

The Nutrimad school feeding program: Impact on failure rate and nutritional status of schoolchildren in Madagascar

Arnaud Laillou¹, Luc Arnaud¹, Menjaharimisa Ramaherisoa², Charlotte Ralison²,
Chantal Monvois¹ and Serge Trèche³

¹ The Research and Technological Exchange Group (GRET), Antananarivo and Paris. ² The Laboratory of Biochemistry Applied to the Food Sciences and Nutrition (Labasan), University of Antananarivo, Madagascar

³ UR106 "Nutrition, Food, Societies", Institute of Research for Development (IRD), Montpellier, France

Introduction

The Nutrimad school feeding program (SFP), co-financed by SIGHT AND LIFE and the Ile de France regional council, is one of the three sections of the Nutrimad program, which is run by GRET (Research and Technological Exchange Group), the IRD (Institute of Research for Development), and the Labasan (Laboratory of Biochemistry Applied to the Food Sciences and Nutrition, of the University of Antananarivo, Madagascar) with the aim of contributing to the sustainable reduction of malnutrition in Madagascar. The objectives of the program are to counter immediate hunger and school failure rates, and to respond to the nutritional deficiencies of children from public primary schools within the framework of a sustain-

able system of school snacks, overseen by the local authorities. The approach of the Nutrimad SFP was to introduce a snack that was accessible to everyone, i.e. *inexpensive*, made from local raw materials, *liked by the children*, readily obtainable and reproducible, i.e. *easy to prepare* within schools, and of *good nutritional value*, i.e. designed so that one portion covers a share of nutritional requirements corresponding to the level of deficiencies generally observed in schoolchildren in Madagascar. The Nutrimad SFP was implemented during the 2004 – 2005 school year in 15 public primary schools in underprivileged districts of Antananarivo, according to the methods described in a previous issue of the SIGHT AND LIFE Newsletter (1). The program comprised two parts.

The first consisted in providing 12,893 children from the 15 schools with a snack in the form of a fortified and high-energy density gruel over an average of 110 days (between 101 and 119, depending on the school) spread over a period of approximately 6 months of the year.

This gruel, which was served during the first break for the price of 40 Ariary (approx 1.5 euro cents), was prepared in each school using a corn meal powder called "Koba Tsinjo" (72.6%), peanut (8.5%), sugar (14.0%) and a vitamin and mineral mixture, to which 2.0% soybean oil was added during the preparation process. The quantities served (350 g of gruel containing 110 g of powder, or 380 kcal) were sufficient to cover 18% of the daily energy requirements of a 10-year-old child,



as well as 75% of their RDA of micronutrients for which there is a major deficiency risk (iron, zinc and vitamin A), 60% of their RDA of calcium, 40% of their RDA of other minerals and vitamins, and 25% of their RDA of proteins, amino acids and essential fatty acids.

The second part consisted in nutrition education activities, whose purpose was to communicate messages aimed at informing the pupils and encouraging them to adapt their diet to their nutritional requirements, and to lead a healthy lifestyle. These messages were delivered throughout the year by specially trained teachers, who were also provided with educational supports developed by the Nutrimad team.

A first, still incomplete appraisal (presented to a meeting of national and international interest groups on 10 May 2006, at the invitation of Madagascar's National Nutrition Office) of the operation and effects of the Nutrimad SFP during the 2004 – 2005 school year has now been drafted, and this forms the basis of the present article.

