

Factors Associated with Hemoglobinemia After 12 Months of Lucky Iron Fich (LIF) Use in Women of Reproductive Age (FAR, 15-49 years) in the Tambacounda Health District in 2020 (Senegal)

Fatoumata Binetou Diongue

Institute of Health and Development (ISED),
Cheikh Anta Diop University of Dakar (UCAD), Senegal

Oumar Bassoum

Institute of Health and Development (ISED),
Cheikh Anta Diop University of Dakar (UCAD), Senegal

Amadou Ibra Diallo

Institute of Health and Development (ISED),
Cheikh Anta Diop University of Dakar (UCAD), Senegal

Fatou Camara

Catholic Relief Services (CRS), Senegal

Ndiacé Dangoura

Catholic Relief Services (CRS), Senegal

Séga Danfakha

Catholic Relief Services (CRS), Senegal

Mor Pene

Catholic Relief Services (CRS), Senegal

Adama Faye

Institute of Health and Development (ISED),
Cheikh Anta Diop University of Dakar (UCAD), Senegal

ABSTRACT

Introduction: Senegal is one of the countries where food insecurity and malnutrition are major development challenges, the aim was to determine the factors influencing the increase in hemoglobinemia after Lucky Iron Fich (LIF) use. **Methods:** The methodological approach was based on a longitudinal, descriptive and analytical study between the results of the baseline (2019) and 12-month (2020) surveys. The population consisted of women aged 15 to 49 years who were followed up since 2019. Multiple linear regression modeling was performed with an alpha risk of 5%. **Results:** Of the 428 anemic women followed up, 34.0% were no

longer anemic. The mean age was 28.4 years (+/-8.9). Almost half of the households (49.8%) lived in poverty. The mean hemoglobinemia was 10.1 (+/-2.3) g/dl, with values of 10.5 (+/-1.6 g/dl); 9.7 (+/-2.2 g/dl); 10.3 (+/-2.6 g/dl); and 9.8 (+/-2.5 g/dl) for the subgroups of LIF alone, LIF and livestock, LIF and farming, and no LIF at baseline. These means were statistically different from baseline in the response groups, except for the control group. The difference in hemoglobinemia was increased by 0.60 g/dl (p-value=0.04) with LIF and by 1.72 g/dl (p-value=0.02) with secondary education or higher. Conclusion: Lucky Iron Fish was effective in increasing hemoglobinemia after 12 months of use. It improved hemoglobinemia in FAR in the medium term.

Keywords: Lucky Iron Fich, Anemia, Hemoglobin, Senegal

INTRODUCTION

Iron deficiency is the most widespread nutritional disorder in the world and a public health problem in both developed and developing countries. Iron deficiency is the result of long-term iron imbalance. In its most severe stages, iron deficiency leads to anemia. Anemia is defined as a low concentration of hemoglobin in the blood. Hemoglobin levels indicative of anemia vary according to physiological status (e.g. age, gender) and have been defined by the World Health Organization (WHO) [1], for different population groups.

Anemia affects women's health and well-being, and increases the risk of adverse maternal and neonatal outcomes. It affects half a billion women of reproductive age worldwide. In 2011, 29% (496 million) of non-pregnant women and 38% (32.4 million) of pregnant women aged 15 - 49 were anemic. The prevalence of anemia is highest in South Asia, Central Africa, and West Africa. While the causes vary, it is estimated that half of all cases of anemia are due to iron deficiency [2].

In Senegal, the prevalence of anemia among women of reproductive age (FAR) in the southern and southeastern regions is 56% in the Kolda region and 51.7% in Kédougou according to a 2015 study by the integrated nutrition project in the Kolda and Kédougou regions (PINKK) [3]. Anemia is considered a public health problem when the prevalence of low hemoglobin concentrations exceeds 5% of the population. The severity of anemia as a public health problem is classified as mild (5.0 to 19.9%), moderate (20.0 to 39.9%) or severe (greater than or equal to 40%) depending on the prevalence of anemia [1]. Iron deficiency can have extra-hematological consequences, such as low birth weight, memory disorders (reduced attention, object recognition and coding in infants), low IQ in children, and reduced productivity in adults [4].

In 2012, the World Health Assembly, in Resolution WHA65.6, endorsed the Comprehensive Plan of Action on Maternal, Infant and Young Child Nutrition, which sets a series of six global nutrition targets to be achieved by 2025. The second of these targets is to reduce anemia in women of reproductive age by 50% [2].

Behavior change communication to encourage consumption of iron-rich foods could be a viable nutritional strategy to reduce the heavy burden of iron deficiency anemia in women [5]. UN agencies, the World Bank and academics have pointed out that agricultural policies and

programs can be made nutrition-sensitive by ensuring that they are designed to increase the availability, affordability and consumption of diverse, safe and nutritious foods [6].

WHO has developed guidelines for the prevention, control and treatment of anemia in women of childbearing age. Responses are needed to achieve the goal of reducing anemia in women of childbearing age by 50% by 2025. The overall objective of the study was to determine the factors influencing hemoglobinemia after LIF use in the Tambacounda health district.

MATERIALS AND METHODS

It was a longitudinal study with two measures, descriptive and analytical, with an evaluative "before and after" method between the results of the baseline survey (2019) and at 12 months (July 2020). It focussed on women of reproductive age (15 to 49 years). For anemia screening, the study included self-reported healthy, non-pregnant FAR not on medication or iron supplementation living in project beneficiary households. The survey instrument was administered to each FAR screened whose hemoglobinemia was less than 11 g/dl.

The sample size required to compare the four groups was calculated using the following Casagrande and Pike formula ($n = [2 \times P_{av} \times (1 - P_{av}) \times (Z_{\alpha} + Z_{\beta})^2] / \Delta^2$). With a prevalence of anemia in FARs of 26.5%, an α risk of 5%, a power of 80%, and a power of 5%, 5% to account for dropouts, loss to follow-up, and missing data, the FAR size was 120 in each comparison group, for a total of 480 FARs. This sample was divided into four groups according to the service package received: i) women from households receiving the LIF+farming package; ii) women from households receiving the LIF+livestock package; iii) women in the LIF group only at baseline; and women from households receiving the LIF package after the evaluation, at one year. A two-stage cluster survey was conducted. All eligible women in the household were screened until a case of anemia was found, and then the questionnaire was administered.

