Original Article

Evaluation of Body Composition in Senegalese Patients with Chronic Respiratory Disease

Sow A. K .[1] , Diaw M. [1,2] , Ouedraogo V. [3] , Tiendrebeogo A. J. F. [4] , Coly M. S. [5] , Ba A. [6] , Diagne/Huondjo S. [1] , Toure M. [1] , Seck A. [1] , Mbengue A [5] , Ba A. [1,2] & Samb A. [1,2]

[1] Laboratory of Physiology and Functional Explorations, FMPOS, Cheikh Anta Diop University, Senegal. [2] IRL3189 Environment, Health, Societies, CNRS-UCAD Dakar, Senegal. [3] UFR/SS, Ouahigouya University, Burkina Faso. [4] UFR/SDS Joseph Ki Zerbo University of Ouagadougou, Burkina Faso [5] Laboratory of Physiology, UFR of Health Sciences of Thies, Service Functional Explorations of the Regional Hospital of Thies, Senegal. [6] Laboratory of Physiology and Functional Explorations, Department of Medicine, Health and Sustainable Development Training and Research Unit (UFRSDD), Alioune Diop University of Bambey (UADB), Senegal.

How to cite this article: Sow A. K., Diaw M., Ouedraogo V. et. al. Evaluation of Body Composition in Senegalese Patients with Chronic Respiratory Disease. International Journal of Physiology / Vol. 12 No. 2, July-December 2024.

Abstract

Background: Body composition could increase morbi-mortality occurrence risk of patients with chronic respiratory disease (CRD). In low income countries, this relation was less studied. Thus, our study aimed to evaluate the body composition in patients with CRD.

Methodology: Study participants were asthmatic or chronic obstructive disease (COPD) patients. Anthropometric and body composition parameters were measured and classified by Schols et al. Spirometric parameters were measured according the ATS/ERS guidelines of 2005.

Results: A total of 39 patients were recruited in our study (18 asthmatics and 21 COPD patients). All patients had muscle depletion. Fat free mass (FFM), fat free mass index (FFMI), skeletal muscle mass (SMM) and skeletal muscle mass index (SMMI) were lower in COPD patients. However, asthma patients were more obese while cachexia were more frequent in COPD patients. Semistarvation were found in all patients with Gold stage III and to a lesser extent in some patient of Gold stage II and IV.FVC and FEV1, expressed on percentage of predicted value, were positively correlated with FFMI and SMMI in COPD patients.

Conclusion: Our patients had mild to moderate forms of their disease and their body composition may increase severity of CRD.

Key-words: Body composition - Spirometry - Asthma – COPD

Corresponding Author: Abdou Khadir SOW, Laboratory of Physiology and Functional Explorations, FMPOS Cheikh Anta Diop University, Senegal.

E-mail: abdoukhadir.sow@ucad.edu.sn

Submission date: Feb 2, 2024 **Revision date:** Feb 27, 2024 **Published date: Sept 13 2024**

Introduction

Measurement of body composition parameters allows to look for the risk of occurrence of a disease. This measure gives parameters that inform on morbidity and mortality risk[1]. High values of body fat (BF) and low values of fat free mass (FFM) are independent predictors of all-cause mortality in general population[2]. It has also been demonstrated in healthy subjects that total body fat, visceral fat and FFM are associated with lung function[3]. Moreover, visceral fat is the best reflects of lung function compared to weight and BMI[4]. In fact, it has been shown in general population that weight loos and decrease in BMI is associated with a better lung function[5].

Consequently, body composition is related to the risk of chronic respiratory disease (CRD) such as chronic obstructive disease(COPD) and asthma[6, 7]. In addition, weight loss can reduce muscle mass and the strength of remaining muscle fibers [6]. Also, obesity represents a risk factor for asthma occurrence[7]. In fact, an increase ofBMI predisposes to a newasthma diagnosis[8].

On the other hand body composition may also be affected by smoking, COPD and asthma. Smoking induce a loss of appetite and therefore weight loss, while smoking cessation provokes weight gain. Moreover, smoking contributes to the accumulation of visceral fat[9]. High values of BMI and FFM index (FFMI) were associated with increased risk of FEV1 in patients with COPD[10]. In asthma patients, weight and BMI are associated with asthma control and overweight asthma patients are more difficult to achieve control[11].

Body composition in CRD patients in not well studied in our countries. Thus the objective of our study was to evaluate the body composition of CRD patients lived in Senegal, a West Africa country.

