

The Impact of Famine on the Cognitive Abilities of School-Aged Children and Their Academic Performance, Affecting the Socio-Economic Development of the Androy Region

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Abstract— This article explores the impact of malnutrition, a recurring and alarming reality in the regions of Androy, Anosy, and Atsimo-Andrefana (UN, 2021). This phenomenon, exacerbated by climate change, desertification, endemic poverty, and the lack of adequate infrastructure, has major repercussions on the population (UNICEF, 2021). School-aged children are the most affected. This scourge undermines their physical, cognitive, and educational development, directly threatening their learning abilities and compromising their future (WFP, 2021a). Consequently, this situation constitutes a major barrier to the development of the southern regions of Madagascar. The central issue of this study is to determine how pupils' nutritional status affects their cognitive abilities and academic performance. This article seeks to demonstrate that famine, or *kere*, has a significant impact on students' cognitive functions and school performance, thereby constituting an obstacle to the socio-economic development process of these regions. Following field investigations conducted in 2023 in Ambovombe and Bekily—areas most affected by famine—quantitative and qualitative analyses of the collected data were combined within a hypothetico-deductive approach. The results indicate that malnourished children perform worse than their healthy peers. Their concentration and memory no longer function normally. According to findings from interviews with teachers, 80% of malnourished children experience hunger during class, compared to 20% of healthy children. Moreover, the impact of hunger on concentration reaches 72% among malnourished children, compared to 15% among children in normal nutritional condition. This study therefore advocates for a combined nutrition-education approach to effectively promote access to quality education, a major indicator of development.

Keywords— *Kéré*, cognition, academic performance, socio-economic development, Androy.

I. INTRODUCTION

Famine, locally known as “*kere*,” constitutes a recurring crisis in southern Madagascar, particularly in the regions of Androy, Anosy, and Atsimo-Andrefana (UN, 2021). Exacerbated by climate change, desertification, structural poverty, and inadequate infrastructure, it profoundly affects local communities (UNICEF, 2021). According to the UN (2023), more than two million people in the south and southeast of the country are experiencing acute food insecurity, nearly half a million of whom suffer from acute malnutrition.

School-aged children are among the most affected: chronic malnutrition compromises their physical and cognitive development, threatening their learning abilities and educational future (WFP, 2021a). Numerous international studies establish a direct link between food security and academic achievement. Kirolos et al. (2022) show that improved nutrition enhances cognitive abilities and academic performance, while Pizzol et al. (2021) emphasize that normal cognitive development depends on access to safe and healthy food.

Grantham-McGregor et al. (2007) demonstrate that childhood malnutrition leads to long-lasting cognitive deficits, affecting attention, memory, and information processing speed, which result in academic difficulties and an increased risk of grade repetition. In the African context, Mwene-Batu et al. (2020) confirm that severe malnutrition during childhood reduces human capital in adulthood in educational, cognitive, and behavioral terms.

In Madagascar, although several institutional reports have documented the nutritional status of children (WFP, 2021; UNICEF, 2022; UN, 2023), the specific impact of famine on cognitive abilities and academic performance, particularly in the Androy region, remains insufficiently explored. Existing research primarily focuses on physical growth and health. Furthermore, studies on school feeding programs (Fiadanana, 2009; Rakotonirainy, Razakamanana, and Ramiandrisoa, 2024) highlight positive effects on school attendance and engagement, without thoroughly analyzing the underlying cognitive mechanisms.

This study stands out for its analysis of the cognitive abilities and academic performance of students living in a famine context in the Androy region. Cognitive functions, defined as the mental operations involved in the acquisition and processing of knowledge—particularly perception, memory, attention, language, and decision-making—constitute a central component of learning (Kiely, 2014). Academic performance, for its part, refers to the level of achievement attained by a student at a given time (Hotyat, 1973). It may be global or partial depending on whether it concerns all subjects or a specific discipline (Seme, 2002), and is reflected in results that may be considered satisfactory or unsatisfactory (Bawa, 2022).

The research aims to fill a scientific gap by establishing a precise link between nutritional status, cognitive functions, and academic achievement. Through a comparative approach between malnourished children and those with normal nutritional status, it seeks to provide an empirical contribution to understanding the effects of famine on education. Conducted within a context of persistent food insecurity, the study analyzes the interactions between famine, cognitive development, and academic success among students living in a situation of Kere in the Androy region. It highlights the fundamental role of nutrition in improving learning outcomes and contributes to reflection on the achievement of Sustainable Development Goal 4 related to quality education for all (UNESCO, 2015).

