Original Article

Body mass index, airflow obstruction and dyspnea and body mass index, airflow obstruction, dyspnea scores, age and pack years-predictive properties of new multidimensional prognostic indices of chronic obstructive pulmonary disease in primary care

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Abstract:

BACKGROUND: The assessment of the severity of chronic obstructive pulmonary disease (COPD) should involve a multidimensional approach that is now clearly shown to be better than using spirometric impairment alone. The aim of this study is to validate and compare novel tools without an exercise test and to extend prognostic value to patients with less severe impairment of Forced expiratory volume 1 s.

METHODS: A prospective, observational, primary care cohort study identified 458 eligible patients recruited from the primary care clinics in the northeast of England in 1999–2002. A new prognostic indicator - body mass index, airflow obstruction and dyspnea (BOD) together with the conventional prognostic indices age, dyspnea and airflow obstruction (ADO), global initiative for chronic obstructive lung disease (GOLD) and new GOLD matrix were studied. We also sought to improve prognostication of BOD by adding age (A) and smoking history as pack years (S) to validate BODS (BOD with smoking history) and BODAS (BOD with smoking history and age) as prognostic tools and the predictive power of each was analyzed.

RESULTS: The survival of the 458 patients was assessed after a median of 10 years when the mortality was found to be 33.6%. The novel indices BOD, BODS, and BODAS were significantly predictive for all-cause mortality in our cohort. Furthermore with ROC analysis the C statistics for BOD, BODS, and BODAS were 0.62, 0.66, and 0.72, respectively ($P < 0.001$ for each), whereas ADO and GOLD stages had a C statistic of 0.70 ($P < 0.001$) and 0.56 ($P < 0.02$), respectively. GOLD Matrix was not significant in this cohort.

CONCLUSION: BOD, BODS, and BODAS scores are validated predictors of all-cause mortality in a primary care cohort with COPD.

Key words:
Age, airflow obstruction, body mass index, chronic obstructive pulmonary disease, dyspnea, mortality, multidimensional prognostic index, smoking history

Chronic obstructive pulmonary disease (COPD) is a complex disease. Patients with COPD experience multiple clinical problems that significantly impair functional, physiological and psychological health. An abnormal inflammatory response of the lungs and airways to noxious particles (usually from smoking cigarettes) leads characteristically to persistent airflow limitation and associated multi-system disorders.[1-4] Comorbidities, however, impact on the prognosis of patients with COPD to the extent that there is a poor correlation between spirometric impairment and disability as evidenced by health status, exercise capacity, and dyspnea.[2-5] In addition,

it has been found that low body mass index (BMI), loss of lean body mass, exacerbation frequency, reduced capacity for exercise, and perceived breathlessness are all independently associated with mortality.[6-11] It has now become generally accepted that the assessment of COPD progression should adopt a multidimensional approach and as cigarette smoking is associated with other potentially fatal comorbidities associated with COPD, incorporating an estimate of the intensity of exposure to tobacco smoke could improve prognostication.

In 2004, Celli *et al.*[12] showed that BMI, airflow obstruction and dyspnea exercise capacity (BODE), a multidimensional index of the severity of COPD (incorporating BMI, airflow obstruction [spirometry], dyspnea [Medical Research Council (MRC) score] and an exercise test with 6 min walk test [SMWT]) proved to be a better predictor of mortality than forced expiratory volume 1 s (FEV_1) alone. The scoring of the BODE index is not complex but the SMWT requires expertise, time, and resources which are not always available in primary care clinics. Moreover, the cohort used for BODE consisted of hospital attendees with a mean FEV_1 percent predicted ($FEV_1\%$) of 43.2% and 92.5% were males. Thus, generalizability to a milder group of COPD patients and especially to women was uncertain. Subsequently, Puhan *et al.*[13] proposed another index "ADO" (age, dyspnea and airflow obstruction). In their cohort, ADO and a re-scaled BODE had a similar accuracy for predicting the risk of death but age has been regarded as a confounder and therefore inappropriate for incorporation into a prognostic tool.[14] The index dyspnea, obstruction, smoking, exacerbation (DOSE)[15] constructed to identify the risk of exacerbations has been shown to predict mortality principally on hospitalized patients[16] but the use of smoking status in DOSE limits the precision of this component as the lifetime burden of smoking is not taken into account. For an index constructed to predict exacerbation rate, current smoking status is highly appropriate but if the impact of comorbidities is to be accounted for, then pack years may be more important.[17]