Material and Methods

Study design

Study participants were asthmatic or COPD patients, without significant comorbidities. Patients with an implantable defibrillator were also excluded in our study. CRD patients were recruited from the outpatients who are referred in the Laboratory of Physiology and Functional Explorations of Cheikh Anta Diop University of Dakar for spirometry realization as part of the follow-up of their disease. Patients had stable disease for the previous 8 weeks. Diagnosis of COPD and asthma had set at least one year before the inclusion in the study by an expert respiratory physician, according to the existing guidelines[7, 12]. CRD patients who gave informed consent were included in this study.

The protocol was approved by the National Ethics Committee of Senegal "protocol: 0381/2018/CER/UCAD", and all participants were informed about the procedures and purpose of the study and all have given their written informed consent.

Anthropometric and body composition measurements

Anthropometric parameters such as weight and height were measured. Body composition were assessed by bioelectrical impedance analysis (BIA), with a body analyzer (OMRON BF511®) according to current recommendations[13, 14]. FFMI were calculated as FFM/height squared. Skeletal muscle mass index (SMMI) were calculated as SMM/height squared. Fat mass index (FMI) given bay FM/height squared. The cut-offs used for low BMI (≤21 kg/m^2) and low FFMI (≤16 kg/m^{2}in men and ≤15kg/m^2 in women) were recommended by ERS/ATS guidelines for pulmonary rehabilitation (19). Normal or altered body composition were defined in 4 categories using the criteria defined by Schols[15, 16]:

- normal body composition: BMI >21 kg/m^2 and FFMI >16 kg/m^2
- semistarvation: BMI ≤21 kg/m^2 and FFMI >16 kg/m^2
- muscle atrophy or sarcopenia: BMI >21 kg/m^2 and FFMI ≤16kg/m^2
- cachexia: BMI ≤21 kg/m^2 and FFMI ≤16 kg/m^2

Muscle depletion was defining according Schols et al. by a SMMI < 10.75 kg/m^2.

Spirometry

All patients were submitted to spirometry by the same experienced technician, using a commercially available system (Master Screen, Erich Jaeger GmbH, Wuerzburg, Germany) according to the guidelines[17].

Classification of severity of CRD

Asthma patients were classified as mild-to-moderate asthma patients according to GINA guidelines[7]. COPD patients were distributed to four stages of the disease according to the forced expiratory volume in the first second (FEV1), as it is referred in the GOLD guidelines (Stage I – mild COPD FEV1≥80.0% predicted; Stage II – moderate COPD 50.0% ≤ FEV1<80.0% predicted; Stage III – severe COPD 30.0% ≤ FEV1<50.0%; Stage IV – very severe COPD FEV1<30.0% predicted or chronic respiratory failure (IRC))[12].

Statistics

Data were analyzed by using GraphPad Prism 5 and R 3.2 softwares. Comparisons of quantitative variables between groups were performed using Student's t-test. Percentage comparison was performed using the Chi-square test. Pearson correlation coefficient were used for the correlation between variables. Multiple regression analysis was performed for the evaluation of FFMI, SMMI and FMI predictors, using FFMI, SMMI or FMI as dependent variables and age and sex as independent variables. P values<0.05 were considered statistically significant.

Results

A total of 39 patients (18 asthma patients and 21 COPD patients), all male, participated in the study. Mean age was 49.8 ± 17 years with extremes ranging from 21 to 75 years. COPD patients were older than asthma patients (p <0.0001).

Body composition

Table 1: Anthropometric and body composition parameters of two patient groups.

	Asthma group N = 18	**COPD group N = 21**	**p**
BW (Kg)	73.5 ± 16.4 [56.1 ; 102.7]	66.64 ± 12.45 [49.8 ; 96.3]	0.06
BMI (Kg/m²)	23.72 ± 4.54 [18.2 ; 34.2]	21.94 ± 3.27 [17.51 ; 29.7]	NS
FM (Kg)	15.99 ± 8.86 [5.48 ; 35.02]	13.68 ± 6.73 [3.59 ; 26.87]	NS
FMI (Kg/m²)	5.17 ± 2.83 [1.62 ; 11.7]	4.46 ± 2.13 [1.28 ; 9.1]	NS
FFM (Kg)	57.51 ± 9.08 [47.36 ; 74.98]	52.95 ± 6.77 [40.5 ; 69.43]	0.03
FFMI (Kg/m²)	18.56 ± 1.92 [16.06 ; 22.61]	17.39 ± 1.48 [14.18 ; 21.43]	0.03
SMM (Kg)	26.86 ± 4.89 [21.31 ; 36.27]	22.77 ± 3.38 [16.93 ; 30.43]	0.001
SMMI (Kg/m²)	8.67 ± 1.15 [6.65 ; 10.74]	7.49 ± 0.95 [5.66 ; 9.54]	0.001