In women, anemia is defined as hemoglobinemia below 11g/dl (EDS-MICS 2010-2011) 7). Anemia levels are defined according to the following ranges (DeMeayer, 1989): i) severe anemia if hemoglobinemia < 7g/dl, moderate anemia if 7g/dl ≤ hemoglobinemia < 10g/dl, and mild anemia if 10g/dl ≤ hemoglobinemia < 11g/dl.

Data were collected by trained and screened interviewers, in face-to-face interviews with anemic FARs, using electronic questionnaires. Blood samples were collected in a discreet location, following the rules of asepsis for hemoglobinemia testing. The electronic questionnaire included the following information (women's hemoglobinemia, household diet, household nutrition practices, types of goods available in households, women's income-generating activities and household income, and household use and acceptability of the LIF product).

Data entry was automated using the tablets on which the questionnaire was deployed. Analysis was performed with Epi Info 7 and R 3.6.0 software.

Univariate analysis was used to determine mean and standard deviation for quantitative variables, and frequencies (absolute, relative) for qualitative variables.

Bivariate analysis was performed using the following statistical tests (Pearson's Chi², McNemar's Chi², Student's t-test, paired Student's t-test, Anova, Kruskal-Wallis, Pearson's correlation), after verification of the conditions under which each test was performed (independence, normality, homogeneity). An alpha risk of error of 5% was accepted. Multivariate analysis was performed using multiple linear regression to search for factors related to the difference in hemoglobin levels between the baseline and 12-month studies. Three models were created, each based on data from a response group (LIF alone, LIF+livestock, LIF+farming) versus a control group (no LIF). The adjustment was made on hemoglobinemia measured at baseline, individual characteristics, knowledge scores, good practices, economic well-being and household dietary diversity (SDAM), and finally on LIF use factors. Once the full model was built, a top-down, stepwise strategy was adopted. The models were compared two by two. The selection of the right model was based on the AIC comparison. The selected model was validated by verifying linearity, independence of the residuals, normality of the residuals and the lever effect.

The Household Dietary Diversity Score (HDDS) was obtained by counting the food groups consumed by a household or individual in the 24 hours prior to the interview [8]. 12 food groups were identified: cereals roots and tubers, vegetables, fruits, poultry meat, offal, eggs, fish and seafood, pulses/vegetables/nuts, milk and dairy products, oils and fats, sugar/honey and miscellaneous (coffee or tea condiments). For each food group, a rating of 1 was given if at least one food was consumed in that group (1=Yes) and 0 if no food was consumed (0=No), during the previous day or night, in the home. The HDDS value represented the cumulative score. The same procedure was used to calculate the property score. A rating of type 1 and type 2 goods resulted in a cumulative score. Then 5 classes corresponding to levels (quintiles) of economic well-being were created.

The protocol was approved by the Senegalese National Committee on Ethics and Health Research (CNERS) (Protocole SEN18/50). Written informed consent was requested and obtained from all study participants. No pressure was applied in case of refusal. Data were collected anonymously and confidentially. In fact, the data were stored on a tablet and then synchronized on a server to which access was limited to the manager. Once the database was shared, only the research team and the monitoring and evaluation manager had access to the data.

RESULTS

The study included 428 women with a 9.7% non-response rate. In fact, 6 refusals, 39 displacements and one death were noted in the cohort. Displacements were related to marriage, with women returning to the marital home, moving house, family ceremonies outside the village, work or preparing for the BFEM and baccalauréat exams.

Socio-Demographic Characteristics

The mean age of the women was 28.4 years, with a standard deviation of 8.9 years. This mean varied between 26 and 29 years in the subgroups. The means with their standard deviations were 26.8 (+/-8.2); 28.9 (+/-9.4); 29.4 (+/-9.3) and 28.5 (+/-8.3), respectively, for the subgroups (LIF only, LIF +livestock, LIF +farming and no LIF). These means were not statistically different, with a p-value=0.2 in the Kruskal-Wallis test. The mean age of women in

2019 (27.4 $\pm$ 9.3 years) and 2020 (28.4 $\pm$ 8.9 years) was not statistically different with $p=0.13$ in the paired Student's t-test (Table 1). The same results were found in each subgroup. Of the women, 36.4% lived in the commune of Missira and 25.2% in Koussanar. Women living in two communes (Dialocoto and Sinthiou Malème) accounted for 18.7% and 19.6% respectively. The percentage of educated women was 24.5%, with 21.0% at the primary level. Of the women, 93.5% were married, of which 26.70% were polygamous. Only 5.4% were single. In the subgroups (LIF only, LIF +farming, LIF +harvesting, and no LIF), the proportions of married women were 91.6%, 94.4%, 89.5%, and 99%, respectively. These proportions were statistically different between LIF alone/without LIF ($p=0.01$) and also between LIF alone/ LIF +farming (Fisher test, $p=0.008$) (Table 2).

Economic Well-Being Score

The mean economic well-being score was 2.8, with a standard deviation of 1.3. It ranged from 1 to 9. This score varied across subgroups. It was 2.8 ($\pm$ 1.1); 2.7 ($\pm$ 1.3); 3.4 ($\pm$ 1.6) and 2.5 ($\pm$ 0.8) for the following subgroups (LIF only, LIF +livestock, LIF +farming and no LIF). The mean score for the LIF +farming subgroup was statistically different from the other three subgroups. The Kruskal-Wallis test showed a p -value <0.001 . Therefore, we can conclude that there was a statistically significant difference between the mean scores of the control group and the LIF +farming group (Table 1).

Table 1: Distribution of women by age, socioeconomic well-being, hemoglobinemia, dietary intake and household dietary diversity score (HDS) and service packages offered

