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## Research report

# Studying the nutritional beliefs and food practices of Malagasy school children parents. A contribution to the understanding of malnutrition in Madagascar <sup>☆</sup>



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## ABSTRACT

Madagascar is severely affected by the problem of children malnutrition. The present study aimed at exploring school children Malagasy parents' food practices and beliefs structures about the nutritional value of foods, to better understand the causes of this malnutrition. A combination of Focus Groups (72 participants), and questionnaires (1000 interviewees) was used to evaluate the food beliefs and the nutritional habits of low income parents of school age children in urban and rural areas of Antananarivo and Antsiranana. The respondents' beliefs were shown to focus not only on the nutrient and energetic composition of food, but also to involve more general relations between food and health and particularly the sanitary properties of food. Compared with such sanitary properties, nutrient content was not considered to be the priority in food choice and food preparation. The food category considered to be the most nutritive was cereals, ahead of protein foods, or vegetables and fruit. Nutritional beliefs were not the same in the Antananarivo and Antsiranana areas, nor between urban and rural areas of Antsiranana. Different socio-economic contexts, food availability and information may explain these differences. This study could guide actors involved in nutrition promotion to adapt to specific areas their nutrition programmes in the fight against malnutrition.

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## Introduction

Madagascar is a country of contradiction: on one hand, a developing country with a high percentage of its population under the poverty line, and on the other, a country rich in natural resources. Two thirds of the population live in rural areas, where the main activity is agriculture (Dostie, Haggblade, & Randriamamonjy, 2002). Like most developing countries, the island is severely affected by the problem of malnutrition, especially in rural areas (Devine, Connors, Sobal, & Bisogni, 2003; Smith, Ruel, & Ndiaye, 2005, WFP & UNICEF, 2011). The term malnutrition is used to refer to suboptimal nutritional health. This problem of malnutrition particularly affects children, with 45–50% of under-fives suffering from stunted growth (Fotso, 2006, WFP & UNICEF, 2011). Two anthropometric

indices are commonly used to define children malnutrition: low height for age (stunting) and low weight for height (wasting). In 2008–2009, Madagascar had the sixth highest incidence of stunted growth in the world, according to UNICEF. Stunting is more prevalent in rural areas (prevalence of 48.7%) than in urban areas (WFP & UNICEF, 2011).

Fifty-three per cent of households in rural Madagascar have an insufficient consumption of nutritious foods to maintain an active and healthy life (WFP & UNICEF, 2011). The Malagasy diet is based mainly on rice, with an average consumption of 6.2 times a week, vegetables (4.4 times) and tubers (3.9 times), principally cassava. Proteins from vegetable and animal sources are rarely consumed (once and 2.3 times per week respectively) (WFP & UNICEF, 2011). Thus, the proportion of carbohydrates in the dietary energy supply is between 77% and 79%, which is high compared with recommended dietary allowance. Protein consumption is low: about 45 g per person per day, while theoretical needs are 56 g per person per day, and fat consumption extremely low: about 20 g per person per day (theoretical needs: 77 g per day) (FAO, 2005b). This chronic under-nutrition is worsened by seasonal poverty (the period between the two rice harvests), during which the caloric intake of poor rural households decreases by 12% (Dostie et al., 2002).

Food insecurity can result from insufficient food availability, distribution problems, the low purchasing power in poor households

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or inappropriate food consumption in families (FAO, 2005b). The Malagasy government has launched different nutritional policies and programmes to reduce malnutrition problems, but most funds have been attributed to a limited number of communities and policies have remained short term (MAEP, 2012).

Healthy and nutritive foods such as fruit, legumes or leaf vegetables are plentiful in Madagascar. It is not yet understood why these resources are not mainstays of the Malagasy food repertoire, as they are available and relatively cheap. According to Rozin (1996), although nature provides a very large variety of products potentially rich in nutrients, only a small subset of these products is considered as food within any given culture. As summarized in Shepherd's food choice model (Shepherd & Raats, 1996), food choice is determined by three classes of factors: foods, individuals and external environment. The first class involves the sensory attributes and anticipated consequences of a food, for example whether it might be poisonous or, on the contrary, healthy. The second class of factors includes psychological factors such as mood or neophobia as well as physiological factors such as sensitivity to tastants. The third class of factors involves the economic and social environment and includes costs, availability of food products as well as social pressure. These three classes of factors interact with one another and are likely to be mediated by the beliefs and attitudes held by the individuals. Beliefs are the simplest form of mental representation (or mental construct) and are defined as a psychological state in which an individual holds a conjecture or premise to be true. They are thought to play a causal role in the production of behaviour. For example, beliefs about the nutritional benefits or harm in eating a food may be more important than the actual nutritional quality and health consequences in determining an individual's choice. When considering children, factors related to parents are also involved. As gatekeepers, parents influence children's food choices by setting rules, providing information, and modelling behaviours. In return, food preference communicated by children affects parents' food choices (Holsten, Deatrick, Kumanyika, Pinto-Martin, & Compher, 2012). While these factors have been widely studied in the context of industrialized countries, there have been very few studies aimed at understanding food choice in developing countries, especially in Madagascar.

The aim of the present study is to explore the school children Malagasy parents' food practices and beliefs structures about the nutritional value of foods, to better understand the causes of the children malnutrition. Our first hypothesis was that in Madagascar, children under-nutrition may be linked not only to general food availability but also to food practices yielded by parent's beliefs towards food nutritional values. Given the importance of environment reported in the literature, our second hypothesis was that parents' food practices and beliefs structures depend on geographical and social context.