This study observed a cohort of patients with COPD derived from primary care clinics in the UK over a 10 years' period, with an equal gender divide and less impaired spirometry than the BODE cohort.[12] Because exercise testing utilizing the SMWT has not been widely adopted and may not be cost-effective in primary care settings, we tested the multidimensional index BOD (BODE without an exercise test) as a potential indicator of the natural history of COPD. We hypothesized that patients with higher BOD scores would have a higher mortality. We also compared BOD with BODS and BODAS - BOD plus age (A) and/or smoking intensity (S) - as alternative prognostic indicators.

Methods

Study design and patients

A prospective primary care cohort study was conducted between September 1999 and December 2002. We investigated patients suspected of having COPD who were attending clinics in a number of general practices in Sunderland, UK. Spirometry was conducted according to British Thoracic Society guidelines[18] and the diagnosis was based on these results using global initiative for chronic obstructive lung disease (GOLD) criteria for diagnosis and severity.[19] Patients were included if the FEV_1/forced vital capacity (FVC) ratio was <0.70. The other inclusion criteria were age > 40 years, cardinal COPD symptoms such as chronic cough (with or without sputum), breathlessness (with or without exertion), wheezing, and chronic airway obstruction. All patients were clinically stable and on standard COPD treatment. Patients with reversible airflow obstruction (>15% and >200 ml postbronchodilator increase in FEV_1) were excluded. This study was approved by the Sunderland Local Research Ethics Committee.

Data collection

We recorded age, gender, smoking status, and smoking history (pack years); comorbidities, quantified as per Charlson index; BMI; MRC dyspnea score;[20] pre- and post-bronchodilator FEV_1 and FVC. Because the history of exacerbations is an important component of the new GOLD system, history of exacerbations or hospital admissions was also collected.

Outcome assessment

Patients were evaluated at baseline for the three novel prognostic indices (BOD, BODS, and BODAS). All-cause mortality data for the whole cohort was collected up to 31 December 2010 using unique National Health Service identifying numbers from the UK Registrar General's database.

For calculating the scores for our proposed indices BOD, BODS, and BODAS, we followed a similar scoring system as was used for BODE [Table 1]. With no clear guidelines or evidence available for grouping of data about age and pack years we adopted the illustrated scoring based on ANOVA related to mortality. Yielding a range of possible scores of 0–7 for BOD, 0–10 for BODS and 0–14 for BODAS. For further analyses, these scores were divided into categories of score [as outlined in the legend to Table 1] because there were insufficient deaths to use all the individual scores to validate the indices as prognostic indicators.

Statistical analysis

Data for continuous variables are presented as mean ± standard deviation (SD) or number (%) The normality of the datasets was checked via the Kolmogorov–Smirnov test. Baseline differences between survivors and nonsurvivors were analyzed. For continuous variables, the Mann–Whitney U-test and Student's *t*-test was employed for nonparametric and parametric data, respectively. Chi-square was used for comparison of nominal variables. Kaplan–Meier survival analysis (KMSA)[21] was employed to assess the ability of $FEV_1\%$ predicted (GOLD stages), ADO, BOD, BODS, and BODAS to predict the binary outcome, death or survival over 10 years. Furthermore, Cox regression analysis was utilized to test covariates for modeling the time to the specified event. To ensure the reliability of the model, the data were randomly split into two parts. The first part was used to build the model and the second part to validate it. Receiver operating characteristic (ROC) curves were then used to determine the sensitivity of BOD, BODS, BODAS, and also ADO,[13] old GOLD stages and new GOLD staging/matrix A-D[19,22] and MRC scores as indicators of mortality, utilizing the "C" statistic (area under the ROC curve [AUC]).[23] C varies between 0.5 and 1.0 for sensible models; the higher the value, the greater the sensitivity of the model. A simultaneous

Table 1: Calculation of the body mass index, airflow obstruction and dyspnea, body mass index, airflow obstruction, dyspnea scores and pack years and body mass index, airflow obstruction, dyspnea scores, age and pack years scores and categories