	Mean (+/- standard deviation)									
Service packages	LIF alone		LIF+Livestock		LIF+ farming		No LIF: DTC iron/folic acid		Total	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Age of women	25.9 (+/-8.5)	26.8 (+/-8.2)	28.8 (+/-9.3)	28.9 (+/-9.4)	27.9 (+/-10.2)	29.4 (+/-9.3)	27.1 (+/-9.0)	28.5 (+/-8.3)	27.4(+/-9.3)	28.4(+/-8.9)
Paired T.test value	0.71		0.89		0.36		0.09		0.13	
Economic well-being score	2.9 (+/-1.1)	2.8 (+/-) 1.1	2.7 (+/-1.1)	2.7 (+/-) 1.3	3.5 (+/-1.4)	3.4 (+/-1.6)	2.8 (+/-1.1)	2.5 (+/-) 0.8	3.0 (+/-1.3)	2.8 (+/-) 1.3
Hemoglobinemia (g/dl)	9.3 (+/-1.5)	10.5 (+/-1.6)	9.1 (+/-1.4)	9.7 (+/-2.2)	9.3 (+/-1.4)	10.3 (+/-2.6)	9.4 (+/-1.3)	9.8 (+/-2.5)	9.3 (+/-1.4)	10.1 (+/-2.3)
P-value of paired Student's t test for hemoglobinemia	<0.001		0.002		<0.001		0.09		<0.001	
Hemoglobinemia (Hb) difference in g/dl: Hb Final study - Hb baseline	1.1 +/-2.1 (0.7 - 1.5)		0.6 +/-2.1 (0.2 - 1.0)		0.7 +/-2.0 (0.3 - 1.1)		0.4 +/-2.5 (-0.1 - 0.9)		0.7 +/-2.2 (0.5 - 0.9)	
Number of meals per day	2.8 (+/-0.4)	2.9 (+/-0.4)	2.9 (+/-0.2)	2.9 (+/-0.6)	3.0 (+/-0.4)	2.9 (+/-0.4)	2.8 (+/-0.5)	2.8 (+/-0.4)	2.9 (+/-0.4)	2.9 (+/-0.5)
Household Food Diversity Score (HFDS)	4.0 (+/-1.5)	4.7 (+/-1.8)	4.2 (+/-1.5)	4.8 (+/-1.6)	4.4 (+/-1.4)	4.5 (+/-1.8)	4.5 (+/-1.3)	4.5 (+/-1.8)	4.3 (+/-1.4)	4.6 (+/-1.7)

Almost half of the households (49.8%) were in the bottom two quintiles of economic well-being, i.e., in poverty. The proportion of poor households was statistically different between the LIF-only and LIF +farming subgroups and the control subgroup without IF. Further analysis showed that the proportions of poor households did not differ within groups between the two studies, except for the control group, where the p -value of McNemar's test was 0.001. Pearson's Chi2 test p -values were $p=0.04$ and $p<0.001$, respectively. Almost one third of the households

(29.4%) had an average level of economic well-being. Only one-fifth or 89 households (20.8%) were in the top two quintiles of economic well-being (Table 2).

Table 2: Distribution of women by level of economic well-being, socio-demographic characteristics and service packages offered

Service package	Absolute (n) and relative (%) frequencies									
	LIF alone		LIF+Livestock		LIF+ farming		No LIF: DTC iron/folic acid		Total	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Level of economic well-being										
Quintile 1 and 2 (Lowest-Second)	50 (40.7)	52 (49.1)	59 (50.9)	60 (56.1)	50 (41.0)	40 (34.8)	44 (38.9)	61 (61)	203(42.9)	213(49.8)
Quintile 3 (Medium)	45 (36.6)	34 (32.1)	29 (25.0)	33 (30.8)	36 (29.5)	30 (26.1)	39 (34.5)	29 (29)	149(31.5)	126(29.4)
Quintile 4 (4) ième	13 (10.6)	9 (8.5)	5 (4.3)	7 (6.5)	18 (14.8)	21 (18.3)	15 (13.3)	6 (6)	51 (10.8)	43 (10.1)
Quintile 5 (Highest)	15 (12.2)	11 (10.4)	22 (19.0)	7 (6.5)	18 (14.8)	24 (20.9)	15 (13.3)	4 (4)	70 (14.8)	46 (10.7)
Commune										
Dialocoto	29 (23.6)	26 (24.5)	20 (17.2)	18 (16.8)	20 (16.4)	18 (15.7)	20 (17.7)	18 (18)	89 (18.8)	80 (18.7)
Koussanar	30 (24.4)	21 (19.8)	29 (25.0)	29 (27.1)	20 (16.4)	23 (20.0)	38 (33.6)	35 (35)	117(24.7)	108(25.2)
Missira	54 (43.9)	48 (45.3)	20 (17.2)	19 (17.8)	60 (49.2)	52 (45.2)	45 (39.8)	37 (37)	179(37.7)	156(36.4)
Sinthiou Malème	10 (8.1)	11 (10.4)	47 (40.5)	41 (38.3)	22 (18.0)	22 (19.1)	10 (8.8)	10 (10)	89 (18.8)	84 (19.6)
Women's level of education										
No	86 (69.9)	75 (70.8)	80 (69.0)	81 (75.7)	78 (63.9)	82 (71.3)	87 (77.0)	85 (85)	331(69.8)	323(75.5)
Primary	30 (24.4)	28 (26.4)	30 (25.9)	25 (23.4)	30 (24.6)	25 (21.7)	22 (19.5)	12 (12)	112(23.6)	90 (21.0)
Secondary	7 (5.7)	3 (2.8)	5 (4.3)	1 (0.9)	13 (10.7)	7 (6.1)	4 (3.5)	3 (3)	29 (6.1)	14 (3.3)
Superior	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.8)	1 (0.9)	0 (0.0)	0 (0)	1 (0.2)	1 (0.2)
Literate women										
Yes	12 (9.8)	10 (9.4)	20 (17.4)	10 (9.3)	23 (18.9)	14 (12.2)	18 (15.9)	9 (9)	73 (15.4)	43 (10.0)
No	111 (90.2)	96 (90.6)	95 (82.6)	97 (90.7)	99 (81.1)	101(87.8)	95 (84.1)	91 (91)	400(84.4)	385(90.0)
Marital status of women										
Monogamous bride	74 (60.2)	75 (70.8)	71 (61.2)	79 (73.8)	64 (52.5)	75 (65.2)	61 (54.0)	64 (64)	270(56.9)	293(68.5)
Polygamous bride	30 (24.4)	22 (20.8)	31 (26.7)	22 (20.6)	38 (31.1)	28 (24.3)	40 (35.4)	35 (35)	139(29.3)	107(25.0)
Single	17 (13.8)	8 (7.5)	13 (11.2)	6 (5.6)	14 (11.5)	8 (7.0)	12 (10.6)	1 (1)	56 (11.8)	23 (5.4)
Widow	1 (0.8)	1 (0.9)	0 (0.0)	0 (0.0)	5 (4.1)	4 (3.5)	0 (0.0)	0 (0)	6 (1.3)	5 (1.2)
Divorced	1 (0.8)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.8)	0 (0.0)	0 (0.0)	0 (0)	2 (0.4)	0 (0.0)