Methodological approach implemented for follow-up and evaluation

The follow-up and evaluation strategy implemented throughout the year 2004 – 2005 to check the relevance and effectiveness of the Nutrimad SFP consisted mainly in measuring:

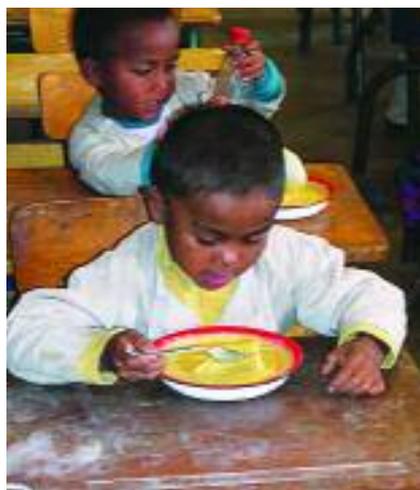
- pupils' participation in the scheme
- the effect of nutrition education activities on pupils' nutrition knowledge
- the effect of gruel consumption on the frequency and nature of pupils' meals, on their nutritional status, and on their school performance



In doing this, we had to take into account three main constraints. The first of these was the non-inclusion of control schools in our evaluation strategy, which meant that we were limited to comparing indicator values either recorded at the beginning and end of the year with the same pupils, or calculated for groups of pupils put together according to their gruel consumption. The second constraint was the insufficiency of financial resources allocated to the evaluation studies, which limited our choice of indicators for impact on nutritional status to those based on anthropometric measurements. The third constraint was the impossibility of gathering, from the relevant services, previous years' statistics on absenteeism and graduation into higher classes.

The analyses carried out can be divided into three categories:

- those carried out on the entire number (12,893) of pupils from 254 classes from the 15 schools, which consisted in creating a typology of schools and in recording information on the classes and teachers, as well as a self-administered questionnaire survey of the socio-economic situation of the families, a daily record of information on absenteeism and consumption of the snacks, anthropometric measurements and tests of nutrition knowledge taken at the beginning and end of the school year, and a record of results from the end-of-year exam determining whether pupils graduate into higher classes and which academic direction they should take;



- those carried out on reduced samples of pupils, in particular a measurement of food-intake which allowed us to check the adequacy of the consumption of gruel actually served (2,573 pupils from 64 classes in 5 schools), serial data-gathering intended to estimate, amongst other things, the effects of gruel consumption on the frequency and composition of meals (all pupils from 5 of the 15 schools), and the share of nutritional requirements covered (a survey based on recall of the past 24 hours carried out on 480 children from 9 of the 15 schools);
- finally, studies concerning gruel preparation, which were carried out in 5 schools to ensure that preparation guidelines were being respected and to check the characteristics of the gruel being served.

Confirmation of the poor nutritional status and low spending power of pupils

In the first place, the surveys and measurements taken allowed us to confirm the poor nutritional status of pupils at the start of the school year, before the Nutrimad SFP was launched.

Delayed growth and low weight affected 46.0% and 32.8% of

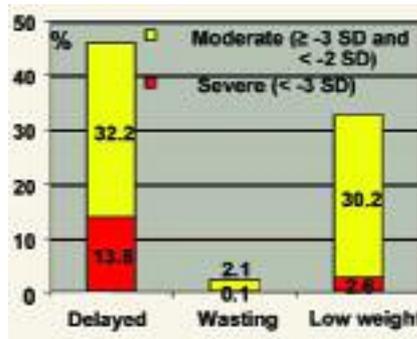


Figure 1. Prevalence of delayed growth, wasting, and low weight in children from the 15 schools (the figures for wasting are for children under 10 only).

children respectively, although there was a low prevalence (2.2%) of wasting among children under 10 years (Figure 1).

Moreover, the nutritional status of boys is noticeably worse than that of girls (49.6% vs. 42.2% for delayed growth; 37.8% vs. 27.3% for low weight), and, while the prevalence of malnutrition remains relatively constant between ages 6 and 10, it increases considerably in older children. Furthermore, it seems that there is an important relationship between academic underachievement and nutritional status insofar as, of the total number of children, the prevalence of arrested size fits 38% of children who are one school year behind, and 55% of children who are two school years behind in their studies.

Regarding the sums of money the children could afford to spend on food each day, the 11,255 children who completed the questionnaire had received an average of 67 Ariary from their parents on their most recent day at school. A third of the children received more than 50 Ariary, while 27% received less, of whom 5.1% received nothing at all.