Indices of severity	Measurements used in different models				
	BMI (kg/m²)	FEV$_1$% (%)	MRC score (1-5)	Age (years)	Pack years (years)
BOD scores (0-7)	(B)	(O)	(D)		
0	>21	≥65	1-2		
1	≤21	50-64	3		
2	NA	36-49	4		
3	NA	≤35	5		
BODS scores (0-10)	(B)	(O)	(D)		(S)
0	>21	≥65	1-2		0-10
1	≤21	50-64	3		11-30
2	NA	36-49	4		31-45
3	NA	≤35	5		>45
BODAS scores (0-14)	(B)	(O)	(D)	(A)	(S)
0	>21	≥65	1-2	40-49	0-10
1	≤21	50-64	3	50-59	11-30
2	NA	36-49	4	60-69	31-45
3	NA	≤35	5	70-79	>45
4	NA	NA	NA	80-89	NA

Scores of each variable used in the newly developed indices. For BOD scores: 0-1 = Category 1; 2-3 = Category 2; 4-5 = Category 3; 6-7 = Category 4. For BODS scores: 0-1 = Category 1; 2-4 = Category 2; 5-7 = Category 3; 8-10 = Category 4. For BODAS scores: 0-2 = Category 1; 3-5 = Category 2; 6-8 = Category 3; 9-14 = Category 4. NA = Not available; BMI = Body mass index; BOD = Body mass index; airflow obstruction and dyspnea; BODS = Body mass index; airflow obstruction; dyspnea scores and pack years; BODAS = Body mass index; airflow obstruction; dyspnea scores; age and pack years; FEV$_1$ = Forced expiratory volume 1 s; MRC = Medical Research Council

comparison of discrimination for all models was performed using the method for nonparametric correlated AUCs as proposed by DeLong *et al.*[24] All the data were analyzed using SPSS version 20.0 (SPSS Inc., Chicago, IL, USA) except for the utilization of MedCalc (MedCalc Software, Mariakerke, Belgium) for ROC analysis. Data are presented as mean ± SD unless otherwise stated.

Results

Subject characteristics
Between 1999 and 2002, 458 eligible patients with COPD were recruited. Overall, 154 patients died during the 10 years follow up. The mean age of the cohort was 64.7 ± 9.7 years and 51% (*n* = 233) were females. 87% of the cohort was either current or ex-smokers, but 53% of women compared with 29% of men were still smoking. Consequently, the mean pack year history of 33.0 ± 18.9 years was similar in both genders. The baseline characteristics of the survivors and deceased with their mean scores on the prognostic indicators and GOLD staging are presented in Table 2. Because there were no differences between men and women (*P* = 0.32) in all measurements and also because a Cox regression analysis of a random split of the cohort showed similar mortality in both samples, the whole cohort has been used in subsequent analyses.

Predictive power for mortality among prognostic indices
Overall, higher BOD scores were associated with higher 10 years mortality; with a BOD score of zero having a 22.9% mortality; 1–30.8%; 2–25.6%; 3–43.3%; 4–52.0%; 5–55.2%; and 6–71.4%. Figure 1 shows a KMSA of BOD scores 0–6 and clearly delineates the greater 10 years mortality with an increase of score (no subject had a BOD score of 7).

Table 2: Baseline demographics for the cohort

Characteristics	Survivors (304)	Nonsurvivors (154)	P
Age (years)	62.0±9.2	69.69±8.7	<0.001
Gender (male/female)	144/160	81/73	0.28
Current or ex-smokers	260	141	
BMI (kg/m²)	26.3±5.1	25.0±5.0	0.007
Smoking history (years)	30.2±18.2	38.3±19.3	<0.001
MRC score (1-5)	2.3±1.0	2.7±1.0	<0.001
Old GOLD stages (1-4)	2.1±0.7	2.3±0.8	0.002
New GOLD groups A-D (%) (GOLD matrix)	A (11)	A (2)	NS (0.6)
	B (49)	B (31)	
	C (2)	C (4)	
	D (4)	D (0)	
FEV$_1$ predicted	63.3±20.3	55.8±19.9	<0.001
BOD categories (1-4)	1.5±0.7	1.9±0.8	<0.001
BODS categories (1-4)	1.8±0.0.8	2.4±0.9	<0.001
ADO (1-8)	2.9±1.4	4.1±1.6	<0.001
BODAS categories (1-4)	2.3±0.7	2.9±0.7	<0.001

BOD = Body mass index; airflow obstruction and dyspnea; BODS = Body mass index; airflow obstruction; dyspnea scores and pack years; ADO = Age; airflow obstruction and dyspnea scores; BODAS = Body mass index; airflow obstruction; dyspnea scores; age and pack years; MRC = Medical Research Council; FEV$_1$ = Forced expiratory volume 1 s; Gold = Global initiative for chronic obstructive lung disease

As indicated in the legend to Table 1 the indices BOD, BODS and BODAS were further grouped into categories with a higher category indicating more severe disease. GOLD and ADO scores were treated in the same way and Table 3 shows the number in each category and the proportion deceased at 10 years for these prognostic indices.

