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Chronic obstructive pulmonary disease and body mass index in five Latin America cities: The PLATINO study

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KEYWORDS
Chronic obstructive pulmonary disease;
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Summary
Background: The body mass index (BMI) is a prognostic factor for chronic obstructive pulmonary disease (COPD). Despite its importance, little information is available regarding BMI alteration in COPD from a population-based study. We examined characteristics by BMI categories in the total and COPD populations in five Latin-American cities, and explored the factors influencing BMI in COPD.
Methods: COPD was defined as a postbronchodilator forced expiratory volume in the first second/forced vital capacity (FEV_1/FVC) <0.70. BMI was categorized as underweight ($<20\,kg/m^2$), normal weight (20–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese ($\geqslant 30.0\,kg/m^2$).
Results: Interviews were completed in 5571 subjects from 6711 eligible individuals, and spirometry was performed in 5314 subjects. There were 759 subjects with COPD and 4555 without COPD. Compared with the non-COPD group, there was a higher proportion of COPD

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subjects in the underweight and normal weight categories, and a lower proportion in the obese category. Over one-half COPD subjects had BMI over 25 kg/m^2. No differences in BMI strata among countries were found in COPD subjects. Factors associated with lower BMI in males with COPD were aging, current smoking, and global initiative for chronic obstructive lung disease (GOLD) stages III–IV, whereas wheeze and residing in Santiago and Montevideo were associated with higher BMI. In females with COPD, current smoking, lower education, and GOLD stages II–IV were associated with lower BMI, while dyspnea and wheeze were associated with higher BMI.

Conclusions: BMI alterations are common in COPD with no significant differences among countries. Current smoking, age, GOLD stages, education level, residing in Santiago and Montevideo, dyspnea and wheeze were independently associated with BMI in COPD.

Introduction

Chronic obstructive pulmonary disease (COPD) has been redefined[1] to indicate that, apart from the deleterious effects on the lungs, the disease is associated with clinically relevant extrapulmonary manifestations.[2–11] Systemic consequences now recognized as important features of the disease contribute to exercise intolerance, decreased health status, and increased mortality.[7,12–19] Among the most extensively studied systemic features are unexplained weight loss, alterations in the body mass index (BMI) and in body composition. Data from epidemiologic studies have shown that the prevalence of COPD is higher in those patients with lower BMI.[20,21] In addition results from longitudinal studies have shown that low BMI is an important risk factor for subsequent development of COPD in men, for increased FEV_1 decline in the same gender and for having a new exacerbation in patients hospitalized for severe exacerbation.[22–24] BMI has also been identified as an independent prognostic factor for COPD, with a clear association between decreased BMI and increased mortality, both in clinical patient series and in subjects from a population sample.[1–3,18,19] Several studies indicate that the prevalence of nutritional abnormalities increases from 20% in stable outpatients up to 35% in patients eligible for pulmonary rehabilitation.[25–27]

To date, most studies concerning the prevalence of nutritional depletion in COPD have been performed in selected populations.[26,28–33] In general they found that the prevalence of nutritional depletion in COPD was high, especially in females, and was not associated with lower levels of airway obstruction. Despite the fact that nutritional depletion has been associated with different deleterious effects and important outcomes in patients with COPD, little information is available regarding BMI alteration in COPD patients from a multicenter population-based study that includes spirometry.[18,19] Population-based studies are necessary because they represent more accurately the total spectrum of patients with the disease, thus allowing unbiased inferences. Furthermore, it is still unclear if BMI alteration in COPD is associated with the severity of airflow limitation or with other factors like gender, age, ethnicity, education, employment, tobacco consumption, clinical symptoms, and geographical variation.

The aims of this study were (a) to evaluate the characteristics by BMI categories of the total population and of subjects with COPD drawn from a multicenter population-based survey conducted in five Latin American cities and (b) to explore the possible factors that influence BMI in COPD.