To this end, the study pursues three objectives. The first is to determine the impact of famine on students' cognitive functions, particularly attention, memory, and reasoning, which are essential prerequisites for school learning. The second is to understand the impact of famine on academic performance through a comparative analysis of the academic results of malnourished students and those with normal nutritional status. The third objective is to analyze the consequences of famine on the socio-economic development of households and students' future prospects, by examining how the lack of school-based competencies limits access to stable employment and pushes some young people toward precarious or informal activities.

Based on these objectives, the research relies on the following hypothesis: Kere affects students' cognitive functions and academic performance, as well as socio-economic development. This hypothesis will guide the entire empirical analysis and will make it possible to assess, in light of the collected data, the extent to which famine undermines the quality and equity of education as well as socio-economic well-being in southern Madagascar.

II. MATERIALS AND METHODS

1.1 Study Area and Target Population

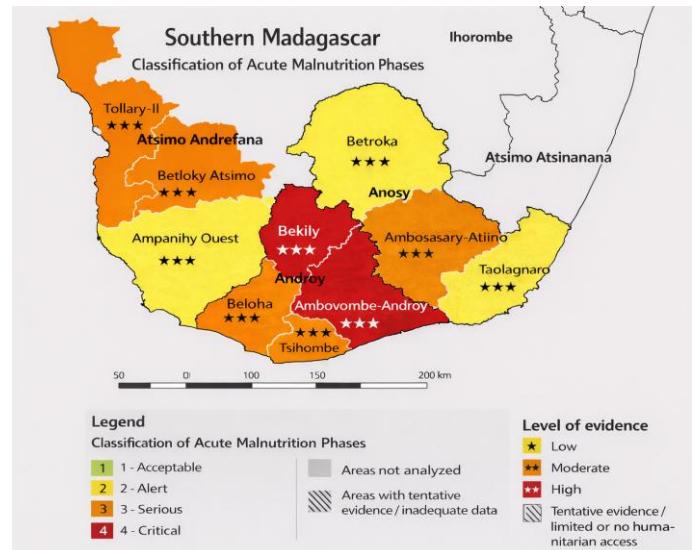
The study was conducted in the Androy region, located in southern Madagascar, a region particularly affected by recurrent famine. The target population consists of students aged 6 to 17 years, enrolled in schools located in areas affected by malnutrition and famine, mainly within the Androy region. The sample is composed of students suffering from malnutrition, students with a history of malnutrition, and healthy students serving as a control group.

The districts of the Androy Region consist on average of 13 communes, with a maximum of 19 communes in each of the districts of Ambovombe-Androy and Bekily. Regarding fokontany (the smallest administrative units), each district has an average of 357 fokontany. The district of Ambovombe has a record number of 792 fokontany, followed by Bekily with 279, Beloha with 200, and Tsihombe with 158 (INSTAT, 2018).

Our study area includes both Public Primary Schools (EPP – École Primaire Publique) and community schools. Among them are Public Primary School (EPP) Ambovombe, EPP Antaola, EPP Ampatalefo, EPP Tsimolofo, and EPP Bemena. The sample also includes several community schools such as Ankilitsimamo Community School, Antainakanga Community School, and Mahahevy Community School.

1.2 Methodological Approach

This research is based on a hypothetico-deductive approach, which consists of formulating—on the basis of theoretical frameworks and previous studies—hypotheses regarding the effects of famine on the cognitive abilities and academic performance of schoolchildren in the Androy region, and then testing their validity using empirical data collected in the field. This approach relies on the combined use of quantitative and qualitative data, allowing for an in-depth and complementary analysis of the phenomenon under study.



Source : UNICEF 2021

The qualitative approach, through the administration of structured questionnaires to teachers and educational administrators, aims to gather their perceptions of the effects of hunger on children's attention, memory, motivation, and academic performance. These stakeholders, who are in direct and daily contact with students, constitute key witnesses to the impact of Kere on learning processes.

The quantitative approach, for its part, seeks to objectively measure the extent of the differences between children affected by famine and those with normal nutritional status. It makes it possible to quantify disparities through specific indicators such as the malnutrition rate, average cognitive scores, and academic results. This numerical dimension enables the empirical validation of field observations and strengthens the reliability of the conclusions.

Finally, participant observation or direct classroom observation was conducted to collect qualitative data on students' behaviors in real learning conditions. Students were classified into two groups and seated side by side in two rows according to their nutritional status, determined using the anthropometric Body Mass Index-for-age (BMI-for-age), based on weight and height measurements taken in the field.