Figures 2-6 show KMSA curves representing the time course of the probability of survival for the indices used in this

study. Compared with GOLD stages 1–4, the BOD, BODS and BODAS curves are more widely separated suggesting better discrimination, with GOLD Stage 4 mortality of 50% compared with the BOD category 4 mortality of 57% and the BODAS category 4 mortality of 77%.

Receiver operating characteristic analysis
ROC analysis [Table 4] yielded objective comparisons of these indices together with new GOLD groups and ADO. From the

Table 3: Stages of severity: Numbers per category and percent deceased

Stages of severity and categories	Deceased percentage (*n*)				
	Old GOLD	ADO	BOD	BODS	BODAS
1	21 (73)	21 (144)	22 (226)	20 (146)	12 (46)
2	28 (240)	32 (204)	32 (152)	22 (173)	17.5 (182)
3	36 (119)	56 (97)	50 (70)	46 (97)	36.5 (172)
4	50 (24)	93 (13)	57 (8)	64 (40)	77 (56)

BOD = Body mass index; airflow obstruction and dyspnea; BODS = Body mass index; airflow obstruction; dyspnea scores and pack years; ADO = Age; airflow obstruction and dyspnea scores; BODAS = Body mass index; airflow obstruction; dyspnea scores; age and pack years; Gold = Global initiative for chronic obstructive lung disease
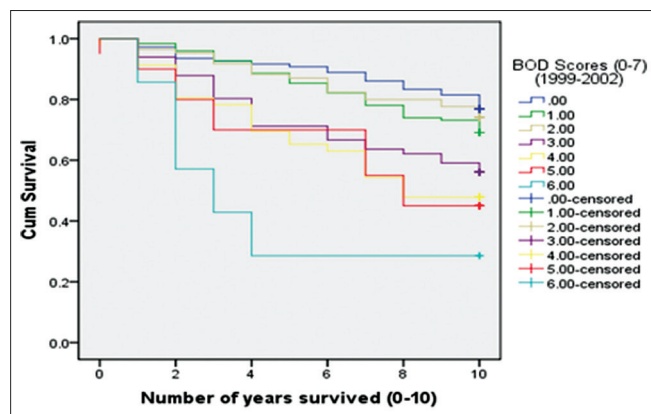

Figure 1: Kaplan–Meier survival analysis curves using BOD scores. BOD=Body mass index, airflow obstruction and dyspnea
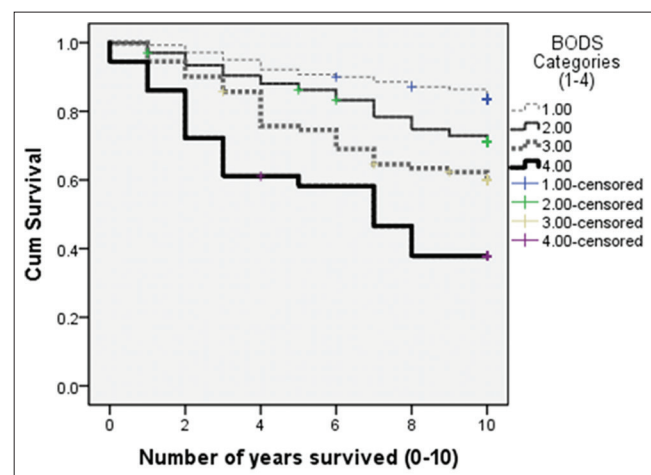

Figure 3: KMSA curves representing the time course of the probability of survival for BODS categories (long rank test; *P* < 0.001). BODS=Body mass index, airflow obstruction, dyspnea scores and pack years, KMSA=Kaplan–Meier survival analysis

"C" statistics, it is evident that BODAS yielded the highest C value of 0.72, whereas the old and new GOLD Matrix staging was not significant as an indicator. Figures 7 and 8 show the ROC curves for each of the indices for their respective scores and categories, respectively.