Methods and materials

The Proyecto Latinoamericano de Investigacion en Obstrucción Pulmonar (PLATINO) study was a population-based epidemiologic study conducted in five Latin American cities: São Paulo (Brazil), Santiago (Chile), Mexico City (Mexico), Montevideo (Uruguay), and Caracas (Venezuela).[20] Complete details of the methodology and detailed descriptions of participation rates and sample characteristics have been published elsewhere.[20,34–36] Briefly, a two-stage cluster sampling method was used at each site in order to obtain a probability sample of households. All adults aged 40 or older living in the selected households were invited to participate. Exclusion criteria for the study were mental illness and institutionalization. Approval was obtained from the ethical committee of the institutions involved in the study and written informed consent was obtained from each subject.

Information was collected on several factors potentially associated with COPD, including age, sex, ethnicity (self-reported), smoking habits, years of formal education, employment, respiratory symptoms, and prior spirometric testing. Copies of the questionnaires are available at the PLATINO website (http://www.platino-alat.org). A portable, battery-operated, ultrasound transit-time-based spirometer (Easy-One™; NDD Medical Technologies, Chelmsford MA and Zürich, Swizerland) was used to perform pulmonary function testing. Calibration was checked daily with a 3-liter syringe. Subjects performed up to 15 forced expiratory maneuvers (average 5–6) to obtain three American Thoracic Society (ATS) acceptable maneuvers, with forced vital capacity (FVC) and forced expiratory volume in the first second (FEV_1) reproducible within 150 ml.[37] Albuterol 200 mcg was then administered by inhalation through a 500-ml spacer, and the test was repeated 15 min later (average 4–5 maneuvers). All spirometric examinations were carried out with the subject seated, using a nose clip and a disposable mouthpiece. Exclusions for spirometry included recent thoracic or abdominal surgery, myocardial infarction, eye surgery or retinal detachment, hospitalization for any cardiac

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condition, tuberculosis, pregnancy, or a pulse rate above 120 beats per minute.

We used the definition of COPD proposed by the Global Initiative for Chronic Obstructive Lung Disease (GOLD): a ratio of the postbronchodilator FEV_1 over FVC below 0.70.[2] This definition is consistent with the European Respiratory Society and ATS directives.[1] Anthropometric measurements were taken. Height was measured with a portable Seca® stadiometer (precision 0.1 cm), using the technique recommended by Lohman et al.[38] Weight was measured using an electric Tanita® scale (precision 200 g). The analysis of nutritional status was based only on the assessment of BMI. It was calculated as the ratio weight/height^2 (kg/m^2) and categorized into four groups: underweight (<20.0 kg/m^2), normal weight (20.0–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese ($\geqslant 30.0$ kg/m^2).[39]

Statistical analyses

For descriptive analyses, differences between BMI groups were tested using Pearson's χ^2 for categorical variables and Cuzick's nonparametric test for trend among continuous variables.[40] Comparisons examining the distribution of BMI categories were age-standardized and adjusted for survey design using the SVY commands in STATA. Between-country comparisons were also adjusted for multiple comparisons using Bonferroni's method. Multivariable linear regression

Table 1 Description of the total population.