By placing the two groups of students side by side in two rows according to their nutritional status, the observer was able to directly compare their attitudes and reactions to the same pedagogical stimuli (lessons, exercises, interactions with the teacher). The observation aimed to identify physical and

cognitive signs associated with malnutrition, such as fatigue, slow reflexes, lack of participation, or difficulty concentrating on school tasks.

1.3 Population and Sampling

A stratified sampling method was applied, based on two criteria:

These students were selected in order to study the relationship between their nutritional status and their academic performance. The sample includes three groups :

Malnourished children group : consisting of students showing signs of malnutrition, as well as those with a history of malnutrition. Nutritional status was determined using the anthropometric Body Mass Index-for-age (BMI-for-age), based on weight and height measurements taken in the field. The thresholds defined by the WHO (2006) were used to identify affected children.

Control group : composed of students with normal nutritional status, in order to compare their academic results and cognitive performance with those of malnourished children.

Adolescent and youth group : comprising adolescents and young adults who were affected by “Kere” during their schooling. This group was included to analyze the long-term consequences of famine on educational trajectories, school completion profiles, professional integration, and socio-economic development.

Stratification according to the level of malnutrition made it possible to highlight the specific links between children’s nutritional status and their cognitive abilities. Care was taken to ensure that the two main groups were similar in terms of age, gender, grade level, and other social factors.

Furthermore, the selected schools also differ according to whether or not they have a school canteen, thereby allowing an assessment of the impact of school feeding on students’ learning and concentration. This classification makes it possible to analyze the differentiated effects of famine on schooling and children’s cognitive performance.

Sample size and composition : A total of 200 enrolled children were selected from 6 schools (3 in each zone), distributed as follows: 50 malnourished children and 50 children with normal nutritional status in severely affected areas. 50 malnourished children and 50 children with normal nutritional status in less affected areas.

1.4 Data Collection

Quantitative Data :

The quantitative data collected in this study include anthropometric measurements, cognitive performance, and students’ academic performance.

Anthropometric measurements, including children’s weight and height, were taken in order to calculate their Body Mass Index (BMI) and assess their nutritional status. This method was also used by the National Office of Nutrition (ONN) in its surveys on nutritional status and retrospective mortality in three districts of Madagascar: Tsihombe and Beloha in the Androy region, and Ampanihy in the Atsimo-Andrefana region (ONN, 2018).

Cognitive performance was measured using questionnaires that generated numerical data suitable for statistical analysis.

Standardized observation allowed for the coding and quantification of behaviors related to malnutrition, including attention, concentration, drowsiness, absenteeism, and non-participation. Focus group discussions also provided quantifiable data on children’s lived experiences, such as the frequency of hunger days or the impact of hunger on completing school homework.

Finally, academic performance was assessed using school records, particularly scores obtained in mathematics and French, as well as attendance rates over the past two years. These data, collected from teachers and school administrations, were based on a methodology inspired by the CONFEMEN Programme for the Analysis of Education Systems (PASEC) (CONFEMEN, 2019). This approach makes it possible to examine students’ academic performance and establish a link between their nutritional status and their school results.

Qualitative Data :

Qualitative data were collected through questionnaires, interviews, field observations, and focus group discussions.

Questionnaires were administered to children, teachers, and parents to gather information on nutritional status, eating habits, the quality and quantity of meals, academic performance, and living conditions. Semi-structured interviews were then conducted to further explore specific aspects and collect more detailed testimonies.

In addition, direct classroom observations were carried out using a participant observation method. The objective of these observations was to collect qualitative data on students’ behavior in their natural learning environment. They made it possible to identify physical and cognitive signs associated with malnutrition, such as fatigue, slow reflexes, lack of participation, or difficulty concentrating on school tasks. Observations were conducted during several 60-minute class sessions, with students’ behaviors recorded using a standardized observation grid. Students were classified into two groups and seated side by side in two rows according to their nutritional status, determined using the anthropometric BMI-for-age index (based on weight and height measured in the field).

By placing the two groups of students side by side in two rows according to their nutritional status, the observer was able to directly compare their attitudes and reactions to the same pedagogical stimuli (lessons, exercises, interactions with the teacher). This approach enhances the reliability, rigor, and usability of the study. It allows for a more rigorous and objective observation, as well as both the quantification and qualification of the impact of malnutrition on cognition, academic performance, and classroom behavior.