The ROC curves and the statistics show that the best overall predictive measure was BODAS with the highest value for Youden index (0.3212) and sensitivity (71%) and the largest AUC (0.72, 95% confidence interval: 0.671–0.762), but BOD had the highest specificity (77%).

Discussion

Body mass index, airflow obstruction and dyspnea
We identified a cohort of 458 patients (51% female) with COPD in primary care between 1999 and 2002 and have tested a number of multidimensional tools to evaluate the clinical impact of the disease. With 10 years mortality as the relevant outcome and focusing on the simplest index, the data support
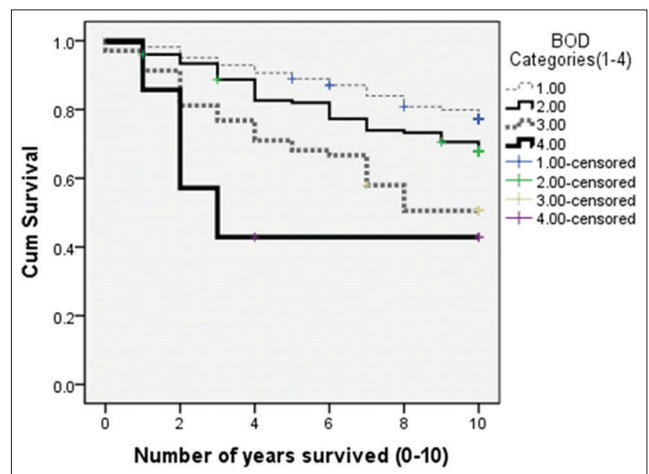

Figure 2: KMSA curves representing the time course of the probability of survival for BOD categories (long rank test; *P* < 0.001). BOD=Body mass index, airflow obstruction and dyspnea, KMSA=Kaplan–Meier survival analysis
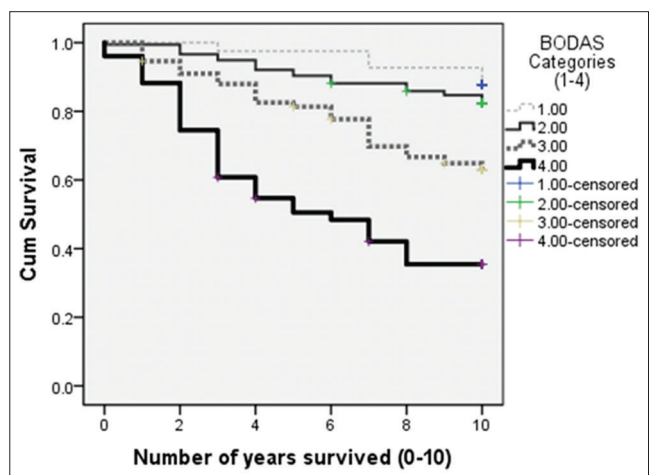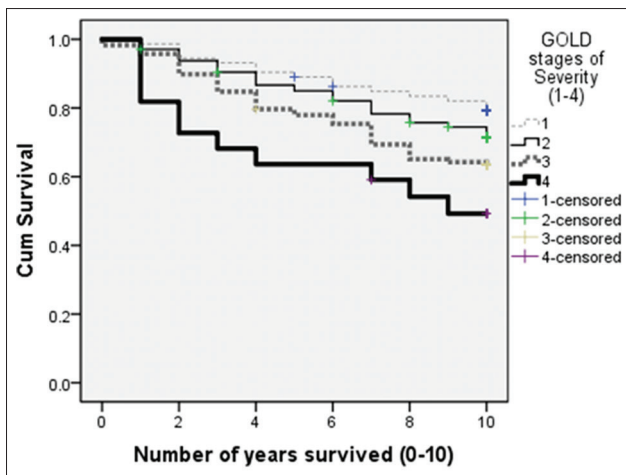

Figure 4: KMSA curves representing the time course of the probability of survival for BODAS categories (long rank test; *P* < 0.001). BODAS=Body mass index, airflow obstruction, dyspnea scores, age and pack years, KMSA=Kaplan–Meier survival analysis

Table 4: Values of C and their statistical significance derived from receiver operating characteristic curves for study indices with sensitivity and specificity