Variables	Underweight ($n = 186$), n (%)	Normal ($n = 1346$), n (%)	Overweight ($n = 2176$), n (%)	Obese ($n = 1606$), n (%)	p-Value
Age, years (mean ± SD)	57.3 ± 13.9	55.4 ± 12.5	56.9 ± 11.8	56.2 ± 10.8	0.001
Age group, years					<0.0001
40–49	75 (40.3)	575 (42.7)	756 (34.7)	543 (33.8)	
50–59	45 (24.2)	358 (26.6)	644 (29.6)	539 (33.6)	
>60	66 (35.5)	413 (30.7)	776 (35.7)	524 (32.6)	
Gender					<0.0001
Male	78 (41.9)	553 (41.1)	975 (44.8)	496 (30.9)	
Female	108 (58.1)	793 (58.9)	1201 (55.2)	1110 (69.1)	
Ethnicity					0.016
White	99 (53.2)	757 (56.4)	1160 (53.5)	882 (53.9)	
Black	16 (8.6)	74 (5.5)	116 (5.4)	98 (6.1)	
Asian	4 (2.2)	18 (1.3)	17 (0.8)	11 (0.7)	
Mulatto	61 (32.8)	449 (33.5)	757 (34.9)	537 (33.6)	
Indian	6 (3.2)	44 (3.3)	120 (5.5)	91 (5.7)	
Education, years (mean ± SD)	6.8 ± 4.5	7.9 ± 5.0	7.8 ± 4.8	7.1 ± 4.5	0.009
Employment					<0.0001
Yes	92 (49.5)	771 (57.3)	1242 (57.1)	814 (50.7)	
No	94 (50.5)	574 (42.7)	934 (42.9)	792 (49.3)	
Smoking, pack-years (mean ± SD)	17.8 ± 24.1	11.1 ± 17.4	10.3 ± 18.3	9.6 ± 19.9	<0.0001
Smoking, pack-years					<0.0001
0–10	91 (49.5)	847 (63.3)	1,494 (68.9)	1,188 (74.0)	
10–20	34 (18.5)	203 (15.2)	297 (13.7)	152 (9.5)	
⩾20	59 (32.1)	288 (21.5)	379 (17.5)	265 (16.5)	
Smoking status					<0.0001
Never	57 (30.7)	499 (37.1)	918 (42.2)	788 (49.1)	
Former	32 (17.2)	373 (27.8)	597 (27.4)	466 (29.0)	
Current	97 (52.2)	472 (35.1)	661 (30.4)	352 (21.9)	
Respiratory symptoms					
Cough	43 (23.1)	281 (20.9)	428 (19.7)	356 (22.2)	0.250
Phlegm	41 (22.0)	241 (17.9)	415 (19.1)	297 (18.5)	0.536
Wheeze	45 (24.2)	261 (19.4)	476 (21.9)	486 (30.3)	<0.0001
Dyspnea	66 (36.5)	491 (36.8)	933 (43.3)	919 (58.0)	<0.0001
FVC, l (mean ± SD)	3.3 ± 1.0	3.5 ± 1.0	3.4 ± 1.0	3.2 ± 0.9	<0.0001
FEV_1, l (mean ± SD)	2.5 ± 0.8	2.7 ± 0.8	2.7 ± 0.8	2.5 ± 0.7	<0.0001
FEV_1/FVC (mean ± SD)	74.3 ± 12.2	77.1 ± 9.4	77.8 ± 8.4	79.3 ± 7.3	<0.0001

FEV_1 = forced expiratory volume in 1 s; FVC = forced vital capacity; SD = standard deviation.

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was aimed at identifying factors associated with BMI as a continuous variable in persons with spirometric evidence of airway obstruction. Regressions were adjusted for survey design using the SVY: REGRESS command in STATA. All analyses were performed with the STATA software package (version 9.2; STATA Corporation, College Station, TX, USA 2006).

Results

Complete interviews were achieved in 5571 subjects from a total of 6711 eligible individuals, and spirometry was performed in 5314 subjects. Among this population there were 759 subjects with postbronchodilator $FEV_1/FVC < 0.70$ (COPD) and 4555 individuals with a postbronchodilator $FEV_1/FVC \geqslant 0.70$ (no COPD).

Descriptions of the total population and subjects with COPD are presented in Tables 1 and 2, respectively. In the entire population there were significant differences among the BMI categories in age, gender, ethnicity, years of education, employment, smoking status, spirometry values, and the frequency of wheezing and dyspnea. As BMI increased, there was a progressive decrease in current smoking status and pack-years of smoking exposure, and a progressive increase in the frequency of dyspnea and the mean FEV_1/FVC ratio.

In the COPD population about 7% had underweight ($<20\,kg/m^2$), 30% normal BMI (20–24.9 kg/m^2), and 64% overweight or obesity ($\geqslant 25.0\,kg/m^2$). Comparisons among the BMI categories showed that only gender, smoking status, the frequency of wheezing and dyspnea, and FEV_1/FVC ratio were different in subjects with COPD. As BMI increased, there was a progressive decrease in current smoking status, and a progressive increase in the frequency of wheezing and dyspnea, and in the mean FEV_1/FVC ratio.

The proportions of subjects from the total population with and without COPD by BMI categories (adjusted for age

Table 2 Description of subjects with COPD.

Variables	Underweight ($n = 51$), n (%)	Normal ($n = 230$), n (%)	Overweight ($n = 303$), n (%)	Obese ($n = 175$), n (%)	p-Value
Age, years (mean ± SD)	65.7 ± 14.4	64.0 ± 12.9	64.8 ± 11.2	62.7 ± 12.4	0.217
Age group, years					0.126
40–49	7 (13.7)	39 (17.0)	33 (10.9)	30 (17.1)	
50–59	14 (27.5)	46 (20.0)	70 (23.1)	49 (28.0)	
>60	30 (58.8)	145 (63.0)	200 (66.0)	96 (54.9)	
Gender					0.024
Male	22 (43.1)	130 (56.5)	168 (55.5)	77 (44.0)	
Female	29 (56.9)	100 (43.5)	135 (44.6)	98 (56.0)	
Ethnicity					0.178
White	28 (54.9)	146 (63.5)	207 (68.3)	108 (61.7)	
Black	5 (9.8)	11 (4.8)	15 (5.0)	8 (4.6)	
Asian	1 (2.0)	6 (2.6)	2 (0.7)	–	
Mulatto	16 (31.4)	59 (25.7)	64 (21.1)	49 (28.0)	
Indian	1 (2.0)	8 (3.5)	15 (5.0)	10 (5.7)	
Education, years (mean ± SD)	4.6 ± 4.0	6.8 ± 4.7	7.1 ± 4.8	6.5 ± 4.1	0.104
Employment					0.068
Yes	14 (27.5)	108 (47.0)	122 (40.3)	73 (41.7)	
No	37 (72.6)	122 (53.0)	181 (59.7)	102 (58.3)	
Smoking, pack-years (mean ± SD)	26.1 ± 32.4	18.5 ± 22.3	19.2 ± 27.1	10.2 ± 32.7	0.014
Smoking, pack-years					0.242
0–10	21 (42.0)	106 (46.1)	156 (51.5)	102 (58.3)	
10–20	7 (14.0)	35 (15.2)	43 (14.2)	20 (11.4)	
⩾20	22 (44.0)	89 (38.7)	104 (34.3)	53 (30.3)	
Smoking status					<0.0001
Never	10 (19.6)	61 (26.5)	106 (35.5)	62 (35.4)	
Former	12 (23.5)	68 (29.6)	97 (32.0)	70 (40.0)	
Current	29 (56.9)	101 (43.9)	100 (33.0)	43 (24.6)	
Respiratory symptoms					
Cough	17 (33.3)	78 (33.9)	90 (29.7)	53 (30.3)	0.736
Phlegm	15 (29.4)	64 (27.8)	88 (29.0)	48 (27.4)	0.977
Wheeze	17 (33.3)	80 (34.8)	111 (36.6)	87 (49.7)	0.009
Dyspnea	19 (38.8)	100 (44.3)	149 (49.2)	111 (65.3)	<0.0001
FVC, l (mean ± SD)	3.1 ± 0.9	3.5 ± 1.1	3.4 ± 1.0	3.3 ± 1.1	0.542
FEV_1, l (mean ± SD)	1.8 ± 0.6	2.2 ± 0.8	2.2 ± 0.7	2.1 ± 0.7	0.288
FEV_1/FVC (mean ± SD)	57.2 ± 9.8	61.3 ± 9.1	62.1 ± 8.5	79.3 ± 7.3	<0.0001

FEV_1 = forced expiratory volume in one second; FVC = forced vital capacity; SD = standard deviation.

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and survey design) are shown in Figure 1. The proportion of subjects without COPD progressively increased from the underweight to obese categories, whereas the proportion of COPD subjects progressively decreased ($p<0.0001$). The BMI categories by COPD status are shown in Figure 2. There was a higher proportion of COPD subjects in the underweight and normal-weight categories compared to non-COPD subjects, whereas in the obese category the proportion of subjects without COPD was higher and a similar trend was observed in the overweight category ($p = 0.07$). In others words, the proportion of COPD subjects progressively increased as BMI decreased.

BMI strata by individual countries in the COPD group (adjusted for age and survey design) are presented in Table 3. No significant differences in BMI strata among countries were found in the COPD population ($p>0.05$).

Lung function in COPD subjects by BMI categories is shown in Figure 3. Using the PLATINO[36] predicted values, there was a curvilinear relationship between BMI with FEV_1 and FVC, that allows us to speculate a possible effect of BMI on lung function or vice versa.

Tables 4 and 5 present the regression models explaining BMI among male and female subjects with COPD, respectively. In males, aging, current smoking, and severe COPD

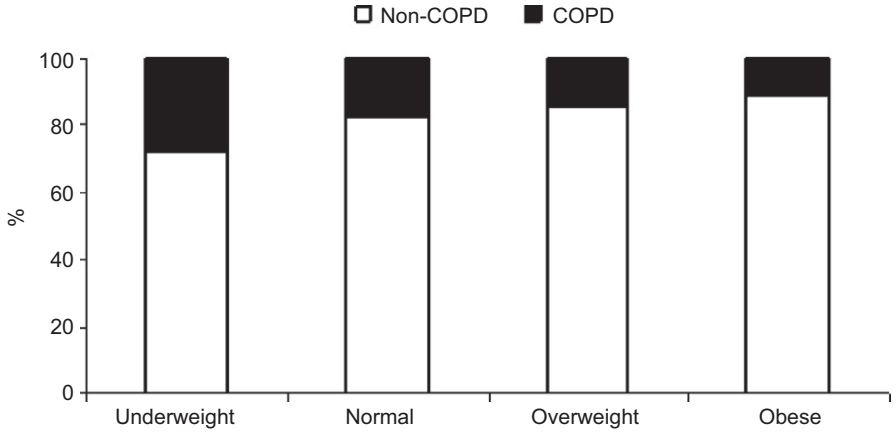

Figure 1 Proportion of the study population with and without COPD, by BMI categories, adjusted for age and study design ($p<0.0001$).

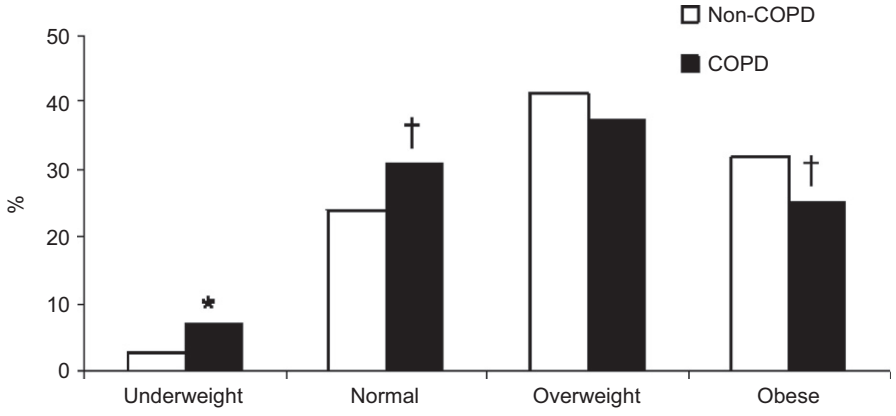

Figure 2 BMI categories by COPD status *$p<0.0001$ (COPD vs. no COPD) †$p<0.001$ (COPD vs. no COPD).

Table 3 BMI categories by countries in the COPD population.

BMI categories	Sao Paulo % (SE)	Santiago % (SE)	Mexico City % (SE)	Montevideo % SE)	Caracas % (SE)
Underweight ($<20\,kg/m^2$)	12.36 (2.97)	4.31 (1.60)	6.91 (3.55)	5.15 (2.92)	7.14 (2.14)
Normal (20–24.9 kg/m^2)	33.17 (4.52)	27.18 (3.41)	31.25 (6.95)	37.42 (5.52)	30.42 (3.66)
Overweight (25.0–29.9 kg/m^2)	32.33 (4.22)	39.75 (4.26)	37.44 (7.62)	31.31 (5.28)	40.38 (4.33)
Obese ($\geqslant 30.0\,kg/m^2$)	22.13 (3.23)	28.76 (3.86)	24.39 (6.12)	26.11 (5.52)	22.06 (3.51)
	100	100	100	100	100

$p>0.05$ (overall Bonferroni adjusted for each category).

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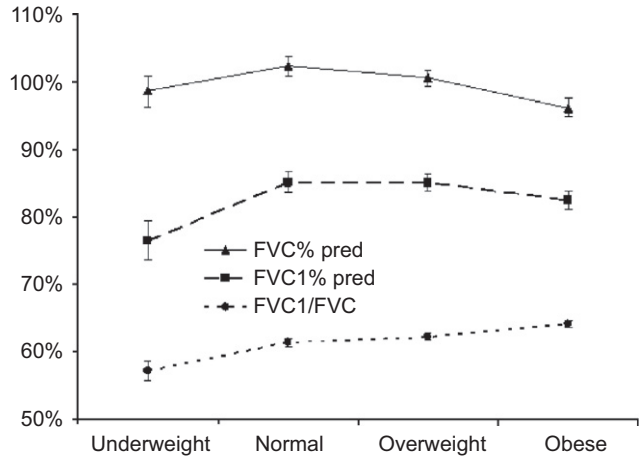

Figure 3 Lung function in persons with COPD by BMI categories using PLATINO predicted values.

Table 4 Regression model explaining BMI among male subjects with COPD ($n = 397$).

	Coefficient	95% confidence interval		*p*-Value
Age (per year)	−0.07	−0.12	−0.03	0.001
Former smoker	0.61	−0.49	1.71	0.278
Current smoker	−1.64	−2.87	−0.42	0.009
GOLD stage II	0.52	−0.50	1.53	0.317
GOLD stages III and IV	−2.92	−4.74	−1.11	0.002
Dyspnea	0.39	−0.53	1.30	0.407
Wheeze	1.17	0.32	2.02	0.007
Cough	−0.55	−1.49	0.40	0.257
Phlegm	−0.29	−1.29	0.71	0.571
Santiago	1.64	0.34	2.94	0.013
Mexico City	1.34	−0.23	2.90	0.095
Montevideo	1.44	0.14	2.73	0.030
Caracas	0.27	−1.06	1.60	0.690
Education < 3 years	−0.62	−1.85	0.61	0.324
Constant	30.31	27.16	33.47	<0.001

Model $R^2 = 0.1501$.

Table 5 Regression model explaining BMI among female subjects with COPD ($n = 343$).

	Coefficient	95% confidence interval		*p*-Value
Age (per year)	−0.02	−0.08	0.03	0.409
Former smoker	−0.09	−1.60	1.41	0.902
Current smoker	−3.13	−4.49	−1.77	<0.001
GOLD stage II	−1.56	−2.82	−0.31	0.015
GOLD stages III and IV	−2.48	−4.75	−0.22	0.032
Dyspnea	2.42	1.24	3.59	<0.001
Wheeze	1.30	0.06	2.53	0.039
Cough	0.55	−0.85	1.94	0.441
Phlegm	0.25	−1.26	1.76	0.742
Santiago	1.14	−0.66	2.94	0.214
Mexico City	−0.77	−2.74	1.20	0.444
Montevideo	0.64	−1.12	2.40	0.476
Caracas	0.04	−1.68	1.75	0.968
Education < 3 years	−1.61	−2.99	−0.23	0.022
Constant	28.22	24.50	31.94	<0.001

Model $R^2 = 0.1365$.

(GOLD stages III and IV) were associated with lower BMI, while wheeze and residing in Santiago and Montevideo were associated with higher BMI, with the model explaining about 15% of variation in BMI. In females, current smoking, lower education level (<3 years), and GOLD stages II–IV were associated with lower BMI, whereas dyspnea and wheeze were associated with higher BMI, with the model explaining about 14% of variation in BMI.

Discussion

The PLATINO study was designed to evaluate the prevalence of COPD in five Latin American cities. However, the data offer a good opportunity to assess different aspects of the disease in a population-based sample. We found a progressive increment in the proportion of COPD subjects as BMI decreased, with the converse in subjects without COPD. Compared with non-COPD subjects the proportion of COPD subjects in the underweight and normal-weight categories were higher, whereas in the obese category was lower. In the COPD population the overall age-adjusted differences in BMI strata were not different among countries. The factors associated with lower BMI in male COPD subjects were aging, current smoking, and GOLD stages III and IV while wheeze and residing in Santiago and Montevideo were associated with higher BMI. In females with COPD, current smoking, lower education and GOLD stages II–IV were associated with lower BMI, whereas dyspnea and wheeze were associated with higher BMI.

During the last decade the influence of the BMI on different epidemiologic and functional aspects of COPD has become an area of increasing research interest. Several studies have documented a clear association between low BMI with poor prognosis and mortality in patients with established COPD.[7,18,19,31,33] Additionally, there is evidence suggesting that COPD prevalence increases as BMI decreases and that low BMI increases FEV_1 decline and subsequent risk for getting COPD.[7,18,19,31,33]

Nutritional depletion has been commonly reported in COPD patients.[18,19,26–28] The prevalence of nutritional depletion in outpatient COPD populations by body compositional analysis varied from 20% to 45%.[26,27] In moderate-to-severe COPD patients recruited from out-patient centers, Vermeeren et al.[27] reported that 73% had normal BMI and normal fat-free mass index (FFMI), 15% normal BMI and low FFMI, 1% low BMI and normal FFMI and 11% low BMI and low FFMI. On the other hand, using data on patients with COPD identified in an epidemiologic study, Vestbo et al.[19] showed that 83.8% had normal or high BMI and FFMI above the 10th

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percentile, 13.1% normal or high BMI and FFMI below the 10th percentile, 0.7% low BMI and FFMI above the 10th percentile, and 2.4% low BMI and FFMI below the 10th percentile.

To our knowledge, no previous assay has examined the characteristics of a COPD population by BMI categories from an international multicenter population-based study. Our results indicate that in COPD subjects the FEV_1/FVC ratio, wheezing and dyspnea progressively increased from underweight to obese category, whereas the proportion of current smokers progressively decreased as BMI increase. We also found that compared with non-COPD population there was higher proportion of COPD subjects falling in the underweight and normal-weight categories. However, the analysis of the total COPD population shows that 93% of them had normal or high BMI ($>20\,kg/m^2$). This is in agreement with Vestbo et al., who reported that 96.9% of the COPD population had normal or high BMI.[19] Compared with the studies of outpatients the prevalence of COPD patients with low BMI was found to be much lower in our study.[25–33] These differences may be due by the source of the populations studied; both our study and Vestbo's[19] included patients with COPD identified in a population survey, whereas the others included patients from either small or selected populations. Data from these latter studies usually included a higher proportion of symptomatic patients and those with advanced COPD stages than do studies based on a large unselected population.