A high rate of pupil participation in the scheme

Over the entire gruel distribution period, the average rate of pupil participation in the scheme, i.e. the average percentage of days on which they consumed at least one serving of gruel during the operational period of the Nutrimad SFP, was 68.4%. This rate was slightly higher in the second semester (71%) than in the other two (67% and 66%). The older the children, the more their participation rate went up (from 60% at age 6 to 77% at age 13), or in other words, participation increased in direct proportion with the level of the school year (Figure 2).

Ultimately, despite having to pay 40 Ar for each serving of gruel, 34.3% of pupils took over 80% of the opportunities offered them to eat it throughout the year, which means that only 9.6% took 20% or less of these opportunities.



Gruel prepared and consumed according to recommendations

The observations and samples taken have shown that gruel prepared in the schools did indeed contain on average the desired concentration of energy (108 kcal/100 g of gruel, which corresponds to 378 kcal for a 350 g serving) and, moreover, that 94.1% of children completely finished their plate of gruel, with only 0.75% of children leaving more than 4 soup-spoonfuls, and 2.9% sharing their gruel with a friend.

Under these conditions, we can calculate that, over the 6 month period (from November 2004 to May 2005) during which the Nutrimald SFP was in operation, the snacks provided 23.8% of the children with over 40% of their RDA in micronutrients for which there is a major deficiency risk, between 20% and 40% of the RDA for 65% of them, and under 20% for only 11.2%.

A snack which does not take the place of regular meals

Pending the processing of data from the survey based on recall of the past 24 hours, which should allow us to compare percentages of nutritional cover between children who ate the snacks and those who did not, the results provided here concern the effect of snack consumption on the frequency of daily meals.

The consumption of breakfasts (96.3%) and lunches (95.7%) at home by the children was just as frequent among those who ate the snacks as it was among those who did not. The consumption of dinners was even slightly, but significantly (98.1% vs. 96.1%; $p < 0.001$), higher among children who ate the gruel than it was among the others. Furthermore, the comparison of snack con-

sumption in the morning (86.5% vs. 71.2% for the children who ate the gruel and those who didn't respectively; $p < 0.01$) and afternoon (69.8% vs. 57.48%; $p < 0.05$) shows that not only do the alternatives to the snacks offered by the Nutrimald SFP have considerably less nutritional value, but also that the children who did not eat the Nutrimald SFP snack did not necessarily eat anything else.

Notable effects on nutritional status

The information gathered over the course of the SFP's 6-month operation period meant that the children could be divided into three groups according to whether they consumed quantities of gruel covering averages of less than 20% (group 1), 20% to 40% (group 2) and over 40% (group 3) of their RDA in micronutrients for which there is a major deficiency risk; it also meant that the children's growth in size and weight could be compared, taking into account a certain number of potentially confounding factors.

A comparison of the prevalence of delayed growth (Figure 3) shows that, for the raw values as well as for the adjusted values, there are highly significant differences between the three groups of children: it can be estimated that differences in consumption are responsible for these differences of prevalence to the order of 10% to 12% observed at the end of the school year.

The comparison of variations in children's weight during the Nutrimald SFP's 6-month operation

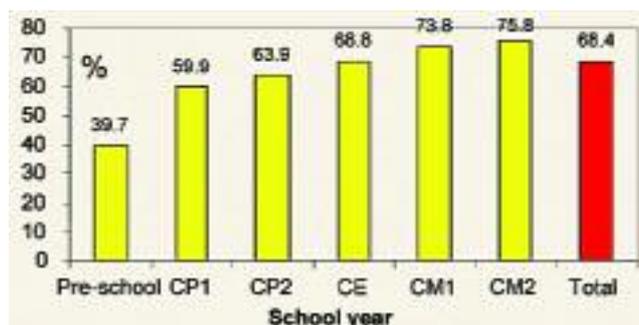


Figure 2. Variation of children's participation in the scheme as a function of their school year (CP–CM2 refers to primary school grades in French-speaking countries).

period shows that gruel consumption had a favorably significant effect on the children's weight (Figure 4): the children from group 3 gained 1.1 kg more than those from group 1. This effect was still significant after adjustment of all potentially confounding variables. Having taken these into account it can be estimated that, thanks to their greater consumption of gruel, the children from group 3 gained over 400 g more than group 1 children over 6 months.