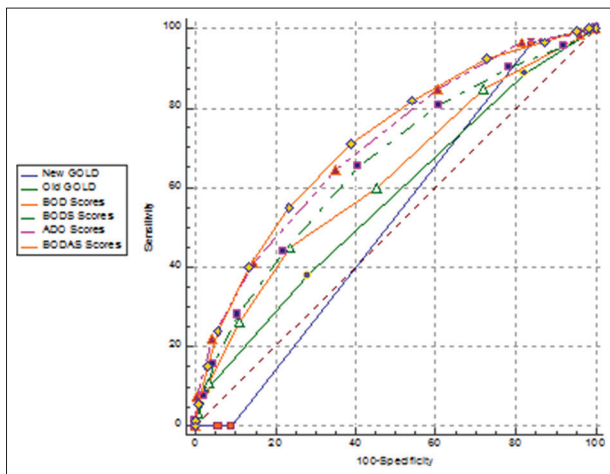|	BODAS scores	BOD scores	BODS scores	GOLD (matrix)	GOLD stages	ADO scores
AUC	0.72	0.62	0.66	0.52	0.56	0.70
SE[a]	0.025	0.027	0.027	0.016	0.026	0.025
95% CI[b]	0.671-0.762	0.577-0.668	0.615-0.706	0.471-0.564	0.521-0.614	0.661-0.747
Z statistic	8.602	4.445	5.895	1.061	2.59	8.080
Significance level *P* (area=0.5)	<0.0001	<0.0001	<0.0001	0.2889	<0.009	<0.0001
Youden index J	0.3212	0.2178	0.2432	0.1093	0.1009	0.2872
Associated criterion	>5	>2	>4	>1	>2	>3
Sensitivity	71.23	44.81	65.07	94.16	37.6	64.05
Specificity	60.88	76.97	59.25	16.78	72.4	64.67

[a]DeLong *et al.*, 1988; [b]Binomial exact. CI = Confidence interval; SE = Standard error; AUC = Area under the ROC curve; ROC = Receiver operating characteristic; ADO = Age; dyspnea and airflow obstruction; Gold = Global initiative for chronic obstructive lung disease


Figure 5: KMSA curves representing the time course of the probability of survival for GOLD stages (long rank test; *P* < 0.001). KMSA=Kaplan–Meier survival analysis, Gold=Global initiative for chronic obstructive lung disease
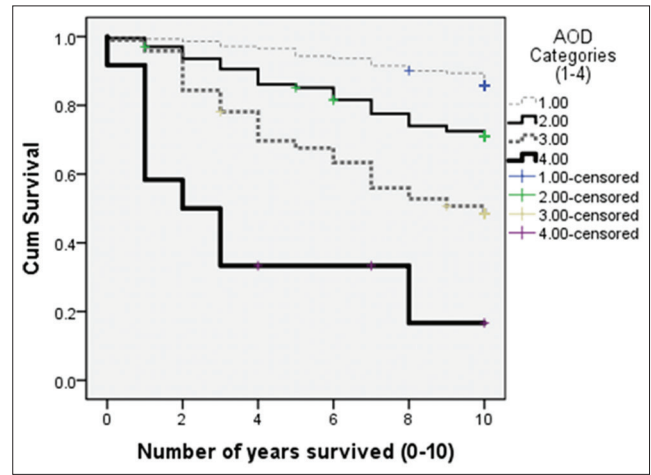
Figure 6: KMSA curves representing the time course of the probability of survival for ADO categories (long rank test; *P* < 0.001). ADO=Age, dyspnea and airflow obstruction, KMSA=Kaplan–Meier survival analysis, Gold=Global initiative for chronic obstructive lung disease

