the physical activity they perform (Gropper and Smith, 2012).

The disorders most associated with calcium deficiency are osteoporosis (Ahmadieh and Arabi, 2011), osteomalacia and rickets (Hazzazi *et al*., 2013). The best sources of calcium are milk and its derivatives (Wardlaw and Smith, 2013). Thus, these foods should be included in the diet of forest workers.

Table 8: Minerals and Vitamins Daily Intake of the Workers and Adequacy According to the Recommendations of NRC (1989)

Nutrients	Average Intake	Daily Average Recommendations	Standard Deviation	Adequacy Percentage
Calcium (mg)	457.3	800.0	158.1	57.2
Phosphorus (mg)	1,371.0	800.0	299.4	171.3
Iron (mg)	22.8	10.0	3.5	227.6
Sodium (mg)	5,339.7	2,400.0	1,028.3	222.5
Potassium (mg)	2,827.0	1,600 to 3,500.0	601.7	100.0
Vitamin C (mg)	27.4	60.0 to 100.0	11.7	27.4 to 45.7
Thiamine (mg)	2.4	1.2	0.3	193.4
Riboflavine (mg)	1.6	1.8	0.4	87.5
Niacine (mg)	27.3	21.5	7.7	127.1
Vitamin B6 (mg)	2.4	2.0	0.7	122.0
Vitamin A (mcg)	465.6	1,000.0	312.0	46.6
Vitamin E (mg-TE)	51.4	10.0	12.0	513.9

The phosphorus, though of vital importance to the body, is a nutrient present in a lot of food (Wardlaw and Smith, 2013). The amount of phosphorus found in the diet of workers was superior to the recommended. An excess of phosphorus decreases the absorption of calcium and depending on its chemical form, such as phytic acid, impairs the absorption of various minerals (Whitney, 1996). The amount of iron provided by the diet is above the average amount recommended by NRC (1989). The recommendation of iron is based on a real need of 1 to 2 mg/day considering the average absorption of 10 to 15%. The nutritional iron adequacy was 227.6%. One of the drawbacks of an excessive iron intake is its negative interference in the absorption of other minerals, such as zinc, which is essential in the performance of enzymes integrated in protein metabolism (Nelson and Cox, 2013).

The amount of sodium provided by the diet is 5,339.7 mg while the NRC recommendation is only 2,400 mg/day. The forest worker develops a hard physical work with great sweat, and consequently loss of electrolytes, including sodium. These losses of water and electrolytes affect the physical performance, which can result in cramps induced by heat, heat exhaustion or heatstroke (Gropper and Smith, 2012; Natow and Heslin, 2004). Thus, the requirement of sodium by the forest worker may be greater than the stipulated by NRC, but more specific studies lack in this area. NRC recommends a daily amount of potassium of 1,600 to 3,500 mg/day. The diet provides workers with 2,827 mg of potassium. Thereby, the supply of potassium is within the optimum range. Sodium, potassium and chloride are involved in the maintenance and normal equilibrium of several vital physiological functions such as water distribution, osmotic balance, acid-base balance and muscle irritability (Mahan and Scott-Stump, 2005).

The vitamin C or ascorbic acid present in the diet of the workers was 27.4 mg, which corresponds to the range from 27.4 to 45.7% of the quota recommended by NRC, ranging from 60 mg for normal adults to 100 mg for smokers. The insufficient intake of vitamin C occurs due to a lack of fruits and vegetables in the diet. Vitamin C is water-soluble and unstable to cooking methods and food processing. Severe deficiency of this nutrient leads to scurvy (Mindell, 1996; Wardlaw and Smith, 2013). Thiamine is a water-soluble vitamin and its deficiency affect the cardiovascular, nervous, muscular and gastrointestinal systems (Wardlaw and Smith, 2013; Whitney, 1996). A contribution of 2.4 mg of thiamine in the diet was found, which totals 193.4% of the NRC recommendation. The ingestion of excessive amounts of thiamine is rapidly metabolized by kidneys, with no evidence of toxicity (Mindell, 1996). Riboflavin, also known as vitamin B2, has in the body the function of favouring the metabolism of fats, sugars and proteins (Buehler, 2011; Wardlaw and Smith, 2013). It is a vitamin which acts on the respiratory system and assists in oxidative processes (Whitney, 1996; Mindell, 1996). NRC recommends an intake of 0.6 mg of riboflavin per 1,000 Kcal.