Hemoglobinemia

The mean hemoglobinemia of the women was 10.1 g/dl with a standard deviation of 2.3 g/dl after 12 months of response. These means were 10.5 (+/-1.6 g/dl), 9.7 (+/-2.2 g/dl), 10.3 (+/-2.6 g/dl), and 9.8 (+/-2.5 g/dl) for the LIF only, LIF +farming, LIF +farming, and no LIF subgroups, respectively. The anova yielded a p-value=0.05, indicating that none of the subgroup hemoglobinemia means differed from the others. These hemoglobinemia means from the 2019 (9.3 +/-1.4 g/dl) and 2020 (10.1 +/-2.3 g/dl) measurements were statistically different, the paired Student's t-test showed a p-value<0.001. The means in the response groups compared to the reference group were statistically different, with respective p-values of <0.001; 0.002 and <0.001 in the paired Student's t-test. In addition, there was a positive linear correlation between the baseline and final hemoglobinemia measurements. The Pearson correlation test yielded a p-value < 0.001 with a correlation coefficient of 0.27 (Table 1). The mean difference between hemoglobinemia measured in the final study and in the baseline, study was 1.1 +/-2.1 g/dl, 0.6 +/-2.1 g/dl, 0.7 +/-2.0 g/dl and 0.4 +/-2.5 g/dl, respectively, for the IF only, LIF +farming, LIF +farming and no LIF subgroups. These means were not statistically different, p-value=0.16 by anova test (Table 1). The proportion of women whose anemia was corrected was 34.0%. This proportion did not differ between the control group (36.4%) and the other groups (IF alone 37.7% - LIF +farming 27.1 - LIF +farming 34.8%). Among the women, 7.7% were in a stage of severe anemia. These proportions of severe anemia in the respective subgroups (LIF alone-3.8%, LIF +breeding-8.4% and LIF +farming-8.7%) were not statistically different from the proportion of severe anemia in the control group (under iron-folic acid-10.1%), (Table 3). Pearson's Chi2 gives the following corresponding p-values: 0.06; 0.34; 0.36.

Knowledge of the Signs of Anemia

Anemia was reported by 53.0% of the women. The proportions of women who thought they were anemic were 47.2%, 54.2%, 57.4%, and 53.0% in the LIF -only, LIF +livestock, LIF +farming, and no LIF groups, respectively. The proportions of women who knew the signs of anemia were Palmar pallor 32.0%, brittle nails 13.8%, dizziness 69.6%, headache 45.6%, and Tinnitus 5.1% (Table 3). More than half of the women were unaware of the symptoms of anemia, except for dizziness, which was recognized by about 70%.

Table 3: Distribution of women according to severity of anemia, knowledge of signs of anemia, knowledge of products to combat anemia and service packages offered.

Service package	Absolute (n) and relative frequencies: (%)									
	LIF only		LIF+Livestock		LIF+ farming		No LIF: DTC iron/folic acid		Total	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Status of women										
Non anemic	0 (0)	40 (37.7)	0 (0)	29 (27.1)	0 (0)	40 (34.8)	0 (0)	36 (36.4)	0 (0)	145 (34.0)
Mild anemia	55 (44.7)	29 (27.4)	39 (33.6)	17 (15.9)	52 (42.6)	26 (22.6)	54 (47.8)	19 (19.2)	200 (42.2)	91 (21.3)
Moderate anemia	57 (46.3)	33 (31.1)	69 (59.5)	52 (48.6)	59 (48.4)	39 (33.9)	51 (45.1)	34 (34.3)	236 (49.8)	158 (37.0)
Severe anemia	11 (8.9)	4 (3.8)	8 (6.9)	9 (8.4)	11 (9.0)	10 (8.7)	8 (7.1)	10 (10.1)	38 (8.0)	33 (7.7)
Current anemia										
Yes	92 (74.8)	50 (47.2)	89 (77.4)	58 (54.2)	101 (82.8)	66 (57.4)	80 (70.8)	53 (53.0)	362 (76.4)	227 (53.0)
No	31 (25.2)	56 (52.8)	26 (22.6)	49 (45.8)	21 (17.2)	49 (42.6)	33 (29.2)	47 (47.0)	111 (23.4)	201 (47.0)
Palmar pallor										
Yes	38 (30.9)	38 (35.8)	25 (21.7)	35 (32.7)	17 (13.9)	34 (29.6)	23 (20.4)	30 (30)	103 (21.8)	137 (32.0)
No	85 (69.1)	68 (64.2)	90 (78.3)	72 (67.3)	105 (86.1)	81 (70.4)	90 (79.6)	70 (70)	370 (78.2)	291 (68.0)
Brittle nails										
Yes	24 (19.5)	16 (15.1)	14 (12.2)	9 (8.4)	11 (9.0)	22 (19.1)	14 (12.4)	12 (12)	63 (13.3)	59 (13.8)
No	99 (80.5)	90 (84.9)	101(87.8)	98 (91.6)	111 (91.0)	93 (80.9)	99 (87.6)	88 (88)	410 (86.7)	369 (86.2)
Vertigo										
Yes	46 (37.4)	76 (71.7)	62 (53.9)	70 (65.4)	76 (62.3)	82 (71.3)	68 (60.2)	70 (70)	252(53.3)	298 (69.6)
No	77 (62.6)	30 (28.3)	53 (46.1)	37 (34.6)	46 (37.7)	33 (28.7)	45 (39.8)	30 (30)	221(46.7)	130 (30.4)
Headaches										
Yes	40 (32.5)	47 (44.3)	30 (26.1)	48 (44.9)	48 (39.3)	57 (49.6)	45 (39.8)	43 (43)	163 (34.5)	195 (45.6)
No	83 (67.5)	59 (55.7)	85 (73.9)	59 (55.1)	74 (60.7)	58 (50.4)	68 (60.2)	57 (57)	310 (65.5)	233 (54.4)
Tinnitus										
Yes	13 (10.6)	10 (9.4)	4 (3.5)	2 (1.9)	13 (10.7)	6 (5.2)	12 (10.6)	4 (4)	12 (10.6)	22 (5.1)
No	110(89.4)	96 (90.6)	111(96.5)	105(98.1)	109 (89.3)	109(94.8)	101 (89.4)	96 (96)	101 (89.4)	406 (94.9)
Iron-folic acid										
Yes	43 (35.0)	40 (37.7)	37 (32.2)	21 (19.6)	27 (22.1)	54 (47.0)	29 (25.7)	31 (31.0)	136 (28.7)	146 (34.1)
No	80 (65.0)	66 (62.3)	78 (67.8)	86 (80.4)	95 (77.9)	61 (53.0)	84 (74.3)	69 (69.0)	337 (71.3)	282 (65.9)
Vitamin A										
Yes	20 (16.3)	14 (13.2)	23 (20.0)	13 (12.1)	16 (13.1)	28 (24.3)	15 (13.3)	11 (11)	74 (15.6)	66 (15.4)
No	103(83.7)	92 (86.8)	92 (80.0)	94 (87.9)	106(86.9)	87 (75.7)	98 (86.7)	89 (89)	399 (84.4)	362 (84.6)
Micronutrients (Iron, vitamin A, Iodine, zinc, Magnesium, etc.)										
Yes	32 (26)	60 (56.6)	32 (27.8)	54 (50.5)	25 (20.5)	60 (52.2)	31 (27.4)	49 (49)	120 (25.4)	223 (52.1)
No	91 (74)	46 (43.4)	83 (72.2)	53 (49.5)	97 (79.5)	55 (47.8)	82 (72.6)	51 (51)	353 (74.6)	205 (47.9)