Figure 7: ROC curves for the respective scores of BODAS (0.72), ADO (0.71), BODS (0.66), BOD (0.63) scores, GOLD (0.56), GOLD matrix A–D (0.51). BOD=Body mass index, airflow obstruction and dyspnea, BODS=Body mass index, airflow obstruction, dyspnea scores and pack years, BODAS=Body mass index, airflow obstruction, dyspnea scores, age and pack years, ADO=Age, dyspnea and airflow obstruction, Gold=Global initiative for chronic obstructive lung disease
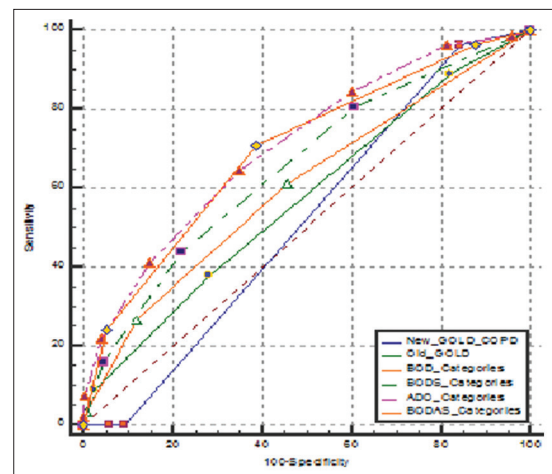
Figure 8: ROC curves for the respective categories of BODAS (0.69), ADO (0.71), BODS (0.65), BOD (0.60) scores, GOLD (0.56), GOLD matrix A–D (0.52). BOD=Body mass index, airflow obstruction and dyspnea, BODS=Body mass index, airflow obstruction, dyspnea scores and pack years, BODAS=Body mass index, airflow obstruction, dyspnea scores, age and pack years, ADO=Age, dyspnea and airflow obstruction, Gold=Global initiative for chronic obstructive lung disease

our hypothesis that higher BOD scores are associated with higher mortality. The added value of this multidimensional

tool is that it clearly demonstrates that when compared with GOLD staging based on impairment of spirometry alone, a

composite index incorporating disability correlates better with disease outcome. Moreover, it is of interest that the new GOLD matrix did not achieve statistical significance as a prognostic indicator in this cohort. BODE incorporates two factors relating to dyspnoea (MRC score and an exercise test), so it is not surprising that BOD can perform in an equivalent fashion. Nevertheless, to deal with doubt about the comparability of BOD and BODE, a subset of survivors in 2007/2008 was studied whereby an excellent correlation over the whole range of scores ($r = 0.94$) was found. The principal benefit of not having an exercise test is that BOD can be applied in all clinical environments as a cost-effective option.

Body mass index, airflow obstruction, dyspnea scores and pack years and body mass index, airflow obstruction, dyspnea scores, age and pack years

Smoking status was incorporated into the DOSE index as current smokers are more prone to exacerbations and DOSE was intended as a tool to predicted hospital admission for an exacerbation. Interestingly, adding smoking status to BOD did not improve prognostication. Instead, the possible influence of pack/years on mortality was explored in our cohort. To incorporate pack years and age into the BOD index, it was necessary to classify these new factors so they could be incorporated into a score. For age, the scores are given as recommended by a recent study[13] that categorized age into 6 categories (0–5). On the other hand, there is no consensus on how to categorize pack year history in patients with COPD. Previous studies[25-27] have used different categorizations. For example, Kweon *et al*.[28] divided their cohort into four categories, i.e., 0 pack years, 1–20, 21–40 and >40 pack years. Another study classified pack years 1–10, 11–20, 21–30, 31–40, 41–60, 61–80, and 81 or more.[29] In addition, the influence of pack years on COPD outcomes varies between genders[30] and subjects.[31] However, Hersh *et al*.[32] stratified their COPD cohort by the quartile of the number of pack years of smoking to examine their predictability. They found that lifetime cigarette consumption (per 10 pack years) was a significant predictor of mortality. This literature suggests that no standard recommendations are available that can be utilized to classify/quantify data on the basis of pack years history. Therefore, in this study pack years history has been divided into four categories (0–10, 11–30, 31–45 and >45). We derived the scoring as set out in Table 1 much as for the BODE scoring system and found that BODS was a better discriminant than BOD (C statistics of 0.66 and 0.63, respectively). This is in contrast to a lack of significance for the addition of smoking status as mentioned above. Not surprisingly, adding age to the index (BODAS) improved the predictive value further (C statistic of 0.72).

Comparison with other cohorts

Because the cohort was derived from urban primary care clinics in the postindustrial North-East of England, it differs from other cohorts used to validate prognostic indices for COPD. Consequently, our gender mix was approximately equal and the mean FEV_1 for the cohort was 60.9 ± 20.0%. Thus, we are prognosticating for patients with less severe COPD than with the BODE,[12] ADO,[13] DOSE[15,16] cohorts where mean values for FEV_1% predicted were 42.5%, 50%, and 51%, respectively and many other cohorts have similar severe degrees of impairment.[33-36] Importantly, these data have demonstrated

that the BOD index is applicable to both men and women (in contrast to BODE - 92% male) and of particular importance, to the less spirometrically impaired patients typically seen in primary care clinics. Because we studied patients attending primary care clinics and thus excluded housebound patients only, one patient had an MRC score of 5. Furthermore, many individuals with very severe impairment of FEV_1 (NICE/ GOLD IV) were found to be long-term survivors, i.e. around a 41% survival at 10 years whereas individuals with the worst category of BOD scores showed only a 28.6% survival. Our study differs also in having a long period of observation - a median of 10 years that is significantly greater than any of the studies cited above where 2–3 years is the norm.