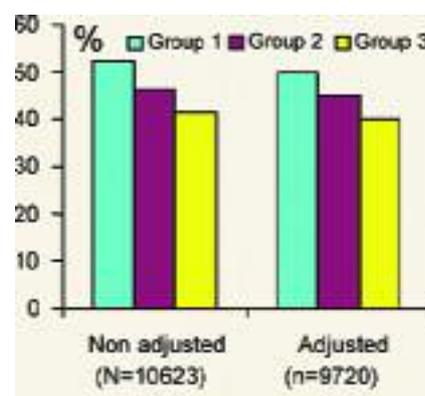


Figure 3. Effects of gruel consumption on the raw and adjusted* prevalence of delayed growth at the end of the school year. Groups according to gruel consumption: 1) less than 20%; 2) 20% to 40%; 3) over 40%.

* Adjusted by logistical regression for indicator variables of characteristics of the school, characteristics of the class (number of children, school year), of the participation level of teachers, of the children's family group (index of possessions, number of siblings, amount of pocket money given them by their parents) and of children's characteristics (age, gender, number of days of absence, academic underachievement).

Improved nutrition knowledge and awareness

The average marks obtained from nutrition knowledge tests taken before and after the Nutrimad SFP's 6-month operation period are given in Figure 5. For all the school years there was a significant improvement of nutrition knowledge during the year, although this improvement is apparently greater in years CP2, CP1 and CE than in CM1 and CM2.

The statistical analyses led to the identification of certain factors influencing the variations in pupils' nutrition knowledge throughout the school year. The most important of these, taking into account the essential role played by the communication of messages, was the teachers' motivation.

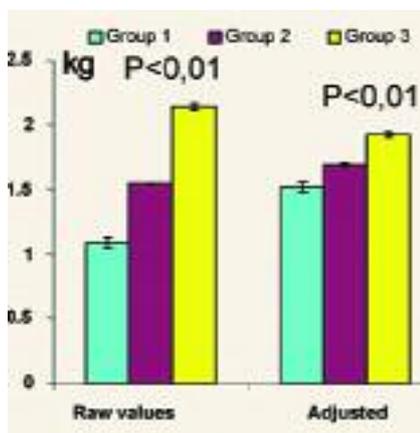


Figure 4. Effects of gruel consumption on differences in weight, raw or adjusted*, between the beginning and end of the Nutrimad SFP's 6-month operation period. Groups according to gruel consumption: 1) less than 20%; 2) 20% to 40%; 3) over 40%.

*Adjusted by analysis of covariance for indicator variables of the characteristics of the school, characteristics of the class (number of children, school year), characteristics of the teachers, of the children's family group (index of possessions, number of siblings, amount of pocket money given them by their parents) and of children's characteristics at the start of the year (age, size, Size/age and Weight/age Z-scores)

