

Food consumption and working conditions in manual sugarcane harvesting in Sao Paulo state'

Consumo alimentar e condições de trabalho no corte manual de cana de açúcar no estado de São Paulo

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† Financed by: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes) and Fundação de Amparo à Pesquisa do Estado de São Paulo (Fapesp).

Abstract

Objective: To describe the working conditions and aspects related with food consumption amongst manual workers in sugar-cane crops intending to contribute to developing public policies towards workers' health surveillance and delivering comprehensive services. **Methods:** Direct observation at the work field in upstate São Paulo and a semi-structured questionnaire were conducted with a group of forty sugar-cane migrant workers who came from Ceará state to work as hand harvesters in São Paulo state, over 15 days during the 2007/2008 crop season. Socio-demographic data, water consumption, food consumption and cultural habits, hydro-electrolyte reposition, work pauses, body pains and duration of working days were registered. **Results:** Workers ingested 5 to 10 liters of water/day and the dilution of electrolytes replacement was below the adequate recommendations. Food consumptions during the crop season did not ensure food and nutritional security. Food consumption was monotonous, conserved and consumed at inadequate temperature, and incompatible with cultural habits, implying reduction and wastage of food. Workers reported pains and cramps during the work day. Pauses for resting were insufficient. Payment by results, the working process and payment practices were taken as determinants of a wide range of precarious conditions to which these workers were subjected. The hand harvesting of sugar-cane is extenuating and the payment by results may be a grievance for health as it implies reducing the work resting pauses. Food consumption and adequate hydration could minimize the working wear and pains during the job.

Keywords: Working Conditions; Crops; Agricultural; Rural Workers; Food Consumption; Fluid Therapy; Workers Health.

Resumo

Objetivo: Descrever as condições de trabalho e aspectos relacionados à alimentação do trabalhador no corte manual de cana para contribuir para desenvolver políticas públicas de vigilância e atenção integral em Saúde do Trabalhador. Métodos: Foram utilizados a observação direta do trabalho no campo em colheita no estado de São Paulo e aplicado questionário semi-estruturado a um grupo de 40 cortadores manuais de cana migrantes procedentes do estado do Ceará, durante 15 dias da safra 2007/2008. Aspectos sócio-demográficos, consumo de água, reposição eletrolítica, alimentação e aspectos culturais, pausas, dores e a jornada de trabalho foram registrados. Resultados: Os trabalhadores ingerem de 5 a 10 litros de água/dia e a diluição dos repositores eletrolíticos foi inferior à adequada. A alimentação durante a safra não garantia a segurança alimentar e nutricional. A alimentação foi monótona, conservada e consumida em temperatura inadequada, e incompatível com os hábitos culturais, gerando desperdício e redução do consumo alimentar. Os trabalhadores relataram dores e câimbras no decorrer da jornada. As pausas para descanso foram insuficientes. O pagamento pela quantidade de produção, o processo de trabalho e as práticas de pagamento foram considerados determinantes da situação de precariedade ampla a que estes trabalhadores estavam submetidos. O trabalho no corte manual de cana é extenuante e o pagamento por produção pode ser um agravante para a saúde, pois implica na redução das pausas para descanso. A alimentação e hidratação corretas poderiam minimizar o desgaste e as dores durante o trabalho.

Palavras-chave: Condições de Trabalho; Safras; Trabalhadores Rurais; Consumo de Alimentos; Hidratação; Saúde do Trabalhador.

Introduction

Brazil is becoming more prominent in the global scene linked to political and economic interests of producing agro-fuels, especially ethanol, obtained from cane sugar. Sugar-cane cutters are the backdrop to the complex sugar-cane agri-business (Silva, 2008).

Due to this crop's steep growth in the state of São Paulo, the need for labor has grown simultaneously with the intensification of work, highlighting even more sharply the topic of rural work and health. Although the mechanized area is expanding, use of manual labor to cut cane has grown in recent years. In 2007, Brazil had around 335 thousand cane cutters (Juttel, 2008); in 2010, that figure had risen to 500 thousand (Unica, 2013).