Knowledge of Products to Combat Anemia

Among the products used to combat anemia, the iron-folic acid combination was cited by 34.1%, vitamin A by 15.4% and micronutrients by 52.1%. About one-third of women were aware of the iron-folic acid combination for the treatment of iron-deficiency anemia. This treatment was known in proportions of 37.7% - 19.6% - 47.0% and 31.0% for the LIF only, LIF +Livestock, LIF +Mariculture and no LIF subgroups, respectively (Table 3). Women's level of knowledge of iron-folic acid anemia treatment changed between 2019 (28.7%) and 2020 (34.1%). McNemar's Chi2 showed a statistically significant difference (Chi2=89.3). The same was found for micronutrients (25.4% and 52.1%), Chi2=0.2.

Diet

The average number of meals eaten per day in the households was 2.9 meals, with a standard deviation of 0.5 and a coefficient of variation of 17.2%, indicating an average dispersion. This mean represented 2.9 (+/-0.4); 2.9 (+/-0.6); 2.9 (+/-0.4) and 2.8 (+/- 0.4) in the LIF -only, LIF +livestock, LIF +farming and no LIF subgroups respectively. The Kruskal-wallis test showed a p-value=0.28, meaning that none of the subgroup averages differed from the others. In the baseline study, however, the average number of meals in the LIF +farming subgroup differed from those in the LIF-only and non- LIF subgroups (p=0.002 Kruskal-wallis test) (Table I). However, the average number of meals eaten per day in households in 2019 (2.9 +/-0.4 meals) and 2020 (2.9 +/-0.5 meals) did not differ, p-value=0.77 in the paired Student's t-test. The proportion of households that complied with eating at least 3 meals a day was 86.7%, compared to 91.0% in 2019. There was a statistically significant difference between these two proportions, p (McNemar's Chi2) =0.02. These proportions were 91.5%, 82.2%, 87.8% and 85.0% in the respective groups (LIF only, LIF +livestock, LIF +farming and no LIF), but only the first two proportions were statistically different, p=0.02 in Pearson's Chi2 test (Table 4).

Accessibility of Food for Household Consumption

All households had access to cereals, roots and tubers, and almost half (52.2%) to legumes and nuts. About a quarter had access to dairy products (milk, yogurt, cheese) (27.3%) and vegetables rich in vitamin A (28.5%), while a third had access to fish (36.9%). The least accessible foods were meat products (15.0% of households), eggs (6.1%) and fruits rich in vitamin A (11.4%). The comparison showed a statistically significant difference in the proportions of households with access to vitamin A-rich vegetables in the different subgroups (LIF only -32.1%-, LIF +livestock -32.7%- and LIF +farming -32.2%-) compared to the control group (16.0%), with p-values around 0.003. However, access to meat and dairy products did not differ from the control group. There was also a positive trend in the availability of certain foods (legumes, meat products, fish, vitamin A-rich fruits and vitamin A-rich vegetables) for household consumption. On the other hand, access to dairy products decreased from 2019 to 2020. This was demonstrated by McNemar's Chi2 test, which showed highly significant differences (Table 4).

Table 4: Distribution of Women by Compliance with Eating at Least Three Meals a Day and Access to Food for Household Consumption and Service Packages Offered

Service packages	Absolute (n) and relative (%) frequencies									
	LIF alone		LIF+Livestock		LIF+ farming		No LIF: DTC iron/folic acid		Total	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
At least 3 meals a day										
Yes	106(86.2)	97 (91.5)	108(93.1)	88 (82.2)	116(95.1)	101(87.8)	100 (88.5)	85 (85.0)	430(91.0)	371(86.7)
No	17 (13.8)	9 (8.5)	7 (6.0)	19 (17.8)	6 (4.9)	14 (12.2)	13 (11.5)	15 (15.0)	43 (9.0)	57 (13.3)
Cereals, roots and tubers										
Yes	122(99.2)	106(100)	113(98.3)	107(100)	121(99.2)	115(100)	113(100)	100(100)	469(99.2)	428 (100)
No	1 (0.8)	0 (0)	2 (1.7)	0 (0)	1 (0.8)	0 (0)	0 (0)	0 (0)	4 (0.8)	0 (0)
Pulses and nuts										
Yes	55 (44.7)	67(63.2)	60 (52.2)	54(50.5)	80(65.6)	67 (58.3)	52 (46.0)	48 (48)	247(52.2)	236(55.1)
No	68 (55.3)	39(36.8)	55 (47.8)	53(49.5)	42(34.4)	48 (41.7)	61 (54.0)	52 (52)	226(47.8)	192(44.9)
Dairy products (milk, yogurt, cheese)										
Yes	41 (33.3)	31 (29.2)	44 (38.3)	23 (21.5)	31 (25.4)	34 (29.6)	32 (28.3)	29 (29)	148(31.3)	117(27.3)