Finally, focus group discussions were organized with the children to explore their personal experiences related to hunger and schooling, thereby providing a more comprehensive understanding of how malnutrition influences their educational trajectories.

1.5 Data Analysis

Les données collectées sont analysées selon deux approches :

- Quantitative Analysis : Responses to closed-ended questions (Likert scales) are analyzed using descriptive

statistics to determine the means and standard deviations of scores for the different cognitive functions and academic performance indicators according to students' nutritional status.

The collected data are analyzed using descriptive statistics to calculate the means and standard deviations for each cognitive variable based on students' nutritional status. Anthropometric data were compared with WHO standards to identify cases of malnutrition.

To analyze data from direct or participant observation conducted in the field, the following procedures were applied : coding and classification of observations, and comparative analysis of the two groups.

- **Qualitative Analysis:** Open-ended questionnaire responses (comments from teachers and administrators, as well as students' perceptions) are analyzed through thematic coding to identify emerging trends and relationships regarding the impact of malnutrition on students' cognitive functions and academic performance.

The collected data are processed using Excel in the form of tables and charts.

III. RESULTS

A. The impact of famine on students' cognitive functions.

The results were obtained from questionnaires administered to 100 students (50 malnourished and 50 in good health), interviews with 30 teachers, and direct participant classroom observations in the Androy region. The questionnaires focused on hunger in class, concentration, memory, motor skills, and behavior. The direct observations made it possible to complement and confirm the information provided by the students and teachers. The responses were analyzed in percentages to compare malnourished and healthy children and to cross-check the findings with the teachers' observations.

TABLE 1: Classroom Concentration and Attention According to Nutritional Status.

Indicator (%)	Malnourished Children (n=50)	Control Group (n=50)	Teachers (n=30)	Difference (%)
Hunger during lessons (%)	80	20	70	60
Decreased concentration related to hunger (%)	72	15	50	57

Information on concentration and hunger in the classroom was obtained by directly asking the children about their feelings of hunger during lessons and the perceived impact on their attention, supplemented by teachers' observations.

The data show that 80% of malnourished children experience hunger during lessons, compared to 20% of healthy children, representing a 60-point difference. The impact of hunger on concentration is 72% among malnourished children, compared to 15% among healthy children (a 57-point difference). Teachers confirm these observations, with 70% reporting hunger and 50% noting a decrease in concentration.

These results indicate a significant difference between the groups regarding classroom concentration.

TABLE 2: Memory and Lesson Retention According to Nutritional Status

Indicator (%)	Malnourished Children (n=50)	Control Group (n=50)	Teachers (n=30)
Difficulty retaining lessons (%)	60	10	50
Difficulty memorizing lessons (%)	50	10	40

Memory difficulties were assessed through targeted questions on the ability to retain and reproduce lessons, and were corroborated by teachers based on their classroom experience.

60% of malnourished children have difficulty retaining lessons, compared to 10% of healthy children (a 50-point difference). Difficulty in memorizing lessons is moderate to high in 50% of malnourished children, compared to 10% of healthy children (a 40-point difference). Teachers observe similar trends (40–50%). These results show a significant relationship between nutritional status and memory capacity.

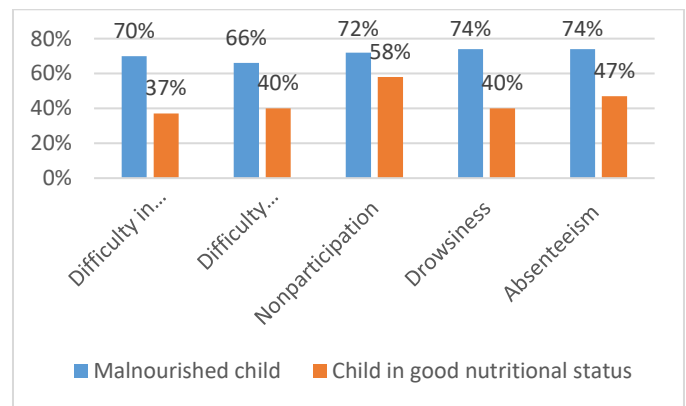


Figure 1: Results from Direct or Participant Observation of Students' Classroom Behavior According to Their Nutritional Status.

The results show a clear correlation between nutritional status and cognitive difficulties in the classroom (attention, concentration, drowsiness). Malnourished children display significantly higher rates of difficulty in maintaining attention (70% vs. 37%), concentration (66% vs. 40%), drowsiness (74% vs. 40%), and absenteeism (74% vs. 47%). Non-participation is also higher among malnourished children (72%) than among children with good nutritional status (58%), contrary to the previous data.