After payment by results was established in 1986 (Oliveira, 2007), there was an enormous increase in the resistance and effort required, often exceeding the workers' physical capacity. Whereas in the 1980s a cane cutter would cut four tons per day, demand rose to eight in the 1990s and today the individual average has risen to at least twelve tons (Alves, 2006), reducing the salary floor of 2.5 minimum wages in 1986 to 1.2 minimum wages in 2006 (Alves, 2007).

The work process of cutting cane consists of harvesting what is known as the "eito" (field). This space is basically composed of an 8.5 meter rectangle containing five rows of cane with 1.5 meters between each row. The length of the row varies according to the physical resistance of each worker. The length of the row is measured in linear meters and multiplied by the value paid per meter, indicating the cane cutter's daily earnings (Alves, 2006). The complete work cycle includes: holding the cane, cutting it using a machete and throwing the cane into the center of the field, returning to the initial position. Both the work process as well as payment by results, together with the high temperatures found in Brazil during practically the whole harvest, generally occurring between April and December, can produce fatigue - caused by a set of physiological disorders in prolonged activities that can include dehydration, increased body temperature and lack of energy substrate for the activity undertaken, such as carbohydrates (Powers and Howley, 2005; Pinto et al., 2001).

Due to the work process and payment by results, as well as a lack of health protective measures, the number of deaths and health problems in these workers has increased in recent years. Between the 2004 and 2007 harvests, 21 cane cutter deaths were reported in the interior of São Paulo state. The deaths affected young workers aged between 24 and 50, migrants from other regions of the country (Laat et al., 2008). According to Alves (2006), the causes of death on the death certificates are very vague, making conclusive analysis impossible. They state cardiac arrest, respiratory failure or stroke, which could result in different health problems, according to this study, friends and family members reported that, before death, the workers had complained of being overworked, pain in the body, cramp, breathlessness and fainting, among other symptoms.

As well as the deaths, the recorded workplace accident rates in the sugar and ethanol sector varied from 47.17 to 75.14, between 2.4 and 3.8 times higher than the national rate (19.51), according to official data from Social Security (Brasil, 2008), showing the precariousness of the work and the risk to which these workers are subjected.

Together with intensifying work, weight and body fat loss aggravates this population's nutritional and health state. A study from the 1980s, when cutters were required to cut four tons of cane per day, revealed that the diet of cane cutters in Brazil was quantitatively and qualitatively inadequate (Desai et al., 1980). Chiarello et al. (2006) also studied this population and concluded that supplementing diet with electrolyte replacing and protein drinks together with carbohydrate-rich cassava, can help to maintain these workers' health and nutritional state during the harvest.

More recently, Luz et al. (2012) also showed that the exhausting work of manually cutting sugar-cane leads to significant weight and body fat loss, as well as muscular injury, evaluated using biochemical blood markers. Due to the scarcity of studies on this population and the need to understand nutritional and work aspects in order to improve workers' protection and prolong the amount of time they can healthily do this work, this study aims to describe the working conditions of manual sugar-cane cutters and aspects related to diet, observing the problems and needs so as to contribute to developing

public policies concerning surveillance, promoting health and protecting against health problems for these workers.

Methods

An observational study was conducted during the 2007/2008 sugar-cane harvest, between the months of April and December. Direct observation was employed during the work, including observing meal preparation, transport to and from the fields and accommodation and a semi-structured questionnaire was used with a group of 40 migrant sugar-cane cutters from the state of Ceará, for 15 days throughout the harvest. These 15 days were divided as follows: five days at the beginning of the harvest, five days in the middle and five days at the end, aiming to collect information shared with other sub-projects from the same study.

