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Food and Nutritional Status of Tubercules Patients Followed at the Bingerville Anti-Tubercules Center

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Abstract Eating a balanced diet to maintain good nutritional status is of paramount interest for anyone who wants to facilitate their recovery in the event of the occurrence of an infectious pathology. The general objective of this study was to highlight the major role of a balanced diet in the management of infectious pathologies, in this case tuberculosis. To do this, a dietary survey was carried out among tuberculosis patients (58) followed at the Anti.Tuberculosis Center (CAT) of Bingerville and the Diagnostic and Treatment Centers (CDT) of Blockhauss and the Cocody University Hospital, from January to May 2022. The evolution of the nutritional status (body mass index (BMI), blood albumin level) of these patients were also monitored.The data obtained were analyzed using SPSS version 22 software at the 5% threshold. The results showed that most of the patients surveyed had an age between 30 and 45 years (44.8%), men and women accounted for 65.5% and 34.5% respectively and susceptible tuberculosis (88.48%). %) was the most common type of tuberculosis. Before the onset of the disease, 15.52% of patients were thin, 68.96% had a normal BMI and 15.52% were overweight or obese. Since the onset of the disease, variations in BMI were observed: 27.59% were thin, 62.07% had a normal BMI and 10.34% were overweight or obese. After two to three months of treatment associated with regular taking of medications and the consumption of foods useful for boosting the immune system (rich in proteins, iron, calcium, vitamins A, E and C), a large part of patients saw their BMI improve, that is to say go from lean to normal (13.79%) or stabilize at normal (60.34%). Also, malnourished patients (BMI ≤ 18.5 Kg/m2) at the start of treatment obtained a normal albumin level (35–50g/l) at the end of treatment. It is therefore important to eat well to promote a speedy recovery for tuberculosis patients under medical treatment.

Keywords: *Balanced diet, nutritional status, tuberculosis, body mass index, albumin*

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1. Introduction

To this day, tuberculosis remains a public health problem in many countries around the world [1]. In Côte d'Ivoire particularly, the number of cases detected increased from 7,446 in 1990 to 11,988 in 1995 to reach 17,242 in 2001, 24,047 in 2008 and 25,299 in 2013. Tuberculosis is an infectious and communicable disease, leading cause of death attributable to an infectious agent, ahead of HIV/AIDS before the advent of the COVID.19 pandemic [2]. According to this same WHO report, nearly a quarter of the world's population is infected by *Mycobacterium tuberculosis*, a pathogen responsible for tuberculosis which can be present in a latent state in the body without the infected person causes the disease: it is latent tuberculosis infection. In the event of a weakening of the immune system, the pathogen is reactivated. This favors the manifestation of the disease with common clinical signs such as fever, anorexia, weight loss, etc. The causes of the persistence and increase in the prevalence of this disease are multiple. We can cite malnutrition, immunosuppressive treatments, excess consumption of alcohol, tobacco, diabetes, renal failure, hepatocellular insufficiency, promiscuity [3]. Diet in particular plays a very important role both in the occurrence and in the management of tuberculosis. A good diet could play a preventive role by giving the individual good immunity but also a curative role by helping with their recovery. It is on the strength of this preponderant role that diet plays before and after the onset of illness that Hippocrates, (460.377 BC) the father of medicine said: « Let your diet be your best medicine! » [4]. He was the first to highlight

the importance and role of diet in health. This famous maxim still remains relevant because any individual who eats healthily maintains his body in good health and also protects it from so.called diseases of civilization as well as certain infectious diseases which develop preferentially in malnourished subjects, due to deficiencies nutritional [5, 6]. The benefit of a healthy, varied and balanced diet therefore takes on its full meaning if we want to be protected from diseases linked to malnutrition [7]. It is in this context that this present study was carried out with the general objective of highlighting the importance of diet and the nutritional status of populations in the prevention and management of tuberculosis. Specifically, food consumption and nutritional status of tuberculosis patients were assessed before and after tuberculosis diagnosis.

2. Material and Methods

2.1. Evolution of Patients' Food Consumption

2.1.1. Type and Period of Study

The frequency of food consumption of tuberculosis patients was assessed using a survey form. This is a retrospective and prospective study with a descriptive aim. This study was carried out over a period of five (5) months, from January 2 to May 31, 2022.

2.1.2. Study Site

Three (03) health centers constituted our study site. These are the Anti.Tuberculosis Center (CAT) of Bingerville, the Diagnostic and Treatment Center (CDT) of Blockhauss and the CDT of the Pneumo.Phtisiologe (PPH) of the Cocody University Hospital.