No	82 (66.7)	75 (70.8)	71 (61.7)	84 (78.5)	91 (74.6)	81 (70.4)	81 (71.7)	71 (71)	325(68.7)	311(72.7)
Meat products										
Yes	16 (13)	17 (16.0)	11 (9.6)	19 (17.8)	16 (13.1)	14 (12.2)	14 (12.4)	14 (14.0)	57 (12.1)	64 (15.0)
No	107 (87)	89 (84.0)	104(90.4)	88 (82.2)	106(86.9)	101(87.8)	99 (87.6)	86 (86.0)	416(87.9)	364(85.0)
Fish										
Yes	44 (35.8)	41 (38.7)	39 (33.9)	40 (37.4)	50 (41.0)	47 (40.9)	32 (28.3)	30 (30.0)	165(34.9)	158(36.9)
No	79 (64.2)	65 (61.3)	76 (66.1)	67 (62.6)	72 (59.0)	68 (59.1)	81 (71.7)	70 (70.0)	308(65.1)	270(63.1)
Eggs										
Yes	12 (9.8)	4 (3.8)	1 (0.9)	11 (10.3)	10 (8.2)	9 (7.8)	6 (5.3)	2 (2.0)	29 (6.1)	26 (6.1)
No	111(90.2)	102(96.2)	114(99.1)	96 (89.7)	112(91.8)	106(92.2)	107(94.7)	98 (98.0)	444(93.9)	402(93.9)
Fruits rich in vitamin A										
Yes	18 (14.6)	13 (12.3)	13 (11.3)	11 (10.3)	10 (8.2)	11 (9.6)	10 (8.8)	14 (14)	51 (10.8)	49 (11.4)
No	105(85.4)	93 (87.7)	102(88.7)	96 (89.7)	112(91.8)	104(90.4)	103(91.2)	86 (86)	422(89.2)	379(88.6)
Vegetables rich in vitamin A										
Yes	25 (20.3)	34 (32.1)	15 (13.0)	35 (32.7)	22 (18.0)	37 (32.2)	11 (9.7)	16 (16.0)	73 (15.4)	122(28.5)
No	98 (79.7)	72 (67.9)	100(87.0)	72 (67.3)	100(82.0)	78 (67.8)	102(90.3)	84 (84.0)	400(84.6)	306(71.5)

Household Food Diversity

The average household dietary diversity score (SDAM) was 4.6 points, with a standard deviation of 1.7 points and a coefficient of variation of 36.9%, indicating a wide dispersion. In the subgroups (LIF only, LIF +livestock, LIF +farming and no LIF), this mean score was 4.7 (+/-1.8); 4.8 (+/-1.6); 4.5 (+/-1.8) and 4.5 (+/-1.8) respectively, and did not differ between them. The anova test gave a p-value=0.44. On average, households consumed 4 food groups. These mean scores were statistically different between 2019 (4.3 +/- 1.4 points) and 2020 (4.6 +/- 1.7 points), with p-value=0.02 in the paired Student's t-test (Table 1). The SDAM varied from 1 to 11 points. Nearly three quarters (70.9%) of households consumed at least 4 food groups.

Types of Generating Activities

22.0% of women were involved in income-generating activities. These included handicrafts (8.9%), cash crops (13.5%), petty trade/sales (0.2%) and domestic service (4.7%). None of the women had a salaried job (Table 5). Women involved in the sale of agricultural or livestock products for the local, regional or national market accounted for 17.8% and 5.8% respectively (Table 5). A proportion of 10.5% produced foodstuffs, 29.4% farmed and 9.6% raised livestock.

Monthly Income

A total of 86 out of 94 women with IGAs agreed to give their income. The average monthly income was estimated at 19860 CFA francs, with a maximum of 250000 CFA francs and a minimum of 500 CFA francs. A drop in income in the context of covid-19 was mentioned by 23.0% of the women, and was estimated at half the income for 2.8% of the women, less than half (3.7%) and more than half (17.1).

Table 5: Distribution of women according to income-generating activities and service packages offered

Service packages	Absolute and relative frequencies: n (%)									
	IF only		IF+Livestock		IF+ farming		No LIF: DTC iron/folic acid		Total	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Income-generating activities										
Yes	30 (24.4)	21 (19.8)	22 (19.1)	21 (19.6)	31 (25.4)	35 (30.4)	25 (22.1)	17 (17)	108(22.8)	94(22.0)
No	93 (75.6)	85 (80.2)	93 (80.9)	86 (80.4)	91 (74.6)	80 (69.6)	88 (77.9)	83 (83)	365(77.2)	334(78.0)
Craftsmanship										
Yes	1 (0.8)	10 (9.4)	0 (0)	10 (9.3)	0 (0)	15 (13.0)	0 (0)	3 (3)	1 (0.2)	38 (8.9)
No	122 (99.2)	96 (90.6)	115 (100)	97 (90.7)	122 (100)	100 (87.0)	113(100)	97 (97)	472(99.8)	390(91.1)
Cash crop										

Yes No	15 (12.2) 108 (87.8)	12 (11.3) 94 (88.7)	16 (13.9) 99 (86.1)	14 (13.1) 93 (86.9)	14 (11.5) 108 (88.5)	19 (16.5) 96 (83.5)	11 (9.7) 102 (90.3)	13 (13) 87 (87)	56 (11.8) 417 (88.2)	58 (13.5) 370 (86.5)
Small business/saleswoman Yes No	13 (10.6) 110 (89.4)	0 (0.0) 106 (100)	6 (5.2) 109 (94.8)	0 (0.0) 107 (100)	20 (16.4) 102 (83.6)	1 (0.9) 114 (99.1)	12 (10.6) 101 (89.4)	0 (0) 100 (100)	51 (10.8) 422 (89.2)	1 (0.2) 427 (99.8)
Domestic worker Yes No	0 (0) 123 (100)	0 (0.0) 106 (100)	0 (0) 115 (100)	0 (0.0) 107 (100)	0 (0) 122 (100)	2 (1.7) 113 (98.3)	0 (0) 113 (100)	0 (0) 100 (100)	0 (0.0) 473 (100)	2 (4.7) 426 (95.3)
Salaried employment Yes No	0 (0) 123 (100)	0 (0.0) 106 (100)	0 (0) 115 (100)	0 (0.0) 107 (100)	0 (0) 122 (100)	0 (0.0) 115 (100)	0 (0) 113 (100)	0 (0.0) 100 (100)	0 (0.0) 473 (100)	0 (0.0) 428 (100)
Sales of agricultural products for local, regional or national markets Yes No	37 (30.1) 86 (69.9)	15 (14.2) 91 (85.8)	27 (23.5) 88 (76.5)	22 (20.6) 85 (79.4)	35 (28.7) 87 (71.3)	27 (23.5) 88 (76.5)	26 (23.0) 87 (77.0)	12 (12) 88 (88)	125 (26.4) 348 (73.6)	76 (17.8) 352 (82.2)
Sales of livestock products for local, regional or national markets Yes No	6 (4.9) 117 (95.1)	4 (3.8) 102 (96.2)	5 (4.3) 110 (95.7)	7 (6.5) 100 (93.5)	6 (4.9) 116 (95.1)	8 (7) 107 (93)	5 (4.4) 108 (95.6)	6 (6) 94 (94)	22 (4.7) 451 (95.3)	25 (5.8) 403 (94.2)

Using Lucky Iron Fish

Household use of LIF since receipt was close to 90%. This product was consumed with the three main meals (breakfast, lunch and dinner) according to the households (table 6).