TABLE 3: Later Cognitive Functions of Students Who Experienced Famine in Early Childhood (0 to 5 Years)

Group	Sample Size (n)	Number of Children with Cognitive Disorders (n)	Percentage (%)
Children who experienced famine	25	19	72 %
Children who did not experience famine	25	7	28 %
Total	50	25	50 %

Cognitive functions were assessed through questionnaires, classroom observations, and focus group discussions, allowing for the measurement of the impact of famine in early childhood on cognitive disorders.

Among children who experienced famine in early childhood, 72% present cognitive disorders. Among children who did not experience famine, only 28% have cognitive disorders. Overall, 50% of the children in the sample present cognitive disorders, but a clear difference is observed depending on exposure to famine. This table highlights a significant link between famine in early childhood and subsequent cognitive disorders among students.

B. The impact of famine on academic performance.

The results presented below make it possible to assess the impact of famine (“Kere”) and malnutrition on students’ academic performance. They are drawn from the analysis of mathematics and French grade records, repetition rates, as well as information collected from teachers and school administrations regarding student attendance and participation. These data, processed using a methodology inspired by PASEC, also make it possible to measure the effect of school canteens and to compare results according to the children’s nutritional status and the severity of famine in their area.

TABLE 4: Results Obtained Illustrating the Impact of Famine on Students’ Academic Performance in Mathematics and French, According to Their Nutritional Status and the Severity of Famine in Their Area

Areas	Nutritional Status	Average Score in Mathematics	Average Score in French
Severely affected areas	Malnourished	35/100	40/100
	Normal	53/100	51/100
Non-affected areas	Malnourished	47/100	44/100
	Normal	64/100	60/100

The data show significant differences in average scores between malnourished children and those with normal nutritional status, and this difference is more pronounced in areas severely affected by famine. In severely affected areas, malnourished children display markedly lower scores (35/100 in Mathematics and 40/100 in French) compared to children with normal nutritional status (53/100 in Mathematics and 51/100 in French). In areas not affected by famine, malnourished children also show clearly lower scores (47/100 in Mathematics and 44/100 in French) compared to children with normal nutritional status (64/100 in Mathematics and 60/100 in French).

TABLE 5: Results of the Study on the Impact of School Canteens on Students’ Academic Performance, with a Comparison of Mathematics and French Scores Between the Two Groups (Students with Access to School Canteens and Students Without Access)

Student Group	Number of Students	Average Score in Mathematics	Average Score in French
Students with school canteen access	50	52/100	46/100
Students without school canteen access	50	44/100	38/100

Students benefiting from the school canteen obtained an average score of 52/100 in Mathematics, compared to 44/100 for those without access to the canteen. Students with access to the school canteen also achieved a higher average in French, scoring 46/100 compared to 38/100 for those without access. *Kere and the Deterioration of Socio-Economic Development Indicators.*

TABLE 6: Distribution of Activities Undertaken According to the Educational Level of the Former Students Surveyed (in %)

Level of Education Attained	Domestic Work / Cattle Herding	Precarious Informal Activities (Laborer, Small Trade)	Illicit Activities (Theft, Delinquency)	Skilled or Stable Employment	Total
No schooling	42,3	31,5	18,2	8,0	100
Incomplete primary	35,6	37,8	14,1	12,5	100
Completed primary	22,4	41,3	9,6	26,7	100
Incomplete secondary	11,8	39,2	5,4	43,6	100
Completed secondary and above	4,5	21,7	1,3	72,5	100

The results indicate that a large proportion of individuals with little or no education engage in low economic value activities, such as domestic work (42.3% among those with no schooling) and precarious informal activities (up to 41.3% for those with completed primary education). Illicit activities remain at a relatively low level (up to 18.2%), while access to stable or skilled employment remains very limited (from 8.0% to 26.7% before completion of secondary education). This shows that the majority of the activities undertaken do not allow for the accumulation of human capital nor a substantial improvement in income, thereby limiting any positive effect on socio-economic development.