2.1.3. Study Population

All tuberculosis patients under treatment and attending the study site during the study period were included. Excluded from our study population were children with tuberculosis and anyone under treatment but who did not regularly obtain medication.

2.2. Nutritional Status of Patients

The nutritional status of the patients was determined from the calculation of their BMI (BMI = Weight (Kg)/[Height (m)]2 and the albumin dosage, carried out by the green spectrophotometric method. bromocresol with Abbott reagent kit on ALINITY C.

2.3. Statistical Analysis

SPSS version 22 software was used to process the data obtained, at the 5% threshold.

3. Results and Discussion

3.1. Results

3.1.1. Sociodemographic Characteristics of the Patients Surveyed

Table 1 presents the sociodemographic characteristics of the tuberculosis patients surveyed. The majority of patients surveyed were men (65.5%), had an age between 30 and 45 years (44.8%) and were under treatment for 6 months (84.5%). There were also women (34.5%) and people aged between 15 and 29 (37.9%) among these patients. Some other patients were also under other types of treatment, particularly those lasting 6 to 18 months (10.3%).

3.1.2. Standard of Living of Patients, Type of Tuberculosis and Treatment Monitoring

Table 2 presents the standard of living of the patients, the type of tuberculosis and treatment follow.up. A large number (81.03%) of patients had a standard of living described as "low" because they indicated having a monthly income of less than 250,000 FCFA, barely covering monthly expenses. There were also 13.7% having an average standard of living, 5.17% having a so.called "high" standard of living and 3.45% receiving a monthly income greater than 250,000 FCFA. Susceptible tuberculosis was the most common form (84.48%) among patients. During treatment, almost all patients took their anti.tuberculosis medications regularly (96.55%) and did not take food supplements (96.55%).

Table 1. Sociodemographic characteristics of the tuberculosis patients surveyed

	Gender		Age group (year)			Duration of the treatment		
	M	*F*	*15 – 29*	*30 – 45*	*46 years and over*	*6 month*	*9 month*	*6 à 18 month*
CAT Bingerville (n = 30)	80%	20 %	36,7 %	46,77%	16,7%	86,7%	10%	03,33 %
CDT of Blockhauss (n = 10)	70 %	30 %	60 %	40 %	0 %	100 %	0 %	0 %
CDT of the PPH of the Cocody University Hospital (n = 18)	38,9 %	61,1 %	27,8 %	44,4 %	27,8 %	72,2 %	0 %	27,8 %
Total (n = 58)	65,5 %	34,5 %	37,9 %	44,8 %	17,2 %	84,5 %	5,2 %	10,3 %

NB: CAT: Anti.tuberculosis Center; CDT: Diagnostic and Treatment Center; PPH: Pneumophthisiology.
M: Male; F: Feminine

Table 2. Standard of living of patients, type of tuberculosis and treatment monitoring

Supported site	Standard of living of patients			Type of tuberculosis			Treatment	
	Weak	*Average*	*Pupil*	*Type 1*	*Type 2*	*Type 3*	*regular intake of medication*	*taking of food supplements*
CAT of Bingerville (n = 30)	90 %	06,7 %	03,3 %	86,67 %	10 %	03,33 %	93,3 %	03,3 %
CDT of Blockhauss (n = 10)	40 %	40 %	20 %	100%	0 %	0 %	100 %	0 %
CDT of the PPH from Cocody University Hospital (n = 18)	88,9 %	11 %	0%	72,2 %	0 %	27,8 %	100 %	05,5 %
Total (n = 58)	81,03%	13,7 %	5,17 %	84,48 %	5,17 %	10,34 %	96,55 %	03,45 %

Type 1: S TB (susceptible tuberculosis), Type 2: MDR TB (multi.drug resistant tuberculosis), Type 3: PET (extra pulmonary tuberculosis). CAT: Anti.tuberculosis Center; CDT: Diagnostic and Treatment Center; PPH: Pneumophthisiology

Table 3. Frequency of consumption of specific foods by patients tuberculous

	Consumption frequency (%)		
	Regularly	***Often***	***Never***
Foods rich in protein			
Red meat	36,2	32,8	31,0
Offal	13,8	25,9	60,3
Tuna	25,9	53,4	20,7
Fish	65,5	24,1	10,3
Poultry	60,3	36,2	20,7
Soy	06,9	17,2	75,9
Pea	06,9	37,9	55,2
Foods rich in iron			
Butter	22,4	17,2	60,3
Oily fish	25,9	24,1	50,0
Vegetable oil	25,9	19,0	55,2
Dark green leafy vegetable	24,1	39,7	36,2
Foods rich in calcium			
Dairy products	34,5	19,0	46,6
Red meat	36,2	32,8	31,0
Fish	65,5	24,1	10,3
Offal	13,8	25,9	60,3
Dark green leafy vegetable	24,1	39,7	36,2
Foods rich in Vit A			
Lawyer	17,2	48,3	34,5
Vegetable oil rich in omega 3 and 6	25,9	19,0	55,2
Sardine	06,9	17,2	75,9
Foods rich in Vit E			
Seafood	05,2	27,6	67,2
Whole grains	13,8	25,9	60,3
Dairy products	34,5	19,0	46,6
Foods rich in Vit C			
Fruits	34,5	19,0 %	46,6 %

3.1.3. Nutrition of Tuberculosis Patients

3.1.3.1. Food Consumption Frequency of Tuberculosis Patients

Table 3 presents different types of foods consumed by the tuberculosis patients surveyed since the onset of the disease. Several types of specific foods, recommended to boost immunity and aid recovery, were regularly consumed by patients. There are, among others, foods rich in protein (red meat: 36.2%; fish: 65%; poultry; 60.3%, etc.), vitamin A (avocado: 17%; vegetable oils rich in omega 3 and omega 6: 25.9%), vitamin E (dairy products: 34.5%), vitamin C (fruits: 34.5%).

3.1.3.2. Beverages Consumed by Patients

Table 4 presents the different drinks consumed by the patients since the onset of tuberculosis disease. Water was the most consumed beverage (70.7%) followed by fruit juice (51.5%), milk and tea/coffee (15.5%). There was also a small proportion of patients who consumed alcoholic beverages (08.6%).

Table 4. Beverage consumed by the patients surveyed since the onset of the disease

Supported site	Consumption sufficient water	Other drinks consumed			
		Milk	*Juice*	*Tea/coffee*	*Alcoholic beverages*
CAT of Bingerville (n = 30)	83,3 %	23,3 %	50 %	10 %	03,3 %
CDT of Blockhauss (n = 10)	50 %	0 %	80 %	20 %	30 %
CDT of the PPH from Cocody University Hospital (n = 18)	61,1 %	11,1 %	44,44 %	16,7 %	05,6 %
Total (n = 58)	70,7 %	15,5 %	53,5 %	15,5 %	08,6%

NB : CAT: Anti.tuberculosis Center; CDT: Diagnostic and Treatment Center; PPH: Pneumophthisiology

Table 5. Evolution of the BMI of the patients surveyed

	Before the onset of the disease (%)			**After the onset of the disease (%)**			**Evolution (%)**		
	Skinny	*Normal*	*Overweight Obesity*	*Skinny*	*Normal*	*Overweight Obesity*	*Decrease*	*Stabilization*	*Increase*
CAT of Bingerville (n = 30)	20	66,7	13,3	23,3	73,3	03,3	16,7	80,0	03,3
CDT of Blockhauss (n = 10)	0	80	20	40	50	10	50	30	20
CDT of the PPH from Cocody University Hospital (n = 18)	16,7	66,7	16,7	27,8	50	22,2	27,8	44,4	27,8
Total (n = 58)	15,52	68,96	15,52	27,59	62,07	10,34	25,62	60,34	13,79

NB: Skinny: BMI < 18.5 Kg/m2; Normal: 18.5 Kg/m2 < BMI < 25 Kg/m2; Overweight: 25 Kg/m2 < BMI < 30 Kg/m2; Obesity: BMI > 30 Kg/m2; Decrease: going from a BMI (normal, overweight or obese) to a lower BMI (lean or normal); Stabilization: no variation in BMI over time, remaining either lean, normal, overweight or obese; Increase: going from one BMI to a higher BMI (from lean to normal or from normal to overweight or obese). NB CAT: Anti.tuberculosis Center; CDT: Diagnostic and Treatment Center; PPH: Pneumophthisiology.

3.1.4. Nutritional Status of Tuberculosis Patients

3.1.4.1. Evolution of Patients' BMI

Table 5 presents the evolution of the BMI of the patients surveyed. Before the onset of the disease, more than half of the patients (68.96%) had a normal BMI, 15.52% were thin and 15.52% were overweight or obese. After the onset of the disease, fewer patients (62.07%) had a normal BMI, more patients were thin (27.59%), and fewer patients were overweight or obese (10.34%). Generally speaking, 25.62% of patients saw their BMI drop, that is to say, they went from obesity to overweight, from overweight to a normal BMI. Also, 60.34% saw their BMI remain stable and only 13.79% had an increase in their BMI.

3.1.4.2. Evolution of the Nutritional Status of Patients

Table 6 presents the results of the blood albumin measurement of patients who were malnourished (BMI less than 18.5) at the start of their treatments. All of these patients had normal albumin levels, with a value between 39.8 and 47.3 g/L, after 2 to 5 months of treatment.

Table 6. Evolution of the nutritional status of patients

N° of the Patient	Processing time (month)	Albumin level (g/l)	Normal value
1	4	42,6	[35 – 55 g/l]
2	3	39,8	
3	5	40,1	
4	4	46,6	
5	4	47,3	
6	3	40,8	
7	2	40,2	
8	3	39,8	
9	4	47,3	

3.2. Discussion

To determine the role of diet in the treatment of tuberculosis patients, the sociodemographic characteristics of patients, their diet and their nutritional status were studied.

In terms of sociodemographic characteristics, the results showed that a greater proportion of patients affected by tuberculosis were aged between 30 and 45

years (44.8%). These results are in agreement with those of [2,8] which revealed that most cases of active TB occur during the economically productive years of patients' lives (19–49 years). Indeed, tuberculosis remains a public health problem as it affects more people in society during the most productive periods of life. This has an impact on economic performance but also on productivity, hence the interest in eradicating this disease which compromises the development of the economy. Also, in 2021, the assessment workshop of the PNLT monitoring and evaluation service also showed that age groups from 15 to 44 years represented 64% of tuberculosis cases with a sex ratio (M/F) favorable to men (1.9) in Ivory Coast [9]. Which corroborates our results which also indicated that men and women represented 65.5% and 34.5% of the surveyed population respectively. It would therefore be important to look for factors favoring the development of tuberculosis preferentially in males in order to know if this is linked to a genetic predisposition or to the male lifestyle.

Tuberculosis presents itself in several aspects depending on the sensitivity of the germ to antibiotics but also depending on the location of the Koch bacillus. This makes it possible to distinguish susceptible tuberculosis and multi.resistant tuberculosis on the one hand and pulmonary and extra.pulmonary tuberculosis on the other hand. The results of our study revealed a greater frequency of susceptible tuberculosis (88.48%) in the tuberculosis patients surveyed. Susceptible tuberculosis represents the most widespread type of tuberculosis because according to the [9], the epidemiological context for the year 2021 in Côte d'Ivoire revealed that 21,085 tuberculosis patients were screened, all forms combined with 20,743 new ones cases and relapses (i.e. 98%) and 15,342 new cases and relapses of bacteriologically confirmed pulmonary tuberculosis, i.e. 74%. “Susceptible tuberculosis” corresponds to the type of tuberculosis in which the Koch bacillus is sensitive to the usual antibiotics for the treatment of the disease.

In terms of diet and the nutritional state of patients before the onset of the disease, the still large number of people affected by tuberculosis in Côte d'Ivoire could be linked to the low standard of living of the populations. This is in agreement with the WHO report which revealed that 86% of tuberculosis cases reported in 2020 came from low. and middle.income countries [10]. This report also mentions that approximately a quarter of the world's population has latent tuberculosis infection which will develop into active tuberculosis in people who have a deficient immune system, or who suffer from malnutrition or diabetes as well as in tobacco users. [11] also highlighted the occurrence of tuberculosis among people with a low standard of living, working in the informal sector or unemployed.

Weak socio.economic conditions, poverty and food insecurity are all factors that force populations to have a poor diet which results in malnutrition or an alteration of nutritional status [12,13]. Indeed, even in cases where the notions of a balanced diet are known by the populations, poverty, food insecurity, wars and natural disasters can prevent populations from having a balanced diet because accessibility, Availability, utilization and stability of foods could be difficult to access. Also poor nutritional status could favor the establishment of deficiencies in micro and macro elements which, associated with the imbalance between intake and needs could lead to a weakening of the body, now incapable of coping with the microbial attacks with which it will be confronted [14,15,16]. This possible mismatch between the standard of living of patients and their adequate accessibility to food could also have resulted in a significant number of thin patients (15.52%) in our study population, before the occurrence of the disease.

In terms of diet, nutritional status and the level of follow.up of patients since the onset of the disease, the results showed that almost all patients took their medications regularly (96.5%) and did not consume no alcohol (91.4%). Also, more than half drank enough water (70.7%) and mostly consumed foods rich in protein, calcium, iron, vitamin C, E, useful for boosting the immune system of patients. The consequences of patients properly following recommendations during their treatment are perceptible over time, through the improvement of their BMI and the restoration of albumin levels. Indeed, our results also showed that before the end of the treatment period (between 2 and 3 months of treatment) which lasts on average 6 months, several patients saw their BMI improve, i.e. go from lean to normal (13.79%) or stabilize at normal (60.34%). Also, undernourished patients (BMI $\leq$ 18.5 Kg/m2) at the start of treatment had a normal albumin level at the end of treatment. This implies that the nutritional status of these patients has improved over time. The results of the albumin dosage also highlight the impact of good therapeutic compliance as well as compliance with hygienic and dietary measures by patients.

From all of the above, we can say that a balanced and varied diet whatever the standard of living allows us to satisfy nutritional needs and contributes to good health which gives the body the ability to fight effectively against infections.

4. Conclusion

We carried out this study with the main objective of determining the diet and nutritional status of tuberculosis patients before and after the onset of the disease. The results first showed that before the onset of the disease, we found among the patients, people who were thin, had a normal BMI and were overweight or obese. Then, since the onset of the disease, variations in BMI have been observed. Finally, after two to three months of treatment, with regular taking of medications, consumption of foods useful for boosting the immune system (foods rich in proteins, iron, calcium, vitamins A, E and C), compliance hygienic.dietary rules, stopping alcohol consumption, observing sufficient time of rest and good hydration, some patients saw their BMI improve, that is to say go from lean to normal or stabilize at normal. Thin patients at the start of treatment had normal albumin levels at the end.

It is therefore essential to eat well to be in good health and have satisfactory immunity, capable of helping to resist infectious agents. Also, a good diet is also essential in the event of the occurrence of infectious diseases because it can help recovery, playing a supporting role in drug treatment.

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Competing Interests

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

References

[1] Macallan D, "Malnutrition in tuberculosis". *Diagn Micr Infec Dis*, 34: 153.157, 1999.

[2] World Health Organization (WHO), "ENGAGE.TB: Integrating community.based tuberculosis activities into the work of NGOs and other civil society organizations", 2012.

[3] National Tuberculosis Control Program (PNLT), "Tuberculosis Technical Guide", 4th Edition: December 2014.

[4] Boudon.Millot Véronique, "May your diet be your best medicine! Or the exceptional fortune of a pseudo.Hippocratic adage (De alimento 19) ". In: Review Greek Studies, volume 129, issue 2, July.December 2016. Pp 329.348.

[5] Perronne C. "Tuberculosis, HIV infection, and malnutrition: an infernal trio in central Africa". *Nutrition*, 15(4) : 321.322, Apr 1999.

[6] Chandra G, Selvaraj P, Jawahar MS, Banurekha VV, Narayanan PR, "Effect of vitamin D3 on phagocytic potential of macrophages with live Mycobacterium tuberculosis and lymphoproliferative response in pulmonary tuberculosis", *J Clin Immunol*, 24(3) : 249.257, May 2004

[7] Shetty PS, McPherson K. "Diet, nutrition and chronic disease. Lessons from contrasting worlds. Chichester", *John Wiley & Sons*, P 301, 1997.

[8] Frieden TR, Sterling TR, Munsiff SS, Watt CJ, Dye C., "Tuberculosis", *Lancet*, 362(9387): 887.899, Sep 2003.

[9] National Tuberculosis Control Program (PNLT), "National assessment workshop on the fight against tuberculosis, Monitoring and Evaluation Service of activities for the year 2021", carried out in April 2022.

[10] World Health Organization (WHO), "World tuberculosis day", special online broadcast, 2022.

[11] Amona M., Kokolo B., Loumouamou M.L., Mbita A.M., Ayah J.P., Konongo A.L.T., Ibata P., "Bacteriological profile of nosocomial infections in the internal medicine department of the central army hospital of Brazzaville.Congo". 3rd GERES conference in Africa; Infectious risks: Safety of caregivers and quality of care, Page 12, 2016.

[12] Brunel Olivier, "Strategies for adjusting to dietary risk", Theoretical model and empirical test [thesis] Lyon: Jean Moulin University Lyon 3, 2002.

[13] Cambrezy Luc, Janin Pierre, "Food risk in Africa". Yvette Veyret. Risks, SEDES, pp.88.103, Collection Files of economic images of the world (DIEM). 2003.

[14] Katona, I., and Freund, T. F., "Endocannabinoid signaling as a synaptic circuit breaker in neurological disease". *Nat. Med.* 14, 923–930, 2008.

[15] Scrimshaw Nevin S., "Effect of Infection on Nutritional Status", *Proceedings of the National Science Council, ROC*. Vol. 16. No. 1, pp. 46.64, 1992.

[16] Schaible UE, Kaufmann SHE, "Malnutrition and infection: Complex mechanisms and global impacts", *PLoS Med* 4(5): 115.