Table 6: Distribution of women according to LIF use and service packages offered

	Absolute (n) and relative (%) frequencies			
Service packages	LIF only	LIF+Livestock	LIF+ Vegetable farming	No LIF: DTC iron/folic acid
Knowledge of LIF Yes No	95 (89.6) 11 (10.4)	105 (98.1) 2 (1.9)	113 (98.3) 2 (1.7)	17 (17) 83 (83)
LIF availability Yes No Not specified	92 (86.8) 3 (2.8) 11 (10.4)	104 (97.2) 1 (0.9) 2 (1.9)	111 (96.5) 2 (1.7) 2 (1.7)	12 (12) 5 (5) 83 (83)
Using the LIF from the LIF reception Yes No Not specified	92 (86.8) 3 (2.8) 11 (10.4)	104 (97.2) 1 (0.9) 2 (1.9)	111 (96.5) 2 (1.7) 2 (1.7)	12 (12) 5 (5) 83 (83)
Using LIF for breakfast Yes No Not specified	37 (34.9) 46 (43.4) 23 (21.7)	67 (62.6) 31 (29.0) 9 (8.4)	39 (33.9) 48 (41.7) 28 (24.3)	1 (1) 10 (10) 89 (89)
LIF at lunchtime Yes No Not specified	81 (76.4) 2 (1.9) 23 (21.7)	97 (90.7) 1 (0.9) 9 (8.4)	86 (74.8) 1 (0.9) 28 (24.3)	10 (10) 1 (1) 10 (10)
Using LIF at dinner Yes No Not specified	63 (59.4) 20 (18.9) 23 (21.7)	78 (72.9) 20 (18.7) 9 (8.4)	59 (51.3) 28 (24.3) 28 (24.3)	4 (4) 7 (7) 89 (89)

Modelling Using Linear Regression:

Multivariate linear regression showed that the difference in hemoglobinemia between the 12-month and baseline assessments was increased by 0.60 g/dl by the LIF response alone (p-

value=0.04). Education at secondary or higher level also increased this difference by 1.72 g/dl (p-value=0.02). However, the study did not objectivate any effect of LIF interventions coupled with livestock rearing (p=0.78) or market gardening (p=0.36), (table 7).

Table 7: Factors associated with the difference in hemoglobinemia between baseline and 12 months after adjustment for baseline hemoglobinemia and baseline variables

Factors	LIF only/No IF		LIF+Livestock/No IF		LIF+farming/No LIF	
	Beta	P-value	Beta	P-value	Beta	Pvalue
Response	0.60	0.04*	0.08	0.78	0.27	0.36
Level of education (secondary-higher)	1.72	0.02*	0.63	0.43	-0.14	0.80
Baseline hemoglobinemia	-0.75	< 0.001	-0.46	< 0.001	-0.58	< 0.001
Good nutrition practice score	-0.22	0.06	0.06	0.60	-0.006	0.95
Food preparation method score	0.44	0.08	0.18	0.53	0.24	0.33

*: Significant, Simple linear regression: adjustment on baseline hemoglobinemia and other factors measured in Baseline.

DISCUSSION

A total of 428 women were surveyed. The mean household dietary diversity score (HDDS) was 4.6 $\pm$ 1.7 points. The proportions of women with signs of anemia were Palmar pallor 32.0%, brittle nails 13.8%, dizziness 69.6%, headache 45.6%, and tinnitus 5.1%. The mean hemoglobinemia in women was 10.1 ($\pm$ 2.3) g/dl. These means were 10.5 ($\pm$ 1.6) g/dl, 9.7 ($\pm$ 2.2) g/dl, 10.3 ($\pm$ 2.6) g/dl, and 9.8 ($\pm$ 2.5) g/dl for the LIF only, LIF +farming, LIF +farming, and no LIF subgroups, respectively. The mean difference in hemoglobinemia between the final study and baseline study was 1.1 $\pm$ 2.1 g/dl, 0.6 $\pm$ 2.1 g/dl, 0.7 $\pm$ 2.0 g/dl, and 0.4 $\pm$ 2.5 g/dl for the LIF only, LIF +farming, LIF +farming, and no LIF subgroups, respectively. These means were not statistically different, p-value=0.16 by anova test. The proportion of women whose anemia was corrected was 34.0%. The difference in hemoglobinemia between the 12-month and baseline assessments was increased by 0.60 g/dl by LIF response alone (p-value=0.04) and by 1.72 g/dl by high school education or higher (p-value=0.02). The mean age of the women in our study was 28.4 $\pm$ 8.9 years. An almost similar result was found by Adeboye TE et al [5] with a mean age of 28.5 $\pm$ 4.6 years for the unmarried pregnant women surveyed. We found a mean hemoglobinemia in women of 10.1 $\pm$ 2.3 g/dl. Elsewhere Adeboye TE et al [5] found an Hb concentration of 97.9 $\pm$ 12.9 g/L. For Wolmarans P et al [9] the mean Hb value was 13.06 ($\pm$ 1.16) g dl.

The proportion of women whose anemia was corrected was 34.0% in our study. In other words, 66.0% of the women were still anemic. This figure is supported by that of Adeboye TE et al [5] who found 83.8% of women to be iron deficient. Milman N et al. found the prevalence of iron deficiency and iron deficiency anemia in European women of reproductive age to be 10-32% and 2-5%, respectively, depending on the thresholds used. Iron supplementation provides sufficient iron reserves to maintain a pregnancy without iron supplementation [10]. According to Gupta PM et al, the prevalence of iron deficiency was 10.4% $\pm$ 0.5% and 16.3% $\pm$ 1.3% in non-pregnant and pregnant women, respectively. The prevalence of iron deficiency anemia in the United States was 5.0% $\pm$ 0.4% and 2.6% $\pm$ 0.7% in pregnant and non-pregnant women, respectively [11]. In our study, LIF response alone increased the difference in hemoglobinemia between the 12-month and baseline assessments by 0.60 g/dl (p-value=0.04), as did secondary or higher education by 1.72 g/dl (p-value=0.02). Adeboye TE et al in their analysis found the