The group of workers from Ceará stayed in provisional shared housing, with around eight individuals per house and worked and lived in the municipality of Elias Fausto, in the region of Piracicaba, in São Paulo state, important in the state's sugar-cane production. The workers were employed at one of the largest plants in Brazil through an outsourced contractor and had their work record signed after three months. They worked five days in a row, followed by one days rest and received lunch and dinner from the company, with all other meals being each worker's individual responsibility. The cost of food and accommodation were subtracted from the salary at the end of the month.

This plants preference for outsourcing labor contracts to companies that exploit migrant labor, as in all the plants in the state of São Paulo, to the detriment of formal contracts with local workers is, above all, due to availability of labor and better performance from subcontracted migrant workers. Their submission to the demanding requirements of this work is generated from the constant process of expulsion from their regions of origin, as well as their responsibility for supporting a family and having no margin for failure, as many of them are heads of families (Alves, 2007).

Workers agreed to participate, signing an informed consent form and the study was approved by the Research Ethics Committee at Unicamp (Process

n. 333/2008). They were interviewed and observed at the workplace during the work day.

The study is part of the research project of public Policies called “Institutional Actions for diagnosing and preventing workplace accidents, improving a proposal for the Piracicaba region”, approved by the Fapesp (Process n. 06/51684-3), and was made viable through coordination promoted by the Reference Center for Occupational Health (Cerest Piracicaba), to obtain support from the Ministry of Labor and Employment - Piracicaba Regional Management and by the Ministry of Public Works of the 15th Region.

The team was composed of three professionals from the health area who helped apply the semi-structured questionnaire, in the observations and measuring which made up other studies and in the images captured at diverse moments. Photographs and videos were recorded of the work routine, clothing, materials used in the cane fields, food containers, different types of cane, the bus and the bathroom in the cane fields, as well as of the activity of cutting. Videos were recorded to discover and quantify the scale of the work cycle during the day, including observing postural movements, number of strikes with the machete, duration of the cycle in seconds, length of break and quantity produced.

Semi-structured questionnaire

The semi-structured questionnaire was applied orally, with the aim of investigating socio-demographic aspects such as sex and age, as well as information on the presence of pain in the body or cramps during the work day, smoking and alcohol intake, water intake, quantity or electrolyte replacement and different aspects of diet through a 24-hour food diary and a questionnaire on food frequency. Actual food container consumption, preparation, collection and consumption times, food breaks and the workers' opinions on the quality and temperature of the food were all observed. They were also asked about their mean salary and long distance family relationships.

24-hour Food Diary and Food Frequency Questionnaire

The 24-hour Food Diary is a nutritional survey commonly used to verify a population's dietary habits. In this study, only one diary per worker was completed

by a nutritionist, so as to minimize errors, as well as to avoid interviewer induced responses. As it was collected only once, it was not used in the quantitative analyses (Garcia, 2004). This material was useful in analyzing this group's dietary behavior and previous dietary standard, helping to create the data collection instrument that made up the Food Frequency Questionnaire (FFQ) (Slater et al., 2003). In addition to the 24-hour food diary, foods indicated by the National Household Budget Survey as forming part of standard Brazilian food intake (IBGE, 2004a).

The FFQ was chosen as the simplest approach for investigating a population's overall dietary quality and it was drawn up according to methodological validation considerations according to Slater et al. (2003).

Food container preparation

The lunch time food containers provided to the workers were prepared in the company's kitchens in the early morning and the process was monitored by one of the researchers to observe how they were prepared, what food they were made of and at what time they were ready to be collected by the workers, before heading to the bus taking them to the cane fields.

Results and discussion

Of the 40 workers interviewed, 10 dropped out of their work contract during the harvest and returned to their cities of origin. According to work colleagues who remained, those who dropped out did so due to exacerbated physical tiredness, an initial indicator of inability to continue with the exhausting activity. The 30 remaining workers were young males, aged between 18 and 44. Some were new to the activity, participating in their first or second harvest in the state of São Paulo (n = 8), with the others (n = 22) already having worked on three or more harvests.

The 30 workers were questioned about the presence of pain or cramps during work, with more than half (n = 17) reporting that they often felt pain in the legs, back, abdomen, arms, calves, neck, wrists and hands.

Only 2 workers were smokers and the majority (n = 17) reported consuming alcohol at least once a week.

Hydration, diet and supplements

The interviewed group reported consuming at least one, maximum two, 5 liter bottles of water per day during the work day, regardless of the season, depending on their effort and the temperature, as observed by the field work team.

At the start of each day, each worker was given two sachets of electrolyte replacement, known as saline. According to the label, the composition was: sugar, salt, and artificial colorant and flavoring. Each sachet held 10g, although this was not noted on the label and was ascertained by the team weighing them. Nor did the label contain information on the nutritional content, although it specified the way in which the powder should be diluted - in a 250ml glass of water for each sachet. Thus, only the electrolyte replacement available in two cups of water are made available for each worker throughout the day.

When asked how the workers diluted made the mixture in the field, the entire group reported that they diluted the two sachets in the 5 liter bottle of water, commonly adding a soft drink powder, bought by the workers themselves and brought to the cane fields.

It is known that adequate hydro-electrolyte replacement is essential in minimizing problems stemming from dehydration in the workers. This effect can compromise the cardiovascular system, affected physiological responses, alterations in the electrolyte balance and muscular fatigue (SBME, 2003). During prolonged exercise, especially in high temperatures - as is the case in this type of work - the human body has physiological mechanisms to lose heat through sweat, regulating bodily temperature. The exhausting work of manual cane cutting, together with the protective equipment used, such as protective sleeves, gloves, headgear, boots and shin guards, which make it more difficult to disseminate the heat externally, increasing body temperature and thus leading to dehydration.

In the literature, there is a consensus that the best strategy for hydration during prolonged periods of exercise is a combination of water, carbohydrates and electrolytes, especially sodium (Shirreffs et al., 2004; Lima et al., 2007), present in the form of sugar and salt, in the case of cane cutters. Sodium, the main electrolyte lost in sweat, prevents hyponatremia

(SBME, 2003) encourages water absorption and helps maintain blood sugar. However, to really benefit from the combination it is important that it is frequently replaced. When this replacement is improperly diluted, the positive effect is minimized. Moreover, as the label on the provided electrolyte replacement does not identify the quantity of each substratum, it is impossible to evaluate their real effect on performance and health during this population's work.

An appropriate combination of all these nutrients, together with good hydration throughout the day, can guarantee improved physical and nutritional status, as well as reduce pain and cramps during and after the working day, minimizing the side effects of over work and guaranteeing short and long-term recovery (Chiarello et al., 2006).

In the kitchen observations, during the preparation of the lunchtime food containers, we observed that the most commonly provided foods were: white rice, pinto beans, 2 types of meat (chicken, red meat or sausage) and a garnish, generally *farofa*, potato or cassava. The dinner time food containers differed as pasta with sauce and fried vegetables or tubers (cassava or potato), generally fried, were added. The type of meal described was the routine during the nine months of harvest. In the kitchen, it was also possible to observe that the food containers were ready, closed and placed on trays at three in the morning, waiting to be collected by the workers before getting the bus, at around five am.

After each worker picked up their lunch boxes, the bus took them to the region where they were to work that day, as decided by the chief contractor according to availability of burned cane ready to be cut. The research team monitored a group of workers at all times, including the bus journey to and from the fields.

After arriving at the cane fields around 6.30am, work began at around 07.00am. On arriving at the cane fields, it was observed that all of the workers went to the cane row they were to cut that day, sat on their 5-liter bottles (Figure 1), opened the food containers and began to eat. On being asked why they "had lunch" at that time, they reported that:

We eat half now and half at around 11, before the food goes "off". We always do that. It gives a bit of energy to cut can in the morning (JAOS).

Observation confirmed that all of the workers followed this routine and they reported that the food would be off (sour and cold) if they ate it at the theoretical lunch hour, between 11am and midday. It was possible to verify that a large part of the workers threw part of their food away and, upon analyzing what was thrown away, it was found that the rice and beans were discarded.