TABLE 7: Deterioration of Socio-Economic Development Indicators in Households Severely Affected by Kere

Development Dimension	Key Indicator	Value (%)
Economic Development	Households below the poverty line	88,4
	Long-term dependence on food aid	71,6
	Lack of stable income-generating activity	63,2
Sustainable Living Conditions	Adult unemployment rate	46,8
	Severe food insecurity	74,9
	Sustainable access to safe drinking water	38,5
	Highly precarious housing	67,8

Development Dimension	Key Indicator	Value (%)
Human Capital Development	Net school enrollment rate (6–14 years)	62,1
	School dropout rate	29,4
	Children suffering from chronic malnutrition	52,3
Développement social et territorial	Forced household migration	34,7

In the area affected by Kere, 88.4% of households live below the poverty line, 71.6% depend on food aid, and 63.2% have no stable income-generating activity, while adult unemployment reaches 46.8%. Regarding living conditions, 74.9% of households face severe food insecurity, only 38.5% have regular access to safe drinking water, and 67.8% live in precarious housing. In terms of human capital, 62.1% of children are enrolled in school, 29.4% drop out, and 52.3% suffer from chronic malnutrition. Finally, 34.7% of households have been forced to migrate at least once.

IV. DISCUSSION

a. *The Impact of Famine on Cognitive Function*

- *Scope of the Results*

The first series of results (Tables 1 and 2) clearly shows that malnutrition, particularly famine (“kere”), directly affects students’ cognitive functions, especially concentration, memory, and motor skills. The data indicate that 80% of malnourished children frequently feel hungry during class, and 70% of them experience difficulties concentrating, compared to only 20% of healthy children. These findings, confirmed by teachers’ observations, are consistent with the work of Grantham-McGregor et al. (2007), which demonstrates that early malnutrition leads to long-term cognitive deficits, as well as with Pizzol et al. (2021), who emphasize that normal cognitive development requires access to adequate and healthy nutrition. Furthermore, malnutrition also affects students’ behavior, particularly through apathy and slowness, phenomena that were likewise observed in our study.

The second set of results (Figure 1), derived from direct classroom observations of students’ behavior, confirms the trends identified in the initial findings. Malnourished children show a marked predisposition to difficulties in concentration, drowsiness, and absenteeism. It is noteworthy that non-participation is higher among malnourished children (72%) compared to healthy children (58%). This behavior can be interpreted as a direct consequence of fatigue and lack of motivation caused by malnutrition. These findings are consistent with several studies on malnutrition, which have demonstrated that nutritional deficiencies disrupt executive functions such as attention and participation (Fanjiang and Kleinman, 2007). Detailed observation of these behaviors therefore strengthens the study’s conclusions and supports the hypothesis that malnutrition negatively affects cognitive and behavioral performance in the classroom.

Similarly, Ernesto Pollitt (1984) emphasized that deficiencies in essential nutrients have a detrimental effect on children’s concentration and motivation, which is confirmed by

the higher rates of drowsiness and non-participation observed in our study. Other studies, such as Behrman et al. (2004), have also shown that malnutrition is a major factor contributing to school absenteeism. This is corroborated by our findings, where malnourished children exhibited an absenteeism rate of 74%, compared to 47% among well-nourished children.

The third result (Table 3) reveals a marked difference between children who experienced famine during early childhood and those who were not exposed: 72% of exposed children present cognitive disorders, compared to 28% of non-exposed children. These findings suggest that early malnutrition has long-lasting effects on brain development. These conclusions are consistent with Basch (2011), who states that nutrition has a profound impact on health and cognitive development throughout life. Similarly, Galler and Barrett (2001) demonstrate that malnutrition negatively affects cognitive and behavioral functioning during childhood and adolescence, even after controlling for socio-economic and family environmental factors.

The work of Barrett et al. (1982) further specifies that “higher cognitive processes” (such as object memory, verbal inferences, and conceptual identification) are strongly determined by nutritional history. Malnutrition is also associated with attention disorders, which impair essential learning abilities such as following instructions and maintaining persistence in effort. Regarding the critical period of exposure, Glewwe, Jacoby, and King (2001), using data from the Philippines, indicate that malnutrition during the second year of life may have a more negative impact than malnutrition during the first year, challenging the view that the first six months are the most decisive. This conclusion is supported by Georgiadis et al. (2016) and Crookston et al. (2013), who also highlight the persistent negative effects of early malnutrition on cognitive development.

- *Confirmation of the Hypothesis.*

The initial hypothesis, according to which malnutrition negatively affects children’s cognitive and academic abilities, is clearly confirmed by the results of this study. Direct observation and data on famine during early childhood highlight that malnourished students, or those who have experienced severe nutritional deprivation, face considerable cognitive difficulties. The findings regarding school canteen beneficiaries also support this hypothesis, showing that access to adequate nutrition can significantly improve students’ concentration, memory, and motivation. Moreover, children who experienced famine in early childhood display more pronounced cognitive disorders, thereby validating the idea of a correlation between early malnutrition and long-term impairment of cognitive abilities.