To test these hypotheses we used a combination of Focus Groups and questionnaires. Focus Groups are typically used to elicit information and insights from small groups of participants representing the population under investigation (Dammann & Smith, 2010; Neumark-Sztainer, Story, Perry, & Casey, 1999). The questionnaire survey, although furnishing less information than the Focus Groups, is helpful in improving the generalization of results. The Focus Groups and questionnaires were conducted with parents of school age children in urban and rural areas of Antananarivo (AU and AR, respectively) and Antsiranana, also known as Diégo-Suarez (DU and DR, respectively). Antananarivo, the capital of Madagascar, is located in the central part of Madagascar, and is characterized by a heterogeneous population. Antsiranana, the seventh most populated urban area, is located on the northern coast of the island. The choice of these two locations was based on their differences in climate, rain failure and natural resources, resulting in different food availability. Economic status and ethnicity of the population also vary (MAEP,

2003a, 2003b), as well as the food intake typology of the population in the two provinces (Madagascar ISFP, 2008). Fifty per cent of under-five children are affected by chronic malnutrition at Antananarivo, compared with 37% at Diego (MAEP, 2012). Important differences exist also between rural and urban population in these two provinces (MAEP, 2003a, 2003b).

## Materials and methods

### Participants

#### Focus Group

Seventy-two parents (six to eight participants per group) of children enrolled in public primary school were recruited in three neighbourhoods (Ambatobe representing AU, Ambatolampy Tsimahafotsy representing AR and Labigorine representing DU) to participate in the discussions. The number of participants totalled 22 in AU (23 women and one man), 26 in AR (24 women and two men) and 24 in DU (23 women and one man).

The recruitment was carried out through the headmasters or teachers of the public primary schools to reach low income parents. Parents who had agreed to discuss the subject of "children's eating habits" took a screening interview. This selection step helped the investigators to balance chattier and less chatty participants in forming the discussion groups. The age range of the participants was between 19 and 62 years old. While the participant selection methods used here cannot be considered likely to yield representative data for the population as a whole, housewives, who are those most likely to be preparing food, comprise the largest proportion of the Focus Groups. Some participants occasionally worked on farms or as domestic help and a few were employed in unskilled jobs (e.g. manual worker in textile fields, selling vegetables). Only a few of them had been educated beyond primary school.

#### Questionnaire

The questionnaire was administered to 1000 parents (797 women and 206 men) of school age children from different social classes using a face-to-face interview-assisted technique in four different areas: 300 participants were interviewed in AU, 300 in AR, 200 in DU and 200 in DR. The difference between the Antananarivo and Antsiranana sites in the number of interviewees was related to differences in the total number of inhabitants in these two areas. The interviewees' characteristics are shown in Table 1.

To ensure even representation of each area, the questionnaire was administered in 24 neighbourhoods in AU, 18 in AR, 11 in DU and five in DR. Interviewees resided in the neighbourhood of the interviewing location. AR sites were located about 20 km from downtown Antananarivo, and DR sites were located about 20–50 km from downtown Antsiranana.

### Procedure

#### Focus Group

Nine Focus Groups, three in each location, were held between March and July 2011 in a Focus Groups room for AU, and in classrooms for AR and DU. Each group discussion lasted from 75 to 90 minutes. The discussions were conducted by a moderator in participants' native language (the official Malagasy language for AU and AR and the north dialect for DU). The Focus Group procedure (planning, questioning and moderating) followed recommendations (Morgan, 1998).

At the beginning of the Focus Group discussion, participants were encouraged to participate actively in the discussion and to share their experience. It was explained to the participants that the discussion concerned their own ideas and that there was neither right nor wrong answers. The moderator informed participants that the con-

**Table 1**  
Respondent characteristics in four areas.

	Areas <sup>a</sup>			
	AU	AR	DU	DR
<b>Age</b>				
18–25 years old	16	29	37	12
26–40 years old	221	232	120	135
41–55 years old	60	36	36	39
>56 years old	27	3	7	14
<b>Sex</b>				
Men	95	65	10	33
Women	205	235	190	167
<b>Education level</b>				
Primary	86	135	21	48
Secondary	107	106	103	115
High school	84	44	54	36
University	23	13	22	1
<b>Number of children in household</b>				
1	34	48	37	14
2–3	196	166	115	94
4–5	61	71	37	71
6–8	9	15	8	15
>9	0	0	3	4
<b>Number of children in primary school</b>				
1	132	155	133	75
2–3	155	140	60	117
4–5	11	5	4	8
>6	2	0	3	0
<b>Kind of school frequented by children</b>				
Public	78	133	55	128
Private	222	167	145	72
<b>Remunerative activities</b>				
Agriculture	46	108	10	163
Farming	34	63	8	123
Fishing	1	8	1	0
Manual worker	9	45	14	5
Domestic work	17	14	34	9
“Road” salesman	157	146	64	47
Independent	104	92	43	30
Salaried	155	79	90	45
Executive	10	7	4	4
Hired man	9	55	2	10
<b>Monthly household income</b>				
<Ar 50,000 (<USD 22.04)	10	30	48	37
Ar 50,000–100,000 (USD 22.04–44.09)	53	113	50	51
Ar 100,000–200,000 (USD 44.09–88.17)	91	94	47	56
Ar 200,000–300,000 (USD 88.17–132.26)	85	28	18	41
Ar 300,000–500,000 (USD 132.26–220.43)	48	20	24	14
>Ar 500,000 (>USD 220.43)	13	14	13	1

<sup>a</sup> (AU, Antananarivo Urban; AR, Antananarivo Rural; DU, Antsiranana Urban; DR, Antsiranana Rural).

versation would be audio recorded but that the tapes would be used only in the framework of academic research and that participants would remain anonymous. Participants then briefly introduced themselves to break the ice.