These beans are nothing like what we have in Ceará. They're awful. Nobody likes them. I don't know why they insist on putting them in the food containers. What we like is cowpeas. They do try to give us things we like...cassava, farofa, but these beans just don't cut it (FGOR).

Feeding oneself implies symbolic values, satisfying hunger and thirst in cultural, social and historical and not merely physiological terms (Menascher et al., 2008). According to observational study, the cultural, social and historical values were not considered, demonstrating the complexity of feeding oneself, discussed in the light of the concept of food and nutrition security. This concept concerns not just human right to regular and permanent access to food in sufficient quantity and quality, but also access that respects cultural diversity, as well as being environmentally, socially and economically sustainable (Vianna and Segall-Corrêa, 2008; II Conferência Nacional de Segurança Alimentar e Nutricional, 2004, 2004b).

Although the food containers are insulated, it was proven to be impossible to maintain the temperature from 03.00 to 12.00, especially when the plastic bag containing the lunch box was exposed to the sun during the whole morning, as shown in Figure 2.

Also in relation to the low temperatures of the food containers, it is stated in the National Health Vigilance Agency (Anvisa), RDC Resolution n. 216, of 2004, that any place providing food, in any form, should, after cooking food should be kept at temperatures above 60°C for a maximum of 6hrs, to guarantee the food's microbiological safety (Brasil, 2004c). It is worth remembering that terms such as “*boias-frias*”, long used to describe these temporary rural workers, come from this occurrence (Alves, 2007).

Figure 1 - Cane cutter eating lunch in the cane field



Figure 2 - 5 liter bottle and the plastic bag with the food containers exposed to the sun



As for other dietary quality factors, the data show that there is little variety in the diet, it is monotonous, poor in nutrients and high in fatty and sugary foods. This is evident in consumption of fruit and other high-fiber foods, which is practically zero, the provision of vegetables and legumes also being insufficient, and the workers consuming powdered soft drinks and filled biscuits almost daily. These highly processed foods are bought by the workers themselves. Each day, one is responsible for buying the biscuits and soft drinks to share with the others. In order to help meet their daily energy needs for their work, the workers also prepared “bread”, which they called “cake” at home using flour, salt, oil and water, which they brought with them to the cane fields.

Work materials (machete and protective equipment)

The machete sharpener and machete are part of the materials of day-to-day work and it was possible to observe how some workers adapted them to facilitate the work, some of the workers bent the machete so that it would fit at the base of the cane without touching the floor, improving the cut. Figure 3 shows the difference between straight and bent knives.

As for the use of the protective equipment (protective sleeves, headgear, shin guards, goggles and gloves), obligatory according to the law, it was observed that they were worn and old and that there was no new equipment available to substitute them, as shown in Figure 4.

Figure 3 - Machete adapted to facilitate cutting and an un-adapted machete



Figure 4 - Ripped protective sleeves



It is worth noting that each worker received only one set of clothes and protective equipment kit, thus being obliged to hand wash the clothing every day, there being no spare set. This often resulted in the cutters going to work in wet clothing, as there was not enough time for them to dry, or working in clothing filthy with the previous days sweat and grime, if they had not managed to wash and dry them the day before.

Types of cane and medication

On arriving at the cane field, it was observed that the workers expressed satisfaction, or dissatisfaction, with the type of cane to be cut that day. This was because they were paid by results, in other words, by the number of tons they managed to cut per day. The workers' expect that the cane will be standing, as fallen, or rolled, cane (Figure 5) is much more difficult to cut, decreasing their income. Daily production of fallen cane can be half that of standing cane, with the doubled work requiring both more patience and physical effort. Even so, the company studied paid the same value for both types of harvest. When still on the bus, the cutters' discouragement on looking at the cane field was commented on by some of them:

Yet another day of working for nothing. You cut and cut and don't make anything (FICP).