- *Limitations of the Results and Proposed Improvements*

One of the main limitations of this study lies in the comparison method between groups, which does not sufficiently account for social and economic factors that may influence the results. For instance, factors such as access to educational resources and students’ socio-economic status were not adequately considered, although they may also play an important role in the observed outcomes. In addition, although

a standardized observation grid was used, observer subjectivity may have influenced the interpretation of students' behaviors.

To overcome these limitations, it would be relevant to adopt a longitudinal approach in order to monitor the evolution of students' cognitive abilities over an extended period and to examine the long-term effects of malnutrition. Furthermore, a more detailed analysis of socio-economic and environmental factors would be necessary to better understand the various determinants of the observed cognitive disorders. A more in-depth examination of different types of malnutrition and their respective impacts on cognitive functions would also represent an important area for improvement. Finally, although teachers' observations were taken into account, involving a larger sample of observers—such as school psychologists or nutrition specialists—could further enrich our understanding of the effects of malnutrition on students.

b. The Impact of Famine on Students' Academic Performance.

- *Scope of the Results*

The first series of results (Table 4) reveals a direct link between malnutrition and decreased academic performance, particularly in mathematics and French. Malnourished children, especially those living in areas severely affected by famine, achieve significantly lower scores than children with normal nutritional status. These findings highlight that nutritional status has a substantial impact on students' academic success, which

can be explained by reduced cognitive abilities and increased fatigue associated with malnutrition. Moreover, these differences are particularly pronounced in the most famine-affected areas, emphasizing the importance of the social and economic environment in which children grow and learn.

The results of our study are consistent with those of Bhutta et al. (2013), who concluded that the impact of malnutrition on academic performance may vary depending on environmental and social factors. This may explain some of the differences observed in our findings according to the geographical areas studied (severely famine-affected areas versus non-affected areas). Numerous cross-sectional studies on children have also shown associations between stunting and poor school progress or low cognitive ability (Grantham-McGregor et al., 2007).

The second set of results (Table 5) indicates that access to a school canteen plays a protective role in academic performance. Students benefiting from this service achieve significantly higher scores in mathematics and French compared to those without access, confirming the importance of adequate nutrition in supporting learning.

These findings are consistent with those of Alladatin et al. (2022), who demonstrated the positive impact of school feeding programs on reading and mathematics performance at the primary level, as well as with Fiadanana (2009), who concluded that academic results in schools with canteens are markedly better than in schools without them. Overall, these studies, like ours, highlight that nutritional interventions significantly contribute to students' academic success.

- *Confirmation of the Hypothesis :*

The initial hypothesis of this study was that malnutrition and nutritional deficiencies caused by famine, as well as the lack of

access to food services such as school canteens, negatively affect students' academic performance. The results largely confirm this hypothesis, showing that malnourished students achieve lower scores in mathematics and French and exhibit higher repetition rates. Furthermore, access to a school canteen has a positive impact on academic performance, thereby reinforcing the idea that nutrition plays a key role in students' academic success.

- *Limites des résultats et suggestions*

Several limitations must be considered in this study. First, the sample of students may not be fully representative of the entire school population, which could affect the generalization of the results. Moreover, the method used to assess academic performance, based solely on mathematics and French tests, may not fully reflect the diversity of students' academic skills. Finally, the study does not take into account certain socio-economic factors that could interact with the impact of malnutrition (for example, family support, access to other educational resources, etc.).

To address these limitations, it would be relevant to expand the study sample and consider additional factors that may influence students' academic outcomes. It would also be valuable to diversify the tools used to measure academic performance by including a broader range of assessments (such as logic tests, behavioral evaluations, etc.) in order to obtain a more comprehensive picture of students' abilities.

c. Kere and the Deterioration of Socio-Economic Development Indicators.

- *Scope of the Results*

The results of Table 6 show that a low level of education significantly limits former students' economic opportunities. Those with no schooling or incomplete primary education are mainly engaged in low-value economic activities (domestic work and the informal sector), while access to stable or skilled employment remains very limited. In contrast, individuals who completed secondary education or higher predominantly access skilled jobs (72.5%). This indicates that Kere, by reducing schooling and human capital, hinders professional integration and socio-economic development.