To access the parents' food practices we first asked them a question on their habits (*what are the foods that you frequently consume?*) Then, to access parents' food beliefs structures, we used an association task in which participants were prompted with a stimulus word (nutrition) and were asked to indicate all the words that came to their minds (*What comes to your mind when I say nutrition?*). The free association task reflects the relative strength (measured by how many participants produced a given word) of automatic associations between concepts. The comparison between the terms generated in the four groups of participants gives some insights into the main beliefs associated with the nutritional value of food in the different areas of Madagascar.

Then we focused on participants' food choice criteria to evaluate the link between their implicit beliefs (association task) and the criteria they explicitly declare using when buying their food and

**Concept of “nutrition” by parents**

Q1: From your mind which of them is the 3 words you use to describe “nutrition”?

Expensive                       Satisfying                       Tasty

Clean                               Nutritious                       Other: \_\_\_\_\_

Balanced                           Well cooked

Q2: Cite 3 foods you think having high nutritional value

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Most important criteria considered by parents in food choice**

Q3: From your mind, when you do your food shopping, which of these are the 3 most important criteria?

Diversity                           Availability                       Habits to buy

Budget                               Children liking                   Health

Q4: From your mind, when you prepare meal for children, which of these are the 3 most important criteria?

Cleanliness                       Diversity

Vitamins and Calcium brought    Children liking

Satiety                               Energizing

**Children food preference**

Q5: Cite 3 most liked foods by your children:

\_\_\_\_\_ (1)

\_\_\_\_\_ (2)

\_\_\_\_\_ (3)

**Fig. 1.** Questionnaire.

their children's food (*What are the most important criteria you use to decide what to eat? For you and your children?*).

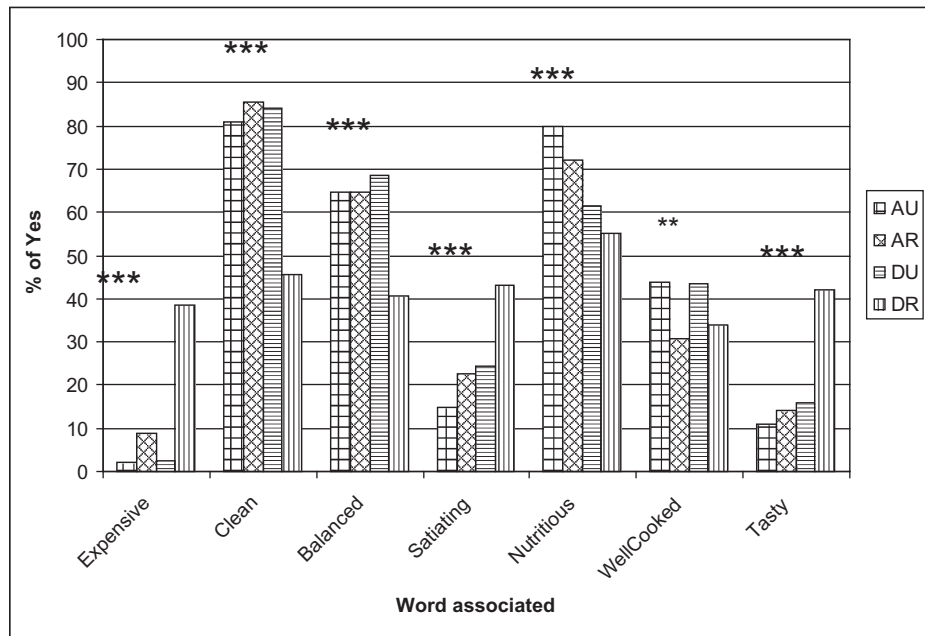
### Questionnaire

The Focus Groups allowed us to assess school children parents' food practices and beliefs structures about the nutritional value of foods. The beliefs structures and food practices that emerged from this technique were then validated using a close-ended questionnaire with a larger population.

The questionnaire was first elaborated in French as French was the common language among the researchers involved in the study, and then translated by the first author into the Malagasy language. To ensure that the original meaning had been maintained, the translation was verified by a bilingual person who was not involved in the conception of the questionnaire.

A pre-test was carried out with 40 interviewees. This first trial led to a reduction in the number of questions and to changes in the formulation of the questions. As a non-negligible proportion of the interviewees had difficulty reading, the interviewers had to read the questions aloud to them, which caused some memory problems in terms of the ranking questions. To avoid such problems, ranking questions were replaced by multiple choice questions in which interviewees had to select three items from among seven possibilities. The final version of the questionnaire consisted of three parts and included 31 main questions (29 close-ended, two open-ended questions) as well as 11 socio demographic questions. Only the questions related to food beliefs, food habits and socio demographic information are presented in this paper (Fig. 1).

Ten interviewers were recruited and trained to use identical questioning techniques. Each interview lasted for about 15 minutes.



**Fig. 2.** Frequency distribution of terms given by participants related to the word “Nutrition” in four areas (\*\* $p < 0.01$  and \*\*\* $p < 0.001$ ). (AU, Antananarivo Urban; AR, Antananarivo Rural; DU, Antsiranana Urban; DR, Antsiranana Rural).

Interviewees were encouraged to give responses related to their own experiences and were told that there was neither right nor wrong response.

All interviews were carried out in July 2011.

#### Data analysis

The audio-recorded discussions of all the Focus Groups were fully transcribed on the days after discussion. The moderator and the assistants independently analysed each transcription using the notes taken by the assistants to supplement the tape recordings. The results were then compared and adjusted after consensus had been reached.

Survey data were first analysed by compiling the frequency count for each question in each interviewing area (AU, AR, DU and DR). The effect of interviewing area was then tested using Pearson and McNemar's ( $\chi^2$ ) chi-square tests with an  $\alpha$  risk set at 5%. A Bonferroni's correction was applied to correct the alpha inflation problem caused by multiple tests.

Finally, a Factorial Correspondence Analysis using SPAD version 5.5 (Coheris, France) was performed to visualize relationships among the questions.

#### Results

Results from Focus Groups and questionnaires are presented conjointly in order to avoid redundant information. Verbatim taken from the Focus Groups are used to explain the quantitative data obtained in the questionnaire. We start by presenting respondents' food practices and we follow with participants' food beliefs and food choice criteria.

#### Respondents' food practices

When asked to indicate the kind of food they eat, some Focus Groups participants declared that they ate three times a day (breakfast, lunch, dinner). They indicated that their diets were largely composed of rice – “Especially rice, three times a day in our case” – eaten

with “laoka”, made up of vegetables or leafy-vegetables and possibly meat or fish on the days when there was enough money”. The questionnaire confirmed that rice is consumed everyday by 99% of the respondents, and even two or three times a day by some of them (68% and 27% respectively). Salads of raw vegetables and fruits as desserts were sometimes added: “We make salad once a week; during the week just rice and laoka”. Breakfast varied depending on the habits of the households. For example, rice or other kinds of food were cited: “In the morning we don't eat rice but just tea [infusion] and bread”.

Tubers like cassava roots in rural areas of Antananarivo, and plantain banana in Antsiranana, were most often cited after rice: “For us [from the north coast], food that can replace rice might be: plantain banana with meat, with coconut. . . Very tasty! It can replace rice”. This may be eaten instead of rice in a meal or as a snack between main meals.

#### Low-income parents' beliefs towards food nutritional value as a function of geographical origin (centre vs north) and urbanization (rural vs urban areas)

The words that were more frequently cited in the association task during the Focus Groups were “clean”, “balanced”, “satiating”, “nutritious”, “well cooked”, “tasty” and “expensive”. The frequency of citation of these terms obtained via the questionnaire is shown in Fig. 2 as a function of the interviewing areas. A  $\chi^2$  analysis revealed an effect of interviewing area with the main difference appearing between DR and the three other areas. In DR, the seven items were almost equally cited with a proportion of citation of around 40%, except “Nutritious” which exceeded 50%. This finding should be interpreted with caution, however, as it might reflect either the fact that respondents in DR did not understand the question and answered randomly, or that they found all the items equally important.

In AU, AR and DU, the most frequently cited item was “Clean” (more than 80%), before “Nutritious” (between 61% and 80%) and “Balanced” (between 64% and 69%). A large number of participants related nutrition to hygienic concerns (“Cleanliness”). In

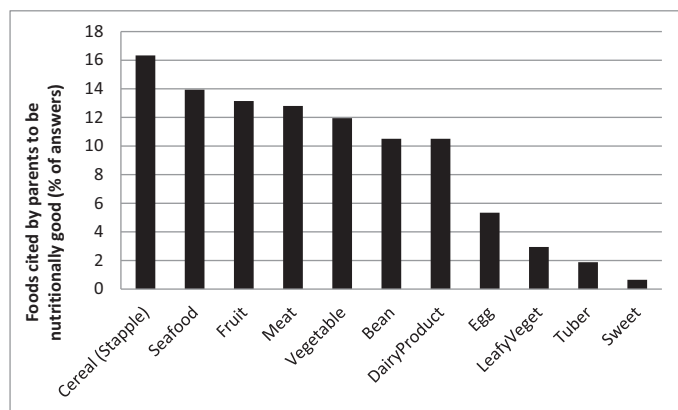


Fig. 3. Foods considered by parents as nutritionally good.

AU and AR, Focus Groups participants' discussions revealed how important cleanliness was in the handling, preparing and eating of foods. "The most important aspect is cleanliness (. . .). When meals are served, the plates have been previously cleaned well, hands should be washed. . . that's cleanliness. . . Even during consumption, cleanliness is necessary". In line with the importance of cleanliness "Well cooked" was cited by between 31% and 44% of interviewees in the three areas.

Qualitative aspects of foods (supply of important nutrients and "balanced") were also important. "Balanced" meals, which can be understood as a diversity of foods, were related to variety in nutrients: "Changing menus corresponding to the six kinds of foods [carbohydrates, fats, proteins, water, vitamins and minerals]". One way to obtain a balanced intake was to make a different meal each day: "For me, the thing to do: when I do [cook] this one today I should not repeat it the next day if I can afford it." But some participants understood "balanced" in a different way: for them it corresponded to using the same ingredients in different recipes. "Diversity is like that: with vegetables. . . I can buy for example vegetables every day, but I modify my way of cooking them". "Satiating", "Tasty" and "Expensive" were the items cited the least frequently: between 16% and 24% in AU, between 11% and 16% in AR and between 2% and 9% in DU.

To further understand participants' food beliefs, we considered the three food products cited as being the most nutritive together, for each participant. Results indicate that a total of 86 food products were generated by participants in the questionnaire as being nutritive. The items most frequently cited as being nutritive were meat, fish and rice. The lists of foods produced by the parents were grouped into 11 categories (Fig. 3). Leafy vegetables and vegetables were separated into two different categories because leafy vegetables represent a specific category in the Malagasy food repertory. Among those categories, cereals were more often cited as nutritionally good (16% of the interviewees). This category includes rice, pasta, and maize. Rice was the most frequently cited food in this category. The second class included foods positioned in the middle: beans, dairy products, vegetables, meat, seafood and fruit.

The last class included categories which were spontaneously less cited as having high nutritional value by parents: sweets, tubers, leafy vegetables and eggs. Tubers, such as cassava roots, were considered as incomplete, judging from Focus Groups discussions: "If cassava is eaten alone, it is not a healthy food. . . only if you prepare it by adding other ingredients." This category of food was identified by the respondents as lacking in certain nutrients. It may be surprising to find that eggs and leafy vegetables were as negatively judged as tubers and sweets. Indeed, eggs are the most complete

source of amino acids and leafy vegetables are a source of vitamins, minerals and fibres.