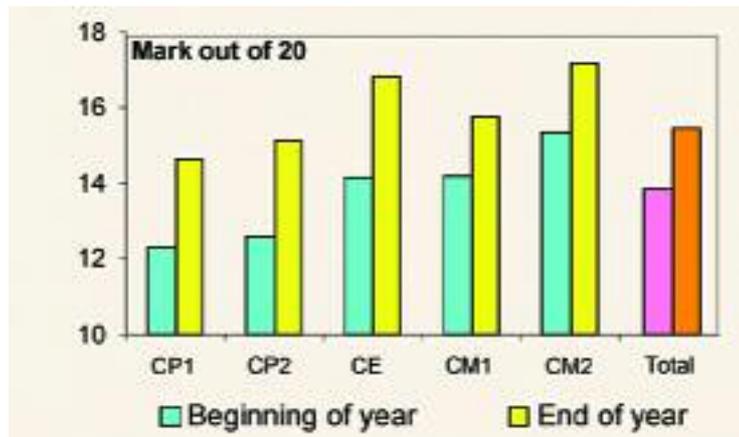


Figure 5. Comparison of average marks obtained by children in nutrition knowledge tests at the beginning and end of the school year (CP-CM2 refers to primary school grades in French-speaking countries).

Impact on school performance

An assessment of the effect of snack consumption on school performance of the total number of pupils from the 15 schools was based on the decision made at the end of the year as to whether they should graduate to the next class, and on the marks they obtained at the end-of-year exams.

The children from group 3 were over 10% more likely to be allowed to graduate to the next class than those from group 1 (81% vs. 71%). Moreover, they were 6% less likely than group 1

to obtain below average marks at the end-of-year exams (27.1% vs. 33.2%). If we adjust, using logistical regression, the percentage scores of children allowed to graduate to the next class for potentially confounding variables, the differences between the groups still remain significant (72.6%, 75.6% and 82.5% for children from groups 1, 2 and 3 respectively; $p < 0.0001$). It can therefore be estimated that the differences in consumption between groups 1 and 3 helped to reduce the number of children having to repeat their school year by about a third.

The average marks obtained at the end-of-year exams by pupils from the three groups are given in Figure 6.



Prior to adjustment, there is only a slight gap between the marks obtained by children from group 3 and those of children from the other groups (from 0.10 to 0.15/10). After adjustment, however, the gaps are larger and the improvement in marks attributable to regular consumption of the snacks can be estimated to within 0.4 points over 10.

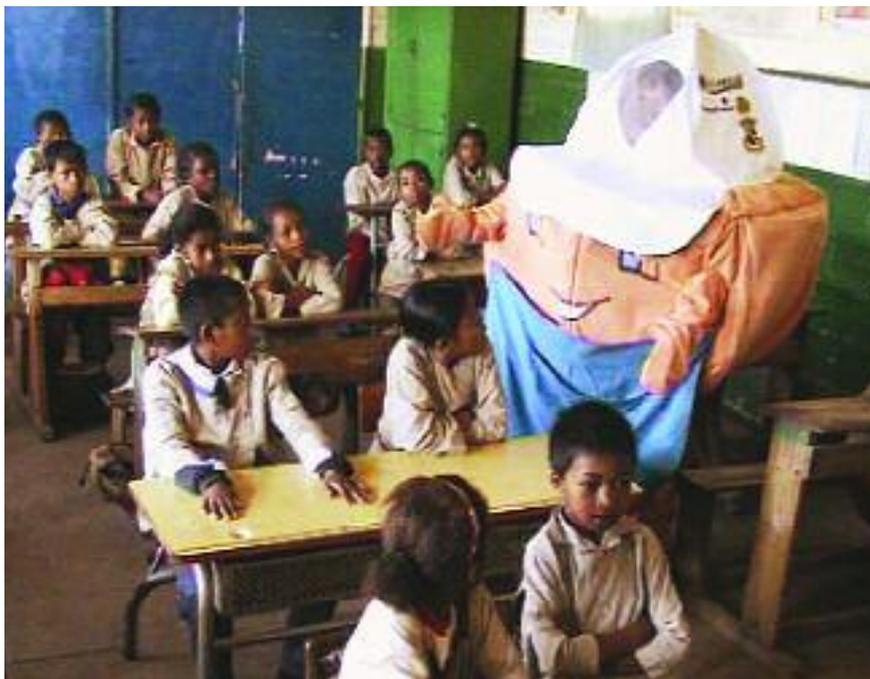
It appears, then, that the implementation of the Nutrimad SFP and the high rate of participation

by the pupils have considerably improved their school performance.