The other important aspect assessed in the present study was the analysis of the COPD population by BMI strata in five different cities. Geographical and regional variations in BMI have been reported in the general population.[41,42] Some of the studies indicate that these variations are partly explained by illiteracy, sedentary lifestyle, and, to a lesser extent by energy intake. To our knowledge no previous study has evaluated geographical variations of BMI in COPD. We found that, in subjects with COPD, the overall differences in BMI categories were not significant among countries ($p>0.05$). These results do not support the geographical influence in the BMI of COPD subjects; however the results of regression models for factors explaining BMI in COPD suggest that, after adjustment for other factors, residing in Santiago and Montevideo was associated with higher BMI in males. It is possible that the evaluation of several geographical regions better reflects the global reality of the BMI stratum of subjects with COPD.

Several studies have assessed the factors associated with nutritional status in selected COPD populations.[8,19,25,27–30] Some of these have suggested a relationship between malnutrition, impaired pulmonary status and female gender. Individuals with low weight have more hyperinflation, lower diffusing capacity, and lower exercise capacity.[25,29,30] Recent reports have suggested a relationship between unexplained weight loss and various mediators of inflammation.[8] Little information is available regarding the factors influencing BMI in a population-based sample of persons with COPD. The study of Vestbo et al indicated that BMI decreased with increasing COPD severity, in particular in women.[19] Our results showed that age, current smoking, dyspnea, wheeze, GOLD stages, education level and residing in Santiago and Montevideo were the main factors influencing BMI among COPD subjects. In addition they suggested that, using locally derived reference values, an important association exists between the BMI and lung function in COPD. The influence of others factors such as gender and smoking consumption on the nutritional state are well established. It is worth noting that our models for both genders had a relatively low predictive ability, suggesting that other factors (e.g. not measured in PLATINO) may have an even greater effect on BMI in COPD. The lack of previous information about this issue in other multicenter population-based studies makes it difficult to make comparisons with our results.

The knowledge of the COPD prevalence by BMI categories and the factors that influence the BMI in these patients is very important because they may help to better understand the important association between BMI with COPD morbidity and mortality and also because some of them are amenable to intervention.

Finally, there are some limitations of the present study that deserve to be discussed. First, because of the characteristics of the PLATINO study, our definition of COPD was based on postbronchodilator $FEV_1/FVC < 0.70$ at a single examination. Although this is the most widely accepted definition for COPD, it represents a simplified case definition for epidemiological purposes and not a definitive clinical diagnosis. Second, the analysis of nutritional status was based only on the assessment of BMI. Although BMI is a marker with a widely accepted prognostic value and a well-known association with morbidity outcomes in COPD, other measures such as body composition have been recommended to evaluate nutritional condition in these patients. Because of the design of the PLATINO study, these types of analyses could not be obtained; therefore it is likely that our results may tend to underestimate the true rate of nutritional depletion in COPD, and in the entire population as well. Third, this is a cross sectional looking at a population at a given point in time and not a longitudinal study. Therefore it only provides the frequency and characteristics of the disease in this population taking place when the study was conducted. It is possible that higher mortality among COPD subject with the lowest BMI causes a selection effect–if so, this would tend to underestimation of the observed effects.

In summary, the results of this study indicate that the proportion of persons with COPD progressively increased as BMI decreased. In addition compared with the non-COPD group, the proportion of COPD subjects in the underweight and normal-weight categories were higher, while in the obese category was lower. However, even among persons with COPD, more than half have a high BMI. No differences in BMI strata of COPD subjects were found among the countries. Current smoking, age, GOLD stages, education level, residing in Santiago and Montevideo, dyspnea and wheeze were independently associated with BMI in persons with COPD.

Conflict of interest statement

None of the authors have a conflict of interest to declare in relation to this work.

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