Using a prognostic index

The use of BODE to identify the risk of mortality has become widely accepted. And the data presented here clearly confirm that a multidimensional approach is better than using FEV_1 alone. Moreover, it shows that an exercise test is not needed to assess the prognosis of patients attending primary care clinics. The BOD score is simple to calculate and in the UK a read code[37] exists for computerized record keeping in primary care. One could argue that the earlier in the disease process one initiates therapy and motivates patients to alter their lifestyle (especially smoking cessation) the more likely is prognosis to improve and that the potential of influencing 10 year mortality may seem to be the more feasible option to an individual patient. Thus, the persistence of smoking among women in this cohort is a concern and may be attributable to underdiagnosis of COPD as it is well established that primary care physicians tend to prefer an alternative diagnosis in women when presented with a clinical scenario typical of COPD.[38] Smoking cessation, therefore, is an intervention that could be effective in this way were the physician or health-care worker aware of the diagnosis of COPD and the prognosis suggested by a prognostic score. An additional possibility for those with high scores would be that a need for end-of-life discussion can be highlighted to health professionals. Interestingly, recent work has demonstrated the value of this approach[39] with patients having a category 4 BOD score in a primary care practice being identified and all who died were enabled to avail themselves of this opportunity in a timely fashion.

BODS and BODAS scores which contain the immutable elements of age and pack/years are less amenable to improvement than BOD as age is inexorable and smoking history has happened. In this regard, reducing one's BOD score by one point is likely to be more readily achievable. An uncontrolled observational study finding that completion of a pulmonary rehabilitation program improved BODE scores and that this was associated with increased survival.[40] Our data allow the risk associated with individual BOD scores to be used [Figure 1] and not having SMWT will facilitate the wider adoption of a more holistic approach represented by an awareness of a patient's BOD score, particularly in primary care.

Limitations

A number of limitations were encountered during the study. One of them is that the study only examined the utility of the multidimensional index BOD but not BODE in predicting 10-year mortality in COPD patients and did not examine the recommended index BODE because the initial database was

established between 1999 and 2002 whereas the BODE index was published in 2004.[12] It is relevant that in considering thirty potential staging variables for use in a multidimensional assessment of COPD,[12,13,15,33] Celli *et al.*[12] selected the three elements of the BOD index because they are reproducible, sensitive to change, provide independent information and have prognostic value. A principal components analysis confirmed their validity (together with bronchodilator reversibility, health status, and symptoms of cough and sputum) as representing independent categories of prognostic information. This *a priori* justification of BOD has been validated by our results. Furthermore, because our cohort was derived in primary care clinics the severe end of the spectrum is underrepresented. Moreover, differs in this regard from those mainly or completely sourced from hospital attendees.[11-14] Younger patients with COPD tend not to feature in symptomatic groups with COPD, and further research would be needed to clarify their risk.

Body mass index, airflow obstruction and dyspnea, body mass index airflow obstruction and dyspnea exercise capacity or body mass index, airflow obstruction, dyspnea scores, age and pack years?

BOD index might be preferred over other indices as it is simpler to calculate, requires no additional resources beyond spirometry and is readily applicable in all clinical settings. It yields prognostic multidimensional information and can facilitate therapeutic and other interventions. We feel that as its three elements are open to improvement, BOD is to be preferred to BODAS for which age and pack/years are immutable. There are many survival studies using BODE so it should be possible for others to reproduce or refute our findings utilizing their historical data in their more severely affected hospital derived cohorts. In addition, studies are also needed to investigate the relationships of these indices with other COPD outcomes such as health status, disability, comorbidities, exacerbations, and hospitalization.

Conclusion

This study will further assess new models and validated predictors of all-cause mortality in a primary care cohort with COPD.

Conflicts of interest
There are no conflicts of interest.

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