Figure 4 presents the two first components of the correspondence analysis showing the categories of foods judged nutritive by parents in the four areas. Factor 1, which represents 56% of the variance, opposes the Antananarivo areas (AR and AU) to the rural Antsiranana area (DR). Rural Antsiranana households cited protein rich foods, and more particularly seafood, meat and eggs. Factor 2, which represents 27% of the variance, opposes the urban Antsiranana area (DU) to urban Antananarivo (AU). DU households more often cited vegetables as nutritionally sound foods, and less often beans, than households from other areas. In AR and AU, parents more often cited fruit, dairy products, tubers and staples as being nutritionally sound.

As no individual food can be considered to be nutritionally complete on its own, after having looked at individual foods, we explored the associations of foods cited by the respondents to evaluate whether their beliefs structures take into account this necessity of associating foods. To do that, cited food products were categorized into six groups, corresponding to the six classes of nutrients they contained (on the basis of the French food pyramid (Absolonne, Sirjacobs, Guggenbühl, & Colin, 1999): (1) products high in complex carbohydrates (cereals, legumes and tubers), (2) products with a high protein content (meat, seafood and eggs), (3) dairy products, (4) fruits/vegetables, (5) sweets, and (6) fats. Next, the number of groups corresponding to the three food products cited by each participant was determined (Table 2). The contingency table revealed a very significant link between areas and number of food groups ( $p = 0.0003$ ). Respondents from rural areas, especially from DR, more often cited three foods belonging to the same group than interviewees from urban areas. Compared with other areas, respondents from AU cited more frequently foods from three groups.

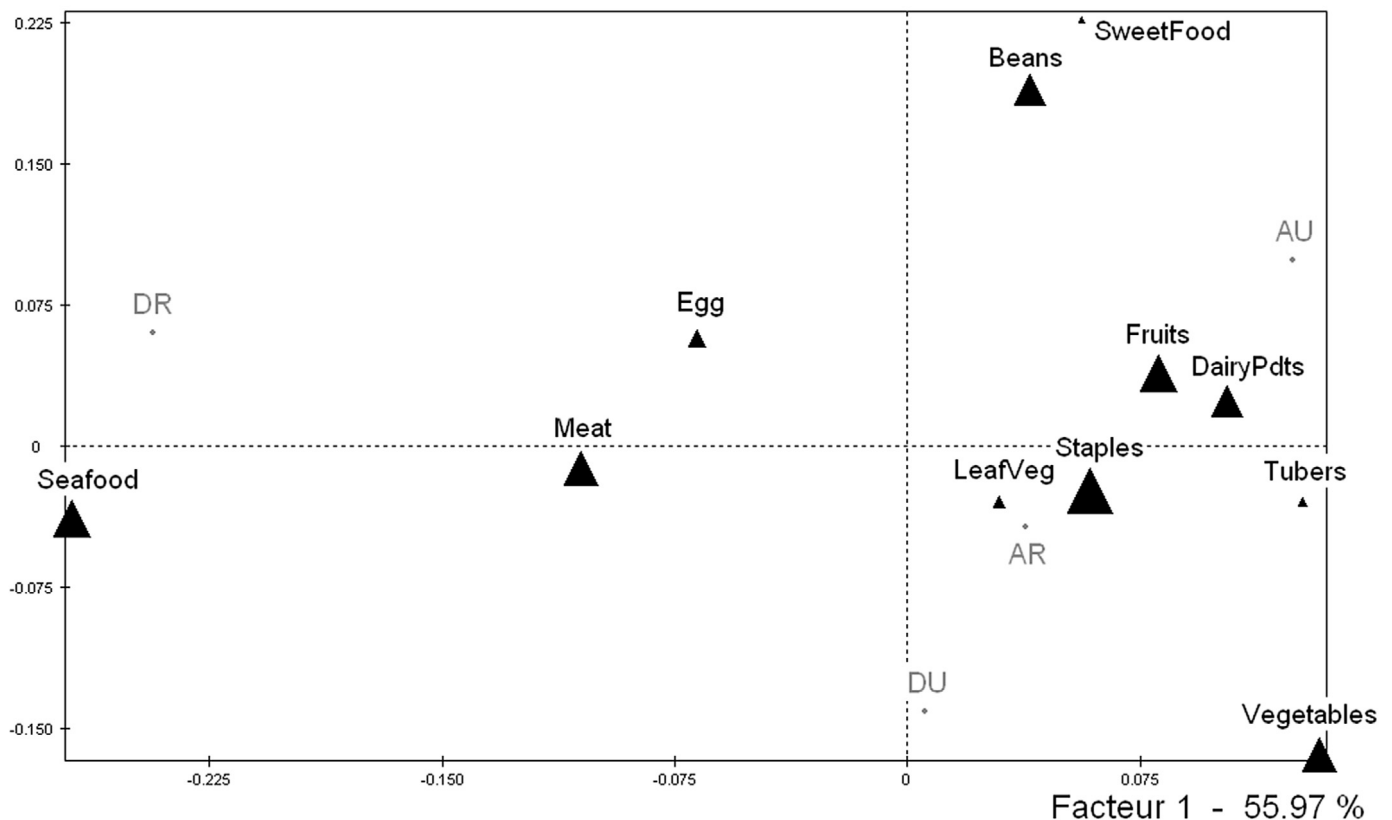
#### Respondents' food choice criteria

In general, the mother of the family or the maid takes care of preparing food in Malagasy households. Shopping for food is a daily activity, due to the lack of refrigeration. Figure 5 shows the percentages of global citation of food purchase criteria when shopping and when preparing meals for children in the four areas. Considering food purchase criteria when shopping, "Price" was frequently cited (>80%). Monetary considerations were often mentioned during the Focus Group discussions; for example: "I look at everything and the lowest price is the one I buy". Most households interviewed cannot afford to buy certain categories of food like meats, except on the days when they receive their salary (once or twice a month): "When we find a bit of money we buy a bit of meat, after work [temporary work]".