BW: Body weight; BMI: Body mass index; FM: Fat mass; FMI: Fat mass index; FFM: Fat free Mass; FFMI: Fat free mass index; SMM: Skeletal muscle mass; SMMI: Skeletal muscle mass index; NS: Not significant

We found that asthmatic patients tended to be overweight and had significantly higher muscle mass. However, all of our patients had muscle depletion.

Then, patients were classified according to the classes of BMI (table 2).Any COPD patients presented an obesity contrary to the asthma patients (p <0.0001) and for the other classes of BMI there are no significant difference between groups.

Table 2: BMI classification of patients

	Asthma group N = 18	COPD group N = 21	P
Underweight (%)	7.14	14.29	NS
Normal weight (%)	64.29	66.67	NS
Overweight (%)	14.29	19.05	NS
Obese (%)	14.29	0	< 0.0001

Results of table 3 showed that Asthmatic patients had a strong tendency to present more frequently a normal body composition (p = 0.05); and only COPD patients had cachexia (p = 0.02) (see table 3).Although, no cases of muscle atrophy or sarcopenia were found in our study.

Table 3: Body composition classes of two patient groups

Body composition	Asthma group (N = 18)	COPD group (N = 21)	p
Normal (%)	71.43	52	NS
Semistarvation (%)	28.57	38	NS
Cachexia (%)	0	10	0.02

Spirometry

Spirometric parameters between the two groups of patients are shown in table 4.

Table 4: Spirometric parameters of two patient groups

Spirometric parameters	Asthma group N = 18	COPD group N = 21	p
FVC, % predicted	113.5 ± 19.4 [72 ; 151]	72.1 ± 15.7 [45 ; 102]	< 0.0001
FEV1, % predicted	97.4 ± 26.5 [36 ; 153]	50.8 ± 20 [21 ; 90]	< 0.0001
FEV1/FVC,%	70.7 ± 13.6 [40.2 ; 92]	53.6 ± 12.8 [28.9 ; 68.3]	< 0.001
MMEF, % predicted	69.7 ± 31 [14 ; 135]	25.1 ± 14.9 [7 ; 61]	< 0.0001

FVC: Forced vital capacity; FEV1: Forced expiratory volume in the first second; MMEF: maximal mid-expiratory flow

Severity of the CRD chronic respiratory disease

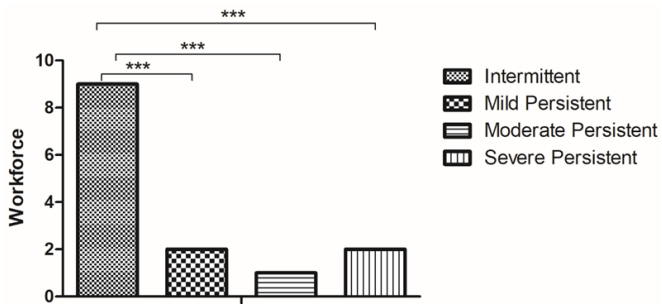


Figure 1: Distribution of asthma patients according to the severity of the disease (GINA 2008)

According to Figure 1, intermittent asthma was the most frequently found form, followed by mild persistent form. Also, the distribution of COPD patients according to Gold's classification showed that moderate COPD was the most common form found in our study population, followed by very severe and severe forms of Gold (Figure 2).

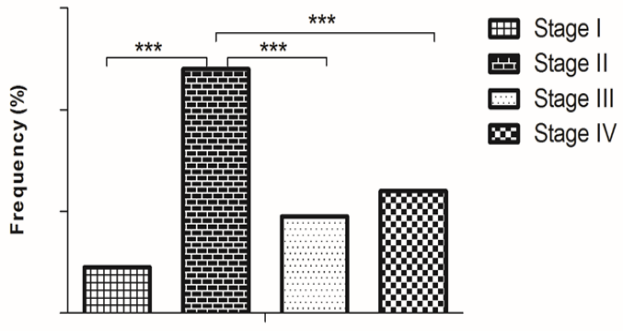


Figure 2: Distribution of COPD Patients by GOLD Classification

Relations between body composition and severity of the CRD

Repartition of asthma patients according to the classes of body composition and the severity of disease is shown in Figure 3. And, only asthma patients with intermittent and persistent severe forms had semistarvation.But, the rest of asthma patients presented a normal body composition.Obese and overweight patients hada higher fat mass and intermittent asthma.

