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Original article

Chronic obstructive pulmonary disease outpatients bear risks of both unplanned weight loss and obesity

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SUMMARY

Background & aims: Malnutrition is commonly seen in chronic obstructive pulmonary disease (COPD) and has been associated with negative outcomes. The objective of this study was to examine unintended weight loss (UWL) within three months, as a primary indicator for disease related malnutrition among COPD outpatients, to evaluate the prevalence of UWL, and to identify possible characteristics for UWL.
Methods: A cross-sectional study including a patient questionnaire and medical record data extraction was made with all patients visiting a Danish COPD outpatient clinic.
Results: Among the 200 included patients (68.7 $\pm$ 11.2 years of age), UWL was seen in 21.5%, with a median weight loss of 3.5 (2—16) kg. Underweight (BMI<18.5 kg/m2) was recognized in 13.5%, while 34.5% were obese (BMI>30 kg/m2). Reduced food intake (RFI) within the past week was experienced among 22.0% of the patients. The most common nutrition impact symptoms (NIS) were shortness of breath, reduced appetite and nausea. NIS, RFI and BMI<18.5 kg/m2 were associated to UWL, while co-morbidities, hospitalization within three months and resent exacerbations showed no association to UWL.
Conclusions: A high prevalence of UWL was found in COPD outpatients, and NIS and RFI as characteristics associated with UWL. Shortness of breath, reduced appetite and nausea were the most common NIS. This study found 13.5% of patients underweight, 23.5 overweight and 34.5% obese. Underweight as well as obesity may have negative consequences for the patient and the community.

1. Introduction

Malnutrition is a commonly seen problem and is often caused by an underlying disease [1]. Malnutrition challenges the individual as well as the community, as it is associated with depression, reduced physical ability, longer hospitalizations and rehabilitation, reduced quality of life, poorer response to treatment and increased mortality [1—8]. Malnutrition and low body mass index (BMI) among patients diagnosed with chronic obstructive pulmonary disease (COPD) is widely known [9—11]. Several studies found that COPD patients with low BMI experience decreased lung function and spirometry values [12—15]. Among patients with COPD, 10—45%

have been shown to be malnourished and it has been frequently shown and unintended weight loss (UWL) in the previous 3—12 months, depending on setting is often reported [9,11,12,15]. UWL is included as an element in all malnutrition risk screening tools used in COPD patients [16—18]. Malnourished COPD patients have been shown to be at greater risk of further exacerbations, and the risk of negative outcomes accelerates with stage of COPD from mild/moderate to severe [9,15,19].

Reduced food intake (RFI) among COPD patients affects the patients muscle strength, which may potentially lead to worsened respiratory muscle function [19]. RFI among COPD patients is also associated with low physical activity, which reduces skeletal muscle mass and bone tissue [9,18]. It is difficult to determine whether malnutrition is caused by worsening of COPD but based on previous studies an association between malnutrition and the stage of COPD is known. Based on existing evidence, there is a need for a greater attention to strengthening nutritional status among COPD patients. Therefore, The Danish Health Authority

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recommend further focus for early detection for nutritional risk among COPD patients [20], however the outpatient setting is not mentioned in this statement. Not all patients with COPD need nutritional intervention and since nutritional screening, assessment and intervention are time-consuming tasks that require specific knowledge, we find it relevant to identify the prevalence of UWL and whether UWL may be used as initial indicator for further nutritional screening in the COPD outpatient clinic.

According to The Danish Association for Pulmonary Diseases, 2019, 160.000 Danish patients are diagnosed with COPD and it is assumed that the double amount remain undiagnosed. Patients are followed in general practice when stable, and unstable patients, as well as patients confined to oxygen therapy are mainly followed in the outpatient clinic. There are no numbers for nutritional risk in COPD patients in outpatient clinics, and no recommendations for screening patients for disease-related malnutrition in Danish outpatient clinics. Screening patients for malnutrition may enable nurses or dieticians when available, to initiate an early nutritional effort in patients at risk of negative outcomes related to malnutrition. In the outpatient clinic, clinicians (nurses and doctors) have a very short time for contacts with patients and therefore tools used for screenings must be targeted and not take too long to use. In Denmark dieticians are rarely represented in the pulmonary outpatient clinics, which may be due to this lack of numbers for the prevalence of malnutrition risk.

Therefore, the aim of this study was to examine the prevalence of UWL within the past three months among patients affiliated to a COPD outpatient clinic, and to identify if UWL may be a relevant indication used as initial indicator for further nutritional screening in the outpatient clinic. Furthermore, the second aim was and to identify possible nutritional risk factors for UWL among patients.

2. Materials and methods

This study was a cross-sectional study based on a patient questionnaire as well as data collected from medical records. We consecutively included the entire sample of COPD patients affiliated to the COPD outpatient clinic at a Danish University Hospital. Inclusions were made during a period of six months, from November 2020 to May 2021. Data collection was extended due to COVID-19.

2.1. Sample

The COPD outpatient clinic is organized and physically placed within the Department of Pulmonary Diseases. The COPD population visiting the outpatient clinic is a quite heterogeneous population. This COPD outpatient clinic currently follows 218 patients, and we aimed to include all patients, in order for the study to be representative of our population, and to meet the sample of Mete et al. [13]. Most patient past the age of 65 are furthermore affiliated to a community COPD database, for which they measure and enter their weight weekly. These community data are not associated with the hospital patient records.

2.2. Procedure

Inclusion criteria were 1. ≥18 years of age and 2. willing to sign an informed consent after written and oral information in Danish or English. Patients were excluded if did not want to be weighed, could not clearly report a weight measured within the past week, did not want to have height measured or could not clearly report their height measured within the past year.

The patients were recruited in the waiting room before their clinical consultation. The investigator approached the patients and gave oral and written information about the study. If the patients wanted to participate in the study, they signed the statement of consent, and thereafter the questionnaire was completed along with the measurements of height and weight. The patients either completed the questionnaire by themselves or the investigator sat next to them and helped fill it out based on the patients information. The database "Clinical suite" was used to access the patients' medical records by the investigator afterwards.

2.3. Questionnaire

The questionnaire was developed by last author and it was tested in prior studies [21,22]. In total, there were five questions. The first questions were the background questions: *Gender* (male, female or other), *age* (years), *weight* (kg), *height* (cm) and *education level* (none, shorter courses, vocational, short, medium or long education). Thereafter, 2. *UWL* (yes or no), if yes then the amount of weight loss (kg), 3. *Reduced food intake* (*RFI*) within the last week (yes or no), 4. *Intended weight loss* (yes or no), if yes then the amount of weight loss (kg). 5. *Nutrition impact symptoms* (*NIS*) (nausea and/or worries and/or appetite and/or shortness of breath and/or lack of help for cooking/shopping and/or pain and/or swallowing problems and/or constipