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ASSESSMENT OF NUTRITIONAL STATUS AND HEMATOLOGIC PROFILE OF INMATES IN GRAND BASSAM PRISON (IVORY COAST)

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ABSTRACT

Our investigation is a cross-sectional study conducted to assess the nutritional status and the haematological profile of prisoners in Grand Bassam (Ivory Coast). This study involved 64 inmates and 56 people used as control. The results of the anthropometric examination revealed that 14.06 percent of the prisoners were malnourished and 9.37 percent were at the threshold of being malnourished. The haematological profile revealed neutropenia, lymphocytosis, thrombocytopenia, anaemia and macrocytosis in this population.

KEYWORDS: nutritional status, haematological profile, prison population, Grand Bassam.

INTRODUCTION

Malnutrition is a public health problem affecting two billion people, nearly a third of the world population.[1] It increases morbidity, worsens the prognosis of healthy volunteers and is the leading cause of acquired immune deficiency worldwide.[2] Its assessment is important for evaluating public health and also an indicator of a better standard of living.[3] Several studies have shown that any change in the nutritional status, disrupts the functioning of the immune system [4, 2] and particularly blood cells that play primary and essential roles in the maintaining of the structure and homeostatic functions of tissues.[5]

In Ivory Coast, works done on nutritional status just focused on sick persons and also children and women.[6, 7] Data on prison populations are not available, whereas according to the World Health Organization, malnutrition particularly affects people with low incomes,

with inadequate access to clean water and deprived of satisfactory health education such as prisoners.[8]

Our study was conducted to evaluate the nutritional status from anthropometric parameters and hematologic profile of inmates in the prison of Grand-Bassam (Ivory Coast).

SUBJECTS AND METHODS

1. Topics: In this study, 64 inmates out of 120 were chose. The choice was based on the holding period which is at least four months. 56 non incarcerated people were used as control. Inmates and people used as control were from both sexes, aged from 18 to 40 years old and were apparently healthy. All of them signed a consent form.

2. Methods

2.1. Data collection: Our investigation is a cross-sectional study in the prison population of Grand-Bassam. All the subjects were questioned about their eating habits and some of their anthropometric parameters were examined. This questioning and examination established, in the one hand, the diet of the study population, and the other, anthropometric data (height and weight). Nutritional status was assessed by measuring the size (T) coupled to the weight (P) for the calculation of the corpulence of Quetelet index or body mass index according to the formula BMI = P / T^2.[9, 10]

From each subject, blood is collected in tubes with anticoagulant (EDTA) by venepuncture in the elbow fasting morning. Blood collected was used for haematological parameters determination using a Coulter (Middrey BC-2800) by flow cytometry technique.

2.2. Statistical analysis

Results are expressed as mean associated with the mean standard error (SEM). The mean values and the proportions were compared using the student t-test and the comparison test of proportions (G test or test log Likelihood ratio) respectively with R.2.0.1 Windows version software.[11] Differences were considered statistically significant at $p<0.05$.

RESULTS

1. Diet of the prison population: Table 1 shows different proportions and frequencies of consumption of groups of food constituting the diet of the prison population. The most consumed food by inmates is starchy cassava with a frequency of 1.17 ± 0.52 times per week. Only 9.37% of the population receive, from outside, foods such as bananas. Concerning

cereals, rice and corn are eaten by all of the inmates in almost equal proportions (p = 0.82). However, corn is consumed on average of9.35 ± 2.00 times per week as porridge and «Kabato» while rice which is consumed only 3.15 ± 0.62 times per week. There is no significant difference in proportion and consumption frequency between vegetables (eggplant, okra, peanut and tomato). Fish is the food of animal origin most consumed by inmates (100%) and averaged 6.96 ± 0.25 times per week. Meat and eggs are consumed by the minority (6.25%) receiving them from outside.

Table 1: Proportions and frequency of consumption of different food groups constituting the diet of the prison population

Foods		Number (n) N= 64	Proportion (%)	P values	Frequency (/week)
Starchy	Cassava	64	100	$2.2.10^{-16}$ **(S)**	1.17 ± 0.52
	Banana	6	9.37		1.33 ± 0.51
Cereals	Rice	64	100	0.82 **(NS)**	3.15 ± 0.62
	Corn	62	96.87		9.35 ± 2.00
Vegetables	Eggplants	64	100	0.97 (NS)	2.20 ± 0.62
	Okra	60	93.75		2.81 ± 0.56
	peanut	61	95.31		2.14 ± 0.51
	Tomato	61	95.31		1.00 ± 0.00
Animal food	Fish	64	100	$2.2.10^{-16}$ **(S)**	6.96 ± 0.25
	Meat	4	6.25		1.25 ± 0.50
	Egg	2	3.12		5.5 ± 0.70

N: Total number of the population; n: Number observed for each food group; S: Statistically significant difference for p <0.05; NS: no statistically significant difference for p> 0.05.

2. Anthropometric characteristics and nutritional status of the studied population

Anthropometric parameters and nutritional status values of the prison population of Grand Bassam are presented in Table 2. These values are 66.10 ± 8.63 kg for the weight, 1.71 ± 0.06 m for the height and 22.44 ± 2.97 kg/m^2 for the Body Mass Index (BMI) in the prison population; For the control group, the weight, the height and the BMI are 66.12 ± 11.49 kg, 1.64 ± 0.08 and 24.35 ± m 3 91 kg/m^2 respectively.

Assessment of nutritional status from BMI revealed that there is no significant difference in proportion between people well-nourished in both groups of population. However, there is a very significant difference between the undernourished (p=0.0010) and overweight people (p=0.0004) in both populations. 14.06% of inmates are malnourished and 9.37% are at the threshold of risk of undernutrition against 1.78% and 5.35% respectively in the control

population. Concerning the weight, the control group people are heavier than (28.57%) those in the prison (7.81%). It's the same case for obesity.

Table 2: Anthropometric characteristics and nutritional status of two populations

	Prison population (N= 64)	Control population (N=56)	P values
Weight (kg)	66.10 ± 8.63	66.12 ± 11.49	0.9989 (NS)
Height (m)	1.71 ± 0.06	1.64 ± 0.08	0.4789 (NS)
BMI (kg/m^2)	22.44 ± 2.97	24.35 ± 3.91	0.6940 (NS)
	n (%)	**n (%)**	
BMI < 18,5 (Malnutrition)	9 (14.06)	1 (1.78)	0.0010 **(S)**
18.5 < BMI <20 (Threshold risk of malnutrition)	6 (9.37)	3 (5.35)	0.2917 (NS)
20 < BMI < 25 (Normal)	43 (67.18)	32 (57.14)	0.3676 (NS)
25 < BMI < 30 (overweight)	5 (7.81)	16 (28.57)	0.0004 **(S)**
BMI> 30 (Obesity)	1 (1.56)	4 (7.14)	0.048 **(S)**

BMI: Body Mass Index; N: Total number of the population; n: Number observed for each type of nutrition; S: Statistically significant difference for p <0.05; NS: no statistically significant difference for p> 0.05.

3. Haematological profile of the studied population

3.1. Average values of haematological parameters: Average values of haematological parameters determined in the two population groups are shown in Table 3. It reveals that Neutrophilis, Eosinophilis and Lymphocytes percentage are significantly higher in the prison population than those in the control population. As for the erythrocyte parameters, apart from red blood cells, all the other parameters are significantly different (p <0.05) from one population group to another with higher proportions in the inmates population. There is no difference in thrombocytes parameters between the two groups.

Table 3: Average values of haematological parameters in both populations

haematological parameters	Prison population N=64	Control population N=56	P values
Leukocytes (10^9/l)	6.18 ± 0.21	6.221 ± 0.19	0.87 (NS)
Neutrophilis (%)	41 ± 1.2	48 ± 1.2	0.0001 **(S)**
Eosinophilis (%)	1.2 ± 0.05	1.1 ± 0.03	0.0335 **(S)**
Monocytes (%)	5.94 ± 0.32	5.607 ± 0.20	0.3965 (NS)
Lymphocytes (%)	52 ± 1.1	46 ± 1.2	0.0003 **(S)**
Thrombocytes (10^9/l)	270 ± 8.6	280 ± 9.5	0.3025 (NS)
Erythrocyte (10^6/µl)	5.32 ± 0,06	5.30 ± 0.18	0.9155 (NS)
Hemoglobin (g/dl)	14 ± 0.15	13 ± 0.21	0.0002 **(S)**
Hematocrit (%)	47 ± 0.55	43 ± 0.63	0.0001 **(S)**

MCV (fl)	89 ± 0.83	84 ± 0.98	0.0004 **(S)**
MCH (pg)	26 ± 0.26	25 ± 0.34	0.0492 **(S)**
MCHC (g/dl)	29 ± 0.18	30 ± 0.21	0.0063 **(S)**

N: Total number of the population; MCV: mean corpuscular volume; MCH: mean corpuscular haemoglobin; MCHC: Mean corpuscular haemoglobin concentration; S: Statistically significant difference for p <0.05; NS: no statistically significant difference for p> 0.05.

3.2. Distribution proportions of haematological parameters: Table 4 shows the proportions of different haematological parameters in both prison and control populations. As for leukocyte and thrombocyte parameters, results indicate neutropenia, monocytopenia, monocytosis, lymphocytosis and thrombocytopenia significantly higher among prisoners than in controls. Normal levels of neutrophils and lymphocytes were significantly higher in controls. As for the red blood cell parameters, the proportion of inmates with polycythemia (7.81%) and low haemoglobin (25%) is significantly higher than the control population. Proportion of persons with low haematocrit level is significantly higher in control group than the inmates. On the other side, the high haematocrit proportion is higher among inmates (51.56%). Microcytosis is higher in controls (23.21%) compared to inmates who have a higher macrocytosis (14.06%). Within the two groups, the low rate of MCH and MCHC are high, with no significant difference between them.

Table 4: Proportion of haematological parameters in both populations

haematological Parameters	**Prison population N=64**	**Control population N=56**	**P values**
	n (%)	n (%)	
Leukocytes (10^9/l)			
Leukopenia	2 (3.12)	2 (3.57)	0.8175 (NS)
Normal	59 (92.18)	53 (94.64)	0.8572 (NS)
Leukocytosis	3 (4.68)	1 (1.78)	0.2454 (NS)
Neutrophilis (%)			
Neutropenia	42 (65.62)	22 (39.28)	0.0097 **(S)**
Normal	22 (34.37)	33 (58.92)	0.0105 **(S)**
Neutrophilia	0 (0)	1 (1.78)	0.1162 (NS)
Eosinophilis (%)			
Normal	64 (100)	56 (100)	1 (NS)
Eosinophilia	0 (0)	0 (0)	1 (NS)
Monocytes (%)			
Monocytopenia	2 (3.12)	0 (0)	0.0375 **(S)**
Normal	57 (89.06)	56 (100)	0.4261 (NS)
Monocytosis	5 (7.81)	0 (0)	0.0010 **(S)**

Lymphocytes (%)			
Lymphopenia	0 (0)	0 (0)	1 (NS)
Normal	29 (45.31)	40 (71.42)	0.0152 **(S)**
Lymphocytosis	35 (54.68)	16 (28.57)	0.0039 **(S)**
Thrombocytes (10^9/l)			
Thrombocytopenia	4 (6.25)	0 (0)	0.0032 **(S)**
Normal	58 (90.62)	52 (92.85)	0.8692 (NS)
Thrombocytosis	2 (3.12)	4 (7.14)	0.2034 (NS)
Erythrocyte (10^6/µl)			
low	0 (0)	0 (0)	1 (NS)
normal	59 (92.18)	55 (98.21)	0.6621 (NS)
High	5 (7.81)	1 (1.78)	0.0430 **(S)**
Hemoglobin (g/dl)			
low	16 (25)	7 (12.5)	0.03931 **(S)**
normal	48 (75)	49 (87.5)	0.3266 (NS)
high	0 (0)	0 (0)	1 (NS)
Hematocrit (%)			
normal	31 (48.43)	50 (89.28)	0,0004 **(S)**
high	33 (51.56)	3 (5.35)	$4.429.10^{-11}$**(S)**
MCV (fl)			
microcytosis	5 (7.81)	13 (23.21)	0.0047 **(S)**
Normal	50 (78.12)	42 (75)	0.801 (NS)
Macrocytosis	9 (14.06)	1 (1.78)	0.0010 **(S)**
MCH (pg)			
low	45 (70.31)	44 (78.57)	0.4983 (NS)
normal	19 (29.68)	12 (21.42)	0.2468 (NS)
high	0 (0)	0 (0)	1 (NS)
MCHC (g/dl)			
low	64 (100)	55 (98.21)	0.8988 (NS)
normal	0 (0)	1 (1.78)	0.1162 (NS)
high	0 (0)	0 (0)	1 (NS)

N: Total number of the population; n: Number observed for each parameter; MCV: mean corpuscular volume; MCH: mean corpuscular haemoglobin; MCHC: Mean corpuscular haemoglobin concentration; S: Statistically significant difference for p <0.05; NS: no statistically significant difference for p> 0.05.

DISCUSSION

Assessment of nutritional status revealed that 14.06% of inmates are malnourished and 9.35% of them are at the threshold of risk of malnutrition. The malnutrition rate found in this study is beyond the emergency threshold which is 10%, according to some authors.[12] This high prevalence is due to unbalanced diet for detainees. Indeed, the detainees had only breakfast (corn porridge) followed by one main meal a day. This diet does not provide nutritional content and daily calories intake required for weight maintenance and therefore good health,

because according to FAO,[13] an adult needs between 2000 to 2500 calories per day to maintain his health. In addition, many families abandon their relatives who are in prison, depriving extra food intake. In this study, only 9.37% of prisoners receive food from outside, but they have to share it; which does not allow them to eat the amount of food needed for a better nutritional status. Our results are similar to those conducted by Tchamba[14] in the Bunia prison (Democratic Republic of Congo) which showed 15.8% of global acute malnutrition and also 6.9% with severe malnutrition that have not been seen in our study. Other study, conducted in the Mahajanga prison (Antananarivo) showed that 28% of prisoners were affected by global malnutrition.[15] The significant difference of malnutrition between prison and control populations could be explained by quantitative and qualitative adequate diet for free-people; which may have been cause high prevalence of overweight and obesity among them.

The results of blood count showed alteration of haematological parameters during incarceration. Neutrophils values diminished sharply while lymphocytes increased, hence neutropenia and lymphocytosis observed in 65.62% and 54.68% of prisoners respectively. These quantitative abnormalities reflect the existence of infective and inflammatory syndromes. According to the national accreditation agency and Evaluation in Health (ANAES), neutropenia coupled with lymphocytosis could be due to infection.[16] But, further tests must be carried out to determine the cause of the infection. However, parasitic and allergic causes could be listed because of the eosinophils value which is significantly higher in prisoners group than controls and a possible viral cause translates thrombocytopenia observed in this study. An obvious cause could be described malnutrition in this population. Indeed, several studies relating nutrition and immunity, showed that malnutrition is accompanied by inflammatory processes, a protein intake (albumin) and an increased proliferation of T lymphocytes,[17, 18] which could explain lymphocytosis observed in this study. Our results are in line with those of some authors[19] which showed that ten times more infections in malnourished subjects than in normonutris.

Red blood cell parameters values were significantly higher among inmates. This result is explained by the difference in red blood cell and haemoglobin between male and female. Indeed, the prison population is composed of 96.87% men against 3.27% women, while the control group contains 53.57% men against 46.42% women. However, low haemoglobin (25%) and a high rate of MCV are observed among inmates. These results reflect anaemia

and macrocytosis respectively result from a disorder of iron metabolism that results in defective production of haemoglobin observed in iron deficiency and a lack of synthesis of genetic material mainly due to deficiency vitamin.[20] This explanation could justify anaemia described in the prison population under its diet without fruit, quantitatively and qualitatively deficient.

CONCLUSION

The results of this research work revealed a poor nutritional status of prisoners in Grand Bassam. In fact 14.06% of them are undernourished whereas only 1.78% of the control population is affected by malnutrition. The difference is probably due to the diet of inmates which is quantitatively and qualitatively insufficient to guarantee a good health.

The haematological profile revealed neutropenia, lymphocytosis, thrombocytopenia, anemia and macrocytosis. All these diseases are favoured by an already precarious nutritional status weakens and causes depression of immune system functions.

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