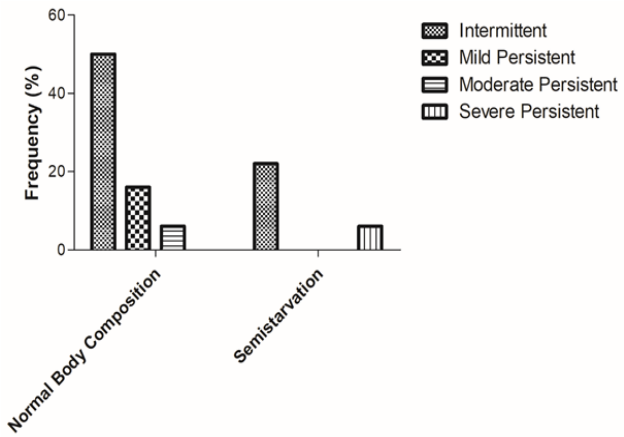


Figure 3: Distribution of asthma patients by severity and classes of body composition

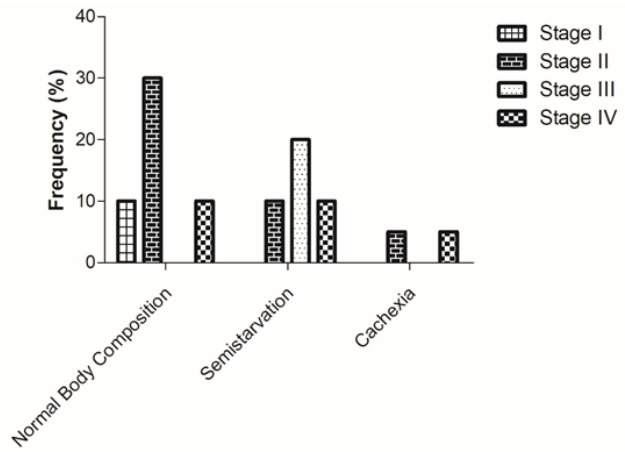
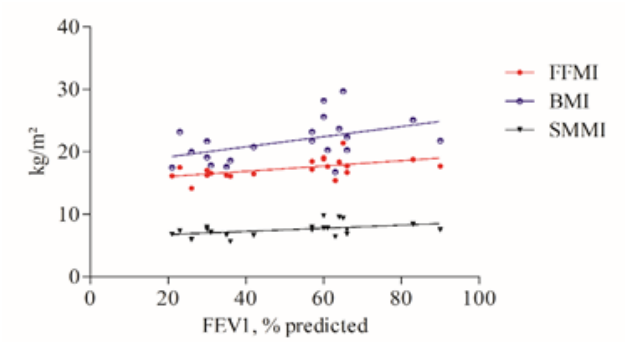


Figure 4: Distribution of COPD patients by severity and classes of body composition

All patients with mild as well as the majority of COPD patients with moderate form had a normal body composition. While all COPD patients at Gold Stage III had semistarvation.Cachexia was found in some COPD patients at GOLD stage II and IV.

In asthma patients, only SMM were positively correlate to FVC in percentage of predicted ($p = 0.04$; $r^2 = 0.23$). In COPD patients FEV1 in percentage of predicted values were positively and weakly correlate tobody composition parameters such as BMI ($p = 0.03$; $r^2 = 0.22$), FFMI ($p = 0.009$; $r^2 = 0.3$) and SMMI ($p = 0.03$; $r^2 = 0.21$). It is the same for FEV1/FVC ratio with FFMI ($p = 0.02$; $r^2 = 0.23$) and SMMI ($p = 0.04$; $r^2 = 0.2$) (Figure 5).



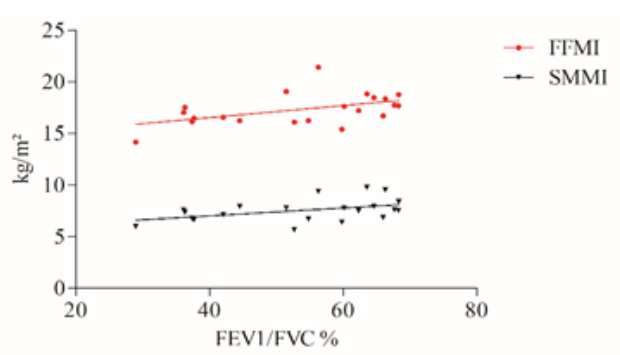


Figure 5: Correlation of BMI, FMI and SMMI to FEV1 in percentage of predicted values and FEV1/FVC in COPD patients

Discussion

We conducted a preliminary study to explore nutritional status of patients with CRD in relation to severity of their disease. Thus, asthma and COPD patients were recruited. Our results showed that asthma patients had significantly higher values of body composition parameters than those with COPD. There were also more cases of obesity in the asthma group while cachexia is more so in COPD. But all patients had a muscle depletion.

Regarding the severity of the disease, the majority of patients with asthma (74%) had an intermittent form, whereas in the COPD group the moderate form of GOLD (GOLD stage II) predominated (48%). Semistarvation was found in some patients with intermittent or severe asthma form while the rest had normal body composition. And in COPD group, cachexia was mainly found in patients with a very severe form.While semistarvation was found in all patients of Gold stage III. Spirometric parameters were more correlated in COPD patients than asthma patients.

Methodologically, we compared body composition and spirometric parameters of asthma and COPD patients. In fact, most of the time they are studies relating only to patients with asthma or COPD compared to either normal subjects free from any chronic respiratory disease or to smokers free from COPD[18, 19]. These studies showed that body composition parameters were lower in these two groups of patients[18, 19]. Regarding to the study comparing body composition parameters of asthma and COPD patients, Minas et al. had results that corroborate ours[20]. However, Trompeter et al. found in the first place that asthma patients had a higher FMI than subjects with non-chronic respiratory disease (non-CRD), with no difference for the FFMI[21]. While COPD patients had lowest FMI and FFMI when comparing to the non-CRD[21]. These results could be explained by several mechanisms. First, COPD patients were oldest and muscle depletion is favored by advanced age[22]. Also in COPD disease, we have an increase in energy expenditure by increasing ventilatory work[23, 24]. If in addition, the diet is not appropriate, the muscular depletion could even worsen. The absence of regular physical activity may also alter body composition as part of a deconditioning[25]. Thus, adequate diet and treatment with cardiorespiratory rehabilitation could improve body composition of patients with CRD. However, oral corticosteroids are responsible for muscle depletion[26]. High FMI values among asthmatics may be related to high prevalence of obesity in asthmatic population. However, we don't found a significant difference in FMI on our two patient groups. This could be related to the low number of asthmatic patients recruited in our study.

Regarding the severity of the disease, our study showed that the majority of asthma patients had mild to moderate forms of their disease. In the COPD group about 40% of them had severe to very severe forms. Most of them had normal body composition. Semistarvation was more frequently found in patients with severe forms. However, the only two cases of cachexia have been found in GOLD stage II and IV COPD patients. Indeed, in COPD, Gologanu et al. reported that stage 2 to 4 of GOLDCOPD patients had the lowest body composition values[27]. Other authors have even reported that the FFM was a strong predictor of mortality in COPD[16]. In addition we have not found obese COPD patients, while obesity would be considered a protective factor of mortality in the severe form[28]. However, in asthmatic patient's, obesity could aggravated symptoms by increasing inflammation[29]. In our study, obese patients had intermittent asthma form. But it must be pointed out that none of them had a morbid obesity. Thus, the influence of body composition on the severity of the CRD would vary depending on whether it is asthma or COPD, but also the degree of obesity.

Our study certainly had some limitations linked to the fact that we did not compare our patients to those without asthma and COPD.

Conclusion

Our results showed that asthma patients had less severe forms of their disease. Also they had a normal body composition or to a lesser extent a semistarvation. While in the COPD group nearly 40% of them were stages III and IV of Gold. On the only two cases of cachexia alone one was stage IV of Gold. These latter were neither obese nor overweight and could have a worse prognosis. Good nutrition associated with adequate drug therapy would be a protective factor in the loss of muscle mass. The close link between lung function parameters and the increase of the muscular mass, pushed us to propose a regular and framed physical activity in these patients. Indeed, this rehabilitation to the effort would increase the muscle mass while decreasing the excess fat which would improve the vital and functional prognosis in CRD.

Conflict of interests: Authors declared that they had no conflict of interest.

Acknowledgments: This study was not funded by any organization.

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