"Health" and "Diversity" were frequently cited (more than 60%). Health may be interpreted either as related to a food's nutrient content or to its sanitary properties. In the Focus Groups discussions, health was related to food content. A mother said: "For me, when I go shopping, I aim at making meals complete [nutritionally], which means providing energy and force for children, to make them healthy". Another mother said: "About vegetables, when we go to the doctor – we go to the doctor frequently – he always says that we should give children vegetables and fruits. If meals contain vegetables and fruits, for me it's alright". "Availability" (about 40%), "Children liking" (30%) and "Habit of buying it" (about 15%) were the least frequently cited items.

In terms of food purchase criteria when preparing meals for children, "Cleanliness" was the most frequently cited item. Parents interviewed in Focus Groups discussions related that foods sold in small restaurants were not safe because they are very exposed to microbiological contamination. Consequently, parents preferred

## Facteur 2 - 26.83 %



**Fig. 4.** Factorial analysis of categories of foods viewed as nutritious by parents in four areas (AU, Antananarivo Urban; AR, Antananarivo Rural; DU, Antsiranana Urban; DR, Antsiranana Rural).

preparing their meals themselves in order to control hygienic conditions during cooking. After “Cleanliness”, food content in terms of vitamins and minerals (“Vitamins”) and caloric content (“Energizing”) were also frequently cited (>65%). “Satiety” and “Diversity” were cited by between 30% and 40% of parents. “Children liking” was the criterion least cited by parents.

Chi square calculation with Bonferroni correction (corrected  $\alpha = 0.044$ ) revealed highly significant differences among the four areas concerning both food purchase criteria and food preparation. Figure 6 shows the first two components of the correspondence analysis carried out on the food purchase and meal preparation criteria by geographic area contingency table. The first dimension, which represents about 61% of the variance, opposes the Antsiranana areas to the Antananarivo areas. Participants from Antananarivo (AU and AR) seemed to use similar criteria and emphasized health concerns more (“Health”, “Clean”, “Vitamin and mineral con-

tents”, “Energizing”) and “Children liking” (when shopping) than participants from the Antsiranana areas (DU and DR). The second dimension, which represents about 36% of the variance, opposes mostly DU participants who seemed to favour “Children liking” and “Diversity” (when preparing meals) to DR participants who seemed to rely more on “Availability”, “Habit of Buying it” and the “Satiating” power of foods.

## Discussion

Our first hypothesis was that in Madagascar, children undernutrition may be linked not only to general food availability but also to food practices yielded by parents’ beliefs. In agreement with this hypothesis, our study highlighted the role of parents’ beliefs structures in children malnutrition. In all four areas, “cleanliness” was one of the words most closely related to the prompt “nutrition” in the association task and one of the most often cited criterion when preparing meals. It has been pointed out that in Madagascar, food contamination has serious health effects: the lack of hygiene, inadequate hand washing and ignorance of risk are at the origin of microbiological toxicity in Madagascar (Sarter & Sarter, 2012). Respondents were aware of the importance of this problem. This association between cleanliness and nutrition probably comes from the well-known synergy of malnutrition and infection as the leading cause of morbidity and mortality in developing countries. Indeed, malnutrition reduces resistance to infection and infection affects nutritional status (FAO, 1997). The importance of the belief that a nutritive food is a food that does not make you sick was shown to lead to food preparation habits detrimental to nutritional quality, such

**Table 2**

Number of food groups considered by the interviewees as good nutritionally (expressed in percentages).

	AU	AR	DU	DR
Frequency of citation of foods belonging to only one group	5 <sup>a</sup>	9 <sup>b</sup>	5 <sup>a</sup>	13 <sup>b</sup>
Frequency of citation of foods belonging to two groups	51 <sup>a</sup>	56 <sup>b</sup>	61 <sup>c</sup>	62 <sup>c</sup>
Frequency of citation of foods belonging to three groups	44 <sup>c</sup>	35 <sup>b</sup>	34 <sup>b</sup>	25 <sup>a</sup>

<sup>a-c</sup> Chi-square results at a confidence level of 95%. Different letters in a row indicate that results are significantly different between areas.

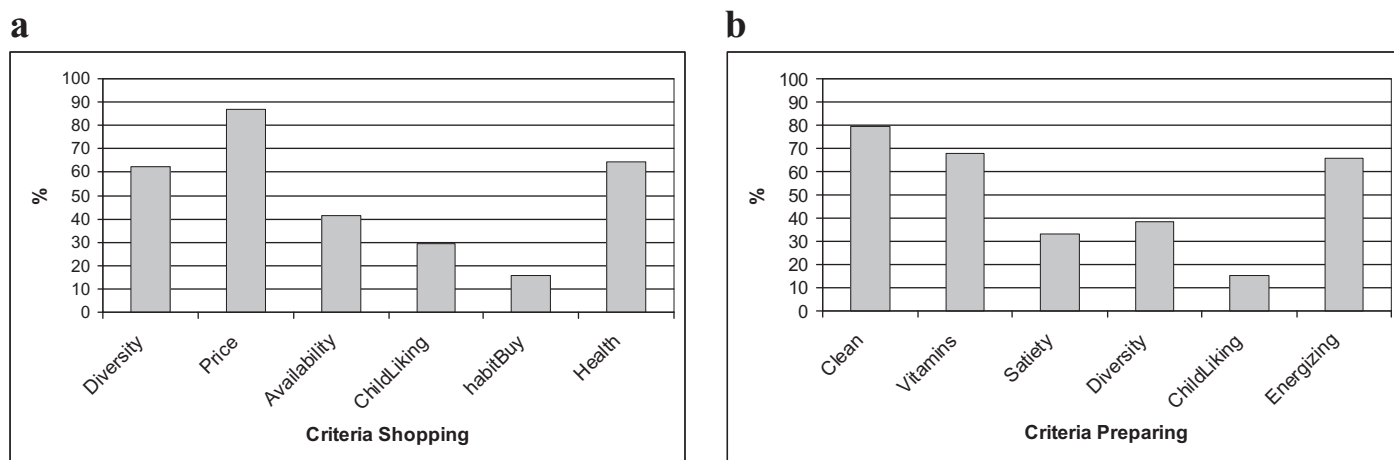


Fig. 5. Percentage of food purchase criteria considered by parents when shopping (a) and when preparing meals for children (b).