Conclusion

The follow-up and evaluation of the Nutrimad SFP during the 2004 – 2005 school year has essentially allowed us to highlight the poor nutritional status of children and to establish, or highlight, the adequacy of the type of snack provided:

- over the 110 days of the program, the children took 68% of opportunities offered them to eat the gruel;
- each portion consumed covered 16% to 22% of their energy requirements and 75% of their requirements of the main micronutrients;
- the snacks did not take the place of regular meals.



Furthermore, at the end of the year the most regular consumers had, in comparison with the

others, a better nutritional status (40% vs. 50% delayed growth), were less likely to have to repeat their school year (20% vs. 30%), and did better at the end-of-year exams.

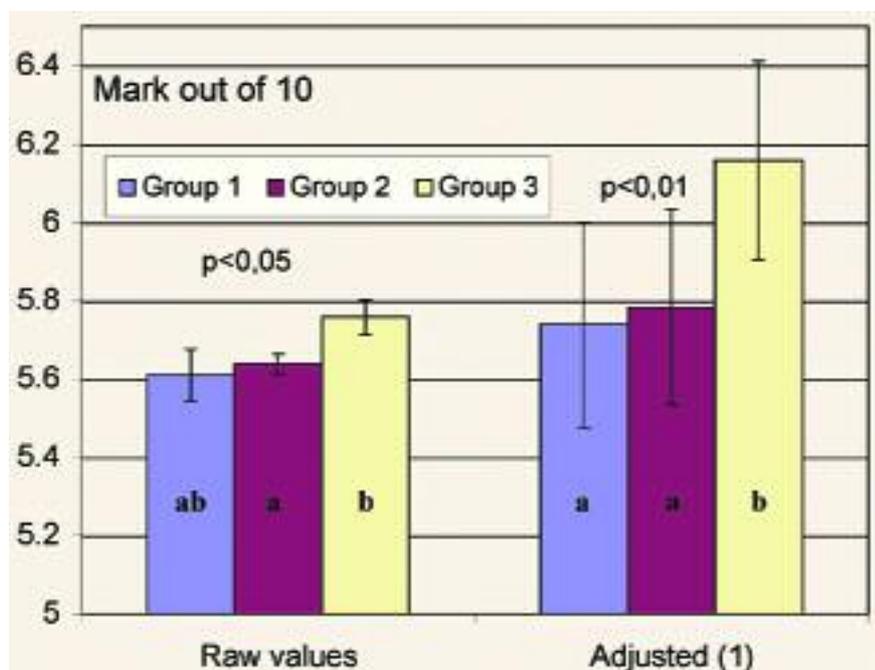


Figure 6. Effects of gruel consumption on average marks, raw and adjusted, obtained by pupils at the end-of-year exams (averages not accompanied by identical letters differ to the level of significance indicated). Groups according to gruel consumption: 1) less than 20%; 2) 20% to 40%; 3) over 40%.

(1) Adjusted for indicator variables of the characteristics of the school, characteristics of the class (number of children, school year), characteristics of the teachers (absenteeism, mark given by monitors of participation in the scheme), of the children's family group (index of possessions, parents' level of education), and characteristics of the children (gender, age, Size/age Z-score at the start of the year).

These very encouraging results are currently undergoing confirmation in the 2005 – 2006 period at the same schools. The integration of 8 control schools into the evaluation process should allow us to highlight not only the effect of snack consumption and nutrition education on the children's nutritional status and school performance, but also the effectiveness of the present strategy within the context of the education system concerned.

References

1. Laillou A, de Sesmaisons A, Ralison R et al. (2005). Distributing fortified and high-energy density gruel to reduce the failure rate and improve nutritional status of Antananarivo schoolchildren. SIGHT AND LIFE Newsletter 2: 22–26.