These findings confirm the work of Brown et al. (2020) on the link between malnutrition, poor academic achievement, and difficulties in accessing stable employment, as well as that of Dossa and Miassi (2025), who highlight that food insecurity reinforces poverty. However, our study adds a new dimension by demonstrating that Kere influences not only academic success but also the type of economic activities former students are able to engage in. The differences observed compared to some other studies can be explained by the severity of the local context, as the areas examined in this study are particularly affected by famine.

The results of Table 7 show that households severely affected by Kere in Southern Madagascar experience profound socio-economic deterioration : high poverty levels (88.4%), dependence on food aid (71.6%), lack of stable employment (63.2%), and high adult unemployment (46.8%). Kere therefore goes beyond a food crisis and weakens the entire household economy, confirming the analyses of Narvaez and Eberle (2022) and Amnesty International (2021).

Living conditions are also highly precarious, with severe food insecurity (74.9%), limited access to safe drinking water (38.5%), and inadequate housing (67.8%), consistent with the findings of Ralaingita et al. (2022). Human capital is likewise affected, with high rates of chronic malnutrition (52.3%), school dropout (29.4%), and limited school enrollment (62.1%), confirming the link between hunger and learning difficulties highlighted by Narvaez and Eberle (2022). Finally, forced migration (34.7%) emerges as a survival strategy that increases social and economic instability, a phenomenon also observed by Ralaingita et al. (2022).

Overall, Kere leads to multidimensional deterioration poverty, unemployment, food insecurity, malnutrition, school dropout, and migration and this study provides precise quantification of its impact at the household level.

• *Confirmation of the Hypothesis :*

The results clearly show that Kere in Southern Madagascar affects both education and living conditions. Former students with little or no schooling mainly engage in low-paying jobs, such as domestic work (42.3%) or informal activities (up to 41.3%), while those who completed secondary education predominantly obtain stable and skilled employment (72.5%).

Households affected by famine face severe hardship : 88.4% live below the poverty line, 71.6% depend on food aid, 63.2% have no stable economic activity, 74.9% suffer from severe food insecurity, and 67.8% live in precarious housing. Malnutrition affects 52.3% of children, 29.4% drop out of school, and 34.7% of families have been forced to migrate due to food shortages. These figures confirm that Kere limits access to education, reduces opportunities for stable employment, and deteriorates the economic and social conditions of affected communities. The research hypothesis is therefore confirmed : famine is a major obstacle to socio-economic development and education in Southern Madagascar.

• *Limites des résultats et suggestions*

This study has some limitations. The sample covers only certain areas of Southern Madagascar, and some information comes from students' and families' responses, which may not be entirely accurate. In addition, the study does not follow children over several years, and some data on income or schooling could have been more precise.

To improve the results, it would be useful to expand the sample to other regions, combine questionnaires with standardized cognitive tests, conduct longitudinal follow-up of children over several years, and collect more detailed economic data. These measures would provide a better understanding of the impact of Kere on education and socio-economic development in affected communities.

V. CONCLUSION

In conclusion, this study has demonstrated the considerable impact of famine on children's cognitive abilities and academic performance in the Androy region, directly linked to their nutritional status. The findings highlight significant negative effects of malnutrition on key cognitive functions such as concentration, memory, and motor skills, with direct consequences for students' academic achievement. Malnourished children, particularly those from areas severely

affected by famine, were found to have significantly lower scores in mathematics and French compared to their well-nourished peers. Moreover, access to school canteens appears to have a positive impact, improving cognitive abilities and reducing repetition rates.

Beyond academic outcomes, this study also shows that Kere contributes to the deterioration of socio-economic development indicators by affecting household living conditions, human capital, and former students' employment opportunities.

The results therefore confirm the crucial role of nutrition in improving the quality of education, especially in famine-vulnerable areas. These conclusions align with the study's objective, which was to understand the impact of famine on children's cognitive function and academic performance. They also demonstrate that famine represents a major barrier to socio-economic development in affected communities, reinforcing poverty, food insecurity, and livelihood vulnerability. Nevertheless, several questions remain: How can nutritional interventions be adapted to maximize their impact on academic performance? Are there specific educational strategies that can support malnourished students beyond improving their nutritional status? These questions open important avenues for future research, particularly regarding the impact of school feeding programs and food policies on education.

A comprehensive approach combining nutritional, educational, and socio-economic measures therefore appears essential to ensure quality education and achieve SDG 4, especially in contexts of food crisis.

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