as overcooking foods. This was revealed in our study by the item “well cooked”, which was chosen by 30–45% of the respondents in each area. It is well known that lengthy cooking decreases certain vitamin contents in foods; this is the case with vitamins C, B<sub>1</sub>, B<sub>2</sub>, B<sub>5</sub>, B<sub>6</sub> and B<sub>12</sub>. So, whatever the initial nutritional value of the foods eaten by the Malagasy population, the cooking process reduces available nutrients and tends to worsen nutrient deficiencies in the population.

The nutritional composition of foods seems to play the second role, after cleanliness, but before satiating potential, in Malagasy food beliefs structures. The fact that respondents did not particularly associate the satiating property of foods with the concept of nutrition, suggests that they believe that they have enough food to satisfy their hunger. Yet, Malagasy food supplies are considered to

be hardly enough to cover the energetic needs of the population (FAO, 2005a) and for this study, the respondents were chosen among the poorest households in zones highly and moderately concerned by malnutrition. One explanation is that while not meeting energetic needs, Malagasy meals are nonetheless sufficiently satiating. This assumption is plausible because of the very high proportion of complex carbohydrates in Malagasy meals. Indeed, the products consumed the most are cereals and tubers, which are at once satiating and poor in energy and essential nutrients. In contrary, leafy vegetables, which are described in the literature as good sources of protein as well as some vitamins and minerals (Uusiku, Oelofse, Duodu, Bester, & Faber, 2010) and are not expensive and largely available in Madagascar were believed by parents to have a low nutritional value.

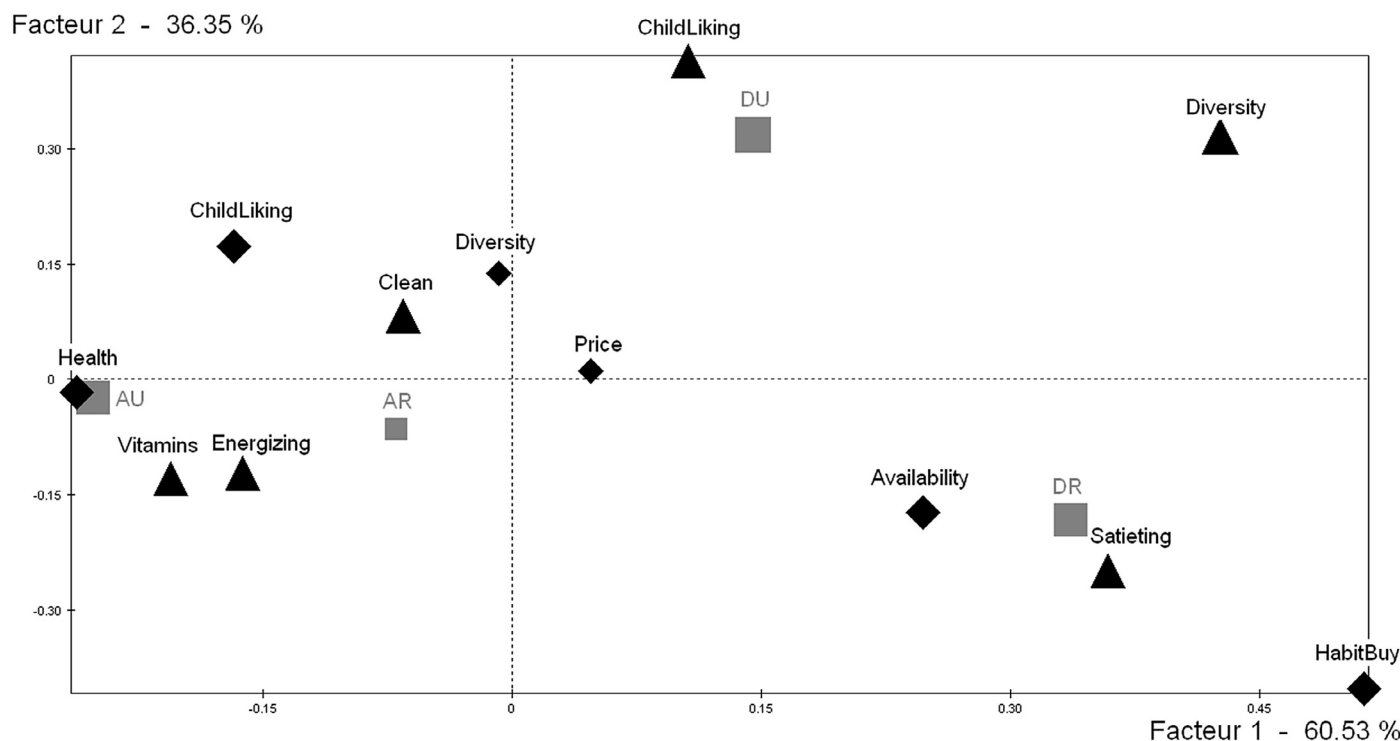


Fig. 6. Factorial analysis of food purchase in four areas when shopping (◆) and when preparing meals (▲). (AU, Antananarivo Urban; AR, Antananarivo Rural; DU, Antsiranana Urban; DR, Antsiranana Rural).