The ingestion of riboflavin by the workers is 1.6 mg/day, which corresponds to 87.5% of the recommended amount. Its deficiency leads to cheilosis, glossitis, seborrheic dermatitis and eye disorders, such as burning, tearing, light sensitivity and corneal vascularisation (Mindell, 1996; Buehler, 2011). Niacin is a B vitamin and its deficiency causes pellagra (Mindell, 1996). The niacin contribution in the diet was 27.3 mg/day, which corresponds to 127.1% of the amount recommended by NRC. This intake level can represent a problem for the workers health, since excessive amounts of niacin they can contribute to liver damage (Williams, 2004), and it can increase the levels of uric acid in the blood (Guyton and Hall, 2006).

Vitamin B6 is the term used for designating pyridoxine, pyridoxamine and pyridoxal (Mindell, 1996; Whitney, 1996; Natow and Heslin, 2004). The deficiency of this vitamin can induce anemia and skin problems in adults (Devlin, 2011). The contribution of vitamin B6 in the diet was 2.4 mg/day, which corresponds to 122.0% of the amount recommended by NRC. The toxicity of vitamin B6 is very low, so the intake of forest workers does not present risks of damage to health (Devlin, 2011). Vitamin A acts in maintaining the integrity of the mucosal epithelium and in the maintenance of visual acuity in low light (Guyton and Hall, 2006). It is also related to the immune system, bone growth and remodelling processes (Guyton and Hall, 2006; Mindell, 1996). Its deficiency can lead to imperfect development of bones and teeth, night blindness and keratinisation of epithelial tissues (Beitune *et al.*, 2004; Souza and Vilas Boas, 2002). The amount of 465.6 µg/day of vitamin A was found in the workers diet, which corresponds to 46.6% of the recommended value, highlighting the need to add foods rich in this vitamin at daily diet composition of forest workers. A group of compounds called tocopherols (alpha, beta, gamma and sigma-tocopherols) carries out Vitamin E activity (Mindell, 1996). It has antioxidant power, mainly in capturing peroxyl, alkoxyl and hydroxyl radicals, preventing myocardial infarctions and heart attacks (Guyton and Hall, 2006; Gropper and Smith, 2012). The amount of vitamin E provided by the diet is superior to the recommended value by NRC. A contribution of 51.4 mg of alpha-tocopherol/day was found, while the recommendation is 10 mg/day. This is explained because vitamin E is the most available vitamin in common food (Wardlaw and Smith, 2013). There are no evidences that the intake above the recommended amount can have negative effects on the body (Devlin, 2011; Mindell, 1996; Natow and Heslin, 2004; Wardlaw and Smith, 2013).

4. Conclusions

In Brazil, there are few studies related to dietary intake of forest workers. The change in occupational activities, health and eating habits of the workers begin to demand a new focus to the field of feeding. The well-fed worker has greater physical disposal, assimilates training better and increases his attention at work, which results in an increase of productivity, besides decreasing the break hours due to the reduction in the occurrence of accidents. It was found that both the quantity and the type of food provided to workers by the company, and also their household diet, are inadequate to their nutritional and energy needs. Knowledge of food profile conducted in the household indicates a need for nutritional education, targeted both to workers and to their families, aiming to improve their eating habits through information on the importance of a balanced diet, both in terms of energy and nutrients. The food profile conducted in the company was inefficient in means of attending the needs of the workers. The increase in the number of meals in the company would help in adjusting the amount of energy required for workers to perform their functions and maintain their health. Furthermore, it would raise physical performance and satisfaction during work, including generating a reduction in accident index and absenteeism. The total daily energy intake was greater in the company, when compared to the household intake.

Regarding the nutrient intake, an adequacy superior to 100% was found for some nutrients, such as phosphorus, iron, thiamine, niacin, vitamin B6 and vitamin E. It was concluded that these values, although superior to the recommended quotas, do not offer risks for the health of forest workers, and the quantities in excess can constitute a measure of security as a result of nutrient loss during food preparation. The contribution of sodium and potassium require specific studies for a conclusion about the intakes found and the actual damages they could cause to the workers, in case the values obtained can not be considered adequate. An energy intake below the necessary was found. Besides the insufficient energy contribution, the intakes of vitamin C, vitamin A, calcium and riboflavin are below the recommendations. These deficiencies constitute impact factors on physical performance and health of the workers, who are subjected to weight loss, malnutrition and other diseases. Not consciously, the worker ends up saving the body reducing his labor intensity, and with it, leading to a drop in his productivity, or so he resorts to absenteeism, to preserve his health.

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