Relationship between overwork, breaks and salary

Another important issue is compliance with Min-

Figure 5 - Standing cane, compared to “rolled” cane



istry of Labor and Employment Regulatory Standard n. 15, Brazil (Brasil, 1990) which covers heavy manual work and taking 30 minute breaks to relax and hydrate for every 30 minutes worked; when the limits of thermal overload, identified using the Globo Wet Bulb Thermometer, are exceeded. Overload was observed in this group, as evaluated by Laet et al. (2008). Adopting breaks not only alleviates musculoskeletal load but also reduces energy expenditure and body temperature. The number of breaks was observed and the workers questioned on what they did during the day and the majority (n = 13) reported two or three breaks of two, maximum three minutes, on the cane row itself, to drink water, excrete or sharpen the machete, and a pause of 5 to 10 minutes for lunch (not forgetting that they had already eaten some of their lunch before starting

work at around 07.00. The workers did not use the tables and shade located near the bus, which would seem a more adequate place to take breaks. The photographic record from inside the bus (Figure 6) shows obligatory breaks already described in another paper.

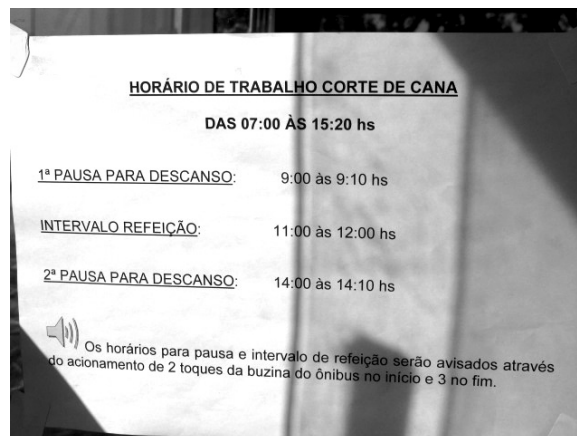
The obligatory minimum quantity cut was 12 t/day. In informal conversations *in situ*, one of the workers related that the first three months, without a contract, served to see whether the migrant could manage to cut the minimum required.

The first three months are for them to test us. Those who can't manage to cut that amount go home, they are fired. Some can't hack it and leave because they want to, they see how hard the work is and can't handle it, especially the younger ones (JFM).

They were asked about the mean monthly income cutting this quantity and one of the - considered one of the most productive - revealed that he earned around six hundred and eighty reais, net, as food and accommodation were subtracted from the salary.

Some months we get more, some less, depends on how much we cut. If you get a good month, good weather, when we are more animated, it goes better. If you get a rainy month, “rolled” cane or towards the end of the harvest, when we're all tired, you earn less. But what we earn is enough to take back to the family in Ceará, to buy a DVD, fridge, maybe, even a bike for the kids.

Figure 6 - Breaks previously determined by employer



Even knowing that their earnings are low and they are required to work too much, they almost always state that they are at least satisfied to at least have work, not available in their cities of origin.

Finally, the form in which the workers' productivity is calculated was analyzed, the cane rows were measured at the end of the job, using a 2-meter compass that the team manager used to estimate how many meters had been cut (Figure 7). This measure was converted into weight - as stipulated by the company - to finally determine the quantity produced by each worker in tons and the value each earned that day. This measurement is rarely revealed to the workers who only see how much they earn at the moment they receive the payment.

When this compass was measured, it was found that it opened to 2.06 m, meaning it underestimated the total meters of row cut by the workers.

The workday ended around 15.30 when the workers were coming to the end of the rows and getting ready to return to the bus, waiting for everyone else to return around 16.00. Around 17.00 or 18.00, depending on location where the cane was cut that day, the workers returned to Elias Fausto, went to the company's central kitchen to exchange the empty lunch time food container for the dinner container and, finally, back to their houses. Arriving there, they still had to hand wash their clothes in the single available tank, eat, wash and sleep; the following day they turned up for the new work day.

The conditions observed show a precariousness in work that is unparalleled in the modern era, with degrading conditions of the use of human strength. This precariousness is driven by the neoliberal logic of productive restructuring, prioritizing the production of goods to the detriment of the environment and the workers' health (Antunes, 2008).

It is worth highlighting that although the Brazilian government articulated the so-called National Commitment to Improving Sugar-cane Cutters' Working Conditions" in 2010, as a way of facilitating the international market's access to ethanol, supported by various ministries and workers' representatives (Brasil, 2010, 2011). The aim of this tri-partite agreement is to certify the plants after implementation of improvements to working conditions. However, certification is private and

Figure 7 - Team manager with the "2 meter" compass



financed by the plants themselves, with no public control over the process, although in 2013, after a legal decision, a sentence declared the termination of the application for revocation of the seal of social responsibility of a plant in the interior of São Paulo that did not meet workers' rights by not granting the seal without prior inspection of the Ministry of Labor (Legal Decision, 2013).

Except for the end of outsourcing, which represents a breakthrough in labor relations, the checklist for audit and certification of supply includes, basically, items already provided for by law. Other items provided for in legislation appear controversial, an example is the observance of workplace exercise for cane cutters.

Final considerations

The observational study enabled it to be affirmed that this population, although improvement have been achieved, with health protection measures enshrined in law, remains far from being dignified work, free of health risks. In this activity, working life is comparable to that in the era of slavery, as Silva (2005) describes, when it was not possible to work for more than 10 years and the workers were subject to different, significant health risks, the impacts of which remained with them for life.

The physical exhaustion described and observed in the workers and their reported pain and cramps throughout the workday can be minimized through

organizing and reshaping the work process in the cane fields and by eliminating payment by results. This latter measure, in particular, has been discussed as one of the most important determinants in physical exhaustion and death in the cane fields, as it results in lack of breaks in the shade, to the detriment of productivity imposed by the logic of the neoliberal model of production.

The lack of quality in diverse aspects of these workers' diet was explicit: inappropriate temperature, leading to the food spoiling; poor nutrient content, due to lack of variety; in addition to cultural incompatibility and over-dilution of the only nutritional supplement provided - the electrolyte replacement.

New studies that aim to achieve more in-depth knowledge of this migrant population's diet and diet quality outside of harvest time may help in understanding the effects of this diet on health and in their performance at work at harvest time and throughout their lives.

The appropriate energy and nutrients can be improved through taking care about the composition and safety of the food provided by contracting and monitoring by nutritionists as recommended by the Workers' Food Program (PAT) (Brasil, 2006).

In contrast to the discourse of those who defend ethanol production, that is, an agro-fuel providing clean and renewable energy, in this sector, in particular, it can be seen that expressions such as "boia-fria", "capataz", "eito", among others, endure, revealing the perversity of archaic work relationships, left over from the colonial slavery period (Silva, 2005), as well as their exposure to conditions of food and nutrition insecurity, suggesting the urgent need for State interventions, in the sense of investing in public policies aimed at socio-cultural transformations guaranteeing promoting and preserving the health of this population.

Health and working conditions in manually harvesting sugar-cane in Brazil to produce ethanol should be the object of future studies contributing to reflection and to constructing a new, less degrading work process that includes workers' health so that production of this agro-fuel is, in fact, clean and sustainable.

Acknowledgements

The authors would like to thank Alessandro José Nunes da Silva, André Felipe Martins and Dr. Eri-velton Fontana de Laat, for all the support during the research; and the 15th region Public Minister of Labor and Minister of Labor and Employment (MTE), Piracicaba Administration; and the Reference Center for Occupational Health (Cerest Piracicaba), for all their contributions to conducting this research.

Authors' contribution

Luz and Corrêa-Filho were the project coordinators and responsible for the study design. Luz, Vilela and Zangirolani were responsible for collecting and interpreting the data. Luz, Zangirolani and Corrêa-Filho edited the manuscript. All of the authors read, corrected and approved the final manuscript.

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Received: 14/04/2013
 Resubmitted: 12/02/2014
 Approved: 14/02/2014