Our study also showed that school children Malagasy parents' beliefs led to food practices that could be linked to children malnutrition. Rice, which is central in Malagasy meals, was one of the foods most spontaneously cited by the respondents as being nutritionally valuable. It has previously been observed among poor households suffering from malnutrition that the diet consists predominantly of cereals, with very few "protective" foods like fruits, pulses and milk (Gopalan, 2000). In Madagascar, rice provides 53% of consumed energy and 50% of consumed proteins (FAO, 1993). The highest percentage of food expenditure is spent on rice (32% in 2010), followed by tubers (8%) (WFP & UNICEF, 2011). But this important cereal consumption does not cover nutritional needs, especially those of children. Indeed, among the major nutritional problems prevalent in rice-consuming countries, imbalanced dietary intake is the most important one. The protein content of rice is the lowest among the cereals. In combination with other factors, it leads to the prevalence of protein-energy malnutrition, iron deficiency, vitamin A deficiency and iodine deficiency disorders. This analysis is in agreement with the reports of NGOs which have observed that the highest occurrence of stunting is not among the very poor, as they eat the vegetables that they grow instead of selling them, and these are rich in nutrients. "The worst cases are those who can afford white rice" (IRIN, 2012).

However, beliefs towards food nutritional value are not the only food determinant. Our results showed that food availability can modulate the impact of beliefs on food practices. As an example, while most respondents believed that tubers are not good nutritionally, tubers are still widely consumed, depending on location. Food availability can explain this phenomenon. Indeed, previous work reported that tubers are consumed by poor households in the centre of the country between two rice harvests, for example, when they cannot afford to buy rice, (Dostie et al., 2002). During the lean season, the simple substitution of rice by cassava cannot provide balanced nutrients. Tubers and particularly cassava have extremely low protein content (less than 1%) (FAO, 1997). Thus, cassava is especially unsuitable as the main source of energy for young children. It also lacks lipids and certain vitamins and minerals. It seems thus that parents' food beliefs structures interacts with food availability to give rise to food practices that may lead to children under-nutrition. Changing these food practices, and thus decrease the rate of children under-nutrition, would therefore require to act both at the level of food availability and of parents' beliefs.

Our second hypothesis was that parents' food practices and beliefs structures depend on geographical and social environment. In agreement with this hypothesis we observed some differences between the studied areas. The differences might be explained by food availability in the four areas. Antsiranana (north) and Antananarivo (centre) climate and geographical situation are different, resulting in different natural resources and food availability. Differences in economic status between the four areas may also be responsible for differences in access to food.

First, a difference between rural and urban areas of Antsiranana was observed. Among the four studied areas, urban area of Antsiranana is the wealthier, resulting in a higher availability of food products of different groups. In DU, children's liking a food was taken most often into account, as if people could afford to fulfil their children's expectations because their access to healthy food was higher than in the other three locations studied. On the contrary, the rural area of Antsiranana is poor, but it is a farming region, where crops are more available than animal products. As a result, DR respondents particularly valued meat and seafood as nutritive foods, compared with other areas. That is probably why they considered nutritive food to be expensive. DR respondents emphasized availability as a criterion of food choice, showing the diversities of situations concerning access to food from different groups. As a result of this limited access, satiating properties and diversity were more

a source of preoccupation in DR than in other locations. When defining "nutrition", respondents in DR did not give as much importance to cleanliness as other respondents. This relative lack of concern for cleanliness could be due to the absence of household facilities in this area (having neither electricity nor running water), as well as a reduced education about sanitary properties of food. Thus, beliefs towards nutritional value of food are clearly different in DR and DU. Such differences between rural and urban areas were not observed at Antananarivo, probably for two reasons. First, in Antananarivo, the rural areas chosen for the study were closer to the urban areas (20 km) than in Antsiranana, where the nearest rural commune was 40 km away from the city. Secondly, in the capital (Antananarivo), rural migration is frequent, making the urban population quite similar to the rural one.

Differences were also observed between Antananarivo and Antsiranana. Despite the relative poverty of their region compared with Antsiranana, parents from Antananarivo seemed to be more sensitive to health concerns than parents from Antsiranana. This is probably due to the fact that in the capital there is more access to media and residents have higher levels of education than in the rest of the country. There are also more educational programmes devoted to food and nutrition than in the provinces, and this situation could be responsible for the differences observed between the centre and the northern areas in terms of beliefs towards food. In agreement with this interpretation parents in Antananarivo cited foods belonging to more classes than parents from Antsiranana, when asked to cite "nutritive foods", suggesting they knew more about nutrients contained in foods. As no individual food can be considered to be nutritionally complete, each answer highlights the nutrients that respondents consider to be important in a healthy diet. Respondents who only cite items belonging to a single group either do not know nutrients and cite current foods, or believe that particular nutrients are intrinsically good or bad. On the contrary, respondents who cite items from three different categories might know that particular nutrients are not intrinsically good or bad but that the key issue is to balance their meals. Another result in favour of the role of nutritional education in the capital is that parents from Antananarivo cited foods frequently mentioned in nutritional education programmes while in the north (DU and DR) parents who have probably not received nutritional information cited foods which were familiar and/or locally available (e.g. seafood, tubers).

## Conclusion

This study showed that current food practices in Madagascar are underlined by an interaction between food availability and food beliefs structures. Recommendations aiming at changing food practices to decrease children undernutrition must take into account these two factors. Nutritional information focusing on the complementarity between foods should be associated with the promotion of local production. These recommendations should be adapted to the geographical areas as we showed rural vs urban, as well as geographical, differences in both food availability and beliefs structures. Yet, this study focuses only on two areas of Madagascar and thus need to be extended to other areas to provide a wider picture of food practice and beliefs in Madagascar.

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