multivariate model-adjusted OR and 95% CI for the probabilities of iron deficiency according to tertiles of energy-adjusted dietary iron intake were 1.00, 0.32 (0.05, 1.77), 0.07 (0.01, 0.36), $p < 0.0001$ adjusting for age, primigravida status and monthly income. Higher dietary iron intake was inversely associated with the likelihood of iron deficiency in pregnant women [5]. Iron intake is important and LIF provides an opportunity to meet the required iron intake. In this study, the signs of anemia reported by the women were palmar pallor, brittle nails, dizziness, headache, and Tinnitus. The authors Jarrah SS et al [12] reported approximately the same symptoms experienced by women in varying proportions, with over 50% reporting daily symptoms including dizziness, fatigue, depression, headaches, and loss of concentration and memory. Our study found an average household food diversity score (SDAM) of 4.6 +/-1.7 points. Approximately 70.9% of households consumed at least 4 food groups. In their study, Jarrah SS et al [12] found that most participants were able to identify iron-containing foods, but did not consume enough iron due to their dietary habits and financial situation [12]. The difference in hemoglobinemia was increased by 1.72 g/dl (p -value=0.02) by having a high school education or higher. Jarrah SS et al found no statistically significant differences in iron-related dietary practices as a function of education. Culturally sensitive research on the use of iron deficiency education principles, temporary supplementation, and adequate income for dietary modification and long-term iron supplementation to prevent iron deficiency is warranted [12]. LIF may also be used as an iron supplement. Our study has limitations, with 9.7% of non-respondents out of 474 women followed up. In fact, there were 6 cases of refusal, 39 displacements and one death in the monitored cohort. This was corrected from the outset, with 10% non-response included in the sample size calculation.

CONCLUSION

Evaluation of the effect of Lucky Iron Fish on hemoglobinemia after 12 months of use showed its effectiveness. Hemoglobin levels in women improved in the medium term. The product can therefore be considered suitable for iron supplementation in women of reproductive age.

References

1. Allen L, de Benoist B de B, Dary O, Hurrell R. Guidelines on food fortification with micronutrients. World Health Organization-Food and Agricultural Organization of the United Nations; 2006.
2. Organisation mondiale de la Santé (OMS). Cibles mondiales de nutrition 2025: Note d'orientation [Internet]. [cité 2 oct 2023]. Disponible sur: <https://www.who.int/fr/publications-detail/WHO-NMH-NHD-14.2>
3. TAL-DIA A. Rapport final: Projet Intégré de Nutrition dans les régions de Kolda et de Kédougou (PINKK) (Sénégal). Dakar, Institut de Santé et Développement; 2016.
4. Sohrabi F. Tip of the iceberg: Extra-haematological consequences of early iron deficiency. *J Glob Health* [Internet]. [cité 2 oct 2023];5(2):020304. Disponible sur: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4587592/>
5. Adeboye TE, Bodunde IO, Okekunle AP. Dietary iron intakes and odds of iron deficiency anaemia among pregnant women in Ifako-Ijaiye, Lagos, Nigeria: a cross-sectional study. *Pan Afr Med J*. 2022; 42:23.
6. Organisation mondiale de la Santé (OMS). Plan d'application exhaustif concernant la nutrition chez la mère, le nourrisson et le jeune enfant [Internet]. 2014. Disponible sur: https://iris.who.int/bitstream/handle/10665/130454/WHO_NMH_NHD_14.1_fre.pdf?sequence=1

7. Agence Nationale de la Statistique et de la Démographie (ANSD). Enquête Démographique et de Santé Continue (EDS-MICS 2010-2011). ICF International Rockville, Maryland, USA; 2011.
8. USAID. Score de Diversité alimentaire des Ménages (SDAM) pour la mesure de l'accès alimentaire des ménages: Guide d'indicateurs [Internet]. Food and Nutrition Technical Assistance (FANTA III); 2006. Disponible sur: https://www.fantaproject.org/sites/default/files/resources/HDDS_v2_French_2006_0.pdf
9. Wolmarans P, Dhansay MA, Mansvelt EPG, Laubscher JA, Benadé AJS. Iron status of South African women working in a fruit-packing factory. Public Health Nutr. août 2003;6(5):439-45.
10. Milman N, Taylor CL, Merkel J, Brannon PM. Iron status in pregnant women and women of reproductive age in Europe. Am J Clin Nutr. déc 2017;106(Suppl 6):1655S-1662S.
11. Gupta PM, Hamner HC, Suchdev PS, Flores-Ayala R, Mei Z. Iron status of toddlers, nonpregnant females, and pregnant females in the United States. Am J Clin Nutr. déc 2017;106(Suppl 6):1640S-1646S.
12. Jarrah SS, Halabi JO, Bond AE, Abegglen J. Iron deficiency anemia (IDA) perceptions and dietary iron intake among young women and pregnant women in Jordan. J Transcult Nurs. janv 2007;18(1):19-27.

Annexe: Approval document Ethics Committee

REPUBLIQUE DU SENEGAL
Un Peuple – Un But – Une Foi

MINISTRE DE LA SANTE
ET DE L'ACTION SOCIALE

CNERS
SENEGAL
Comité National d'Ethique
pour la Recherche en Santé

N° 0000119 MSAS/DPRS/CNERS

Dakar, le 19 DEC 2018

Le Coordonnateur

AVIS ETHIQUE ET SCIENTIFIQUE

Référence : Protocole SEN18/50 : « Une approche multifactorielle pour la lutte contre la malnutrition et l'anémie au Sénégal ».

Docteur,

J'accuse réception de vos réponses aux questions relatives au protocole en référence ci-dessus. A l'analyse, le Comité National d'Ethique pour la Recherche en Santé les trouve globalement satisfaisantes. En conséquence, le comité émet un avis éthique et scientifique favorable pour permettre la mise en œuvre dudit protocole.

Cet avis a une durée d'une année à compter de sa date de signature. Son renouvellement reste assujéti à la présentation d'un rapport d'étape permettant d'être informé sur le niveau de mise en œuvre de l'étude.

Je vous prie de croire, **Docteur**, à l'assurance de ma considération distinguée et de mes encouragements renouvelés.

Docteur Adama FAYE
Maître de Conférences Agrégé
Directeur des Etudes de l'ISED
Investigateur Principal de l'étude

COMITE NATIONAL D'ETHIQUE
POUR LA RECHERCHE EN SANTE
Le Secréariat

Ministère de la Santé et de l'Action Sociale : Direction de la Planification, de la Recherche et des Statistiques ; Division de la Recherche : tél 33 969 43 13 email : cnrs2008@live.fr N° Assurance du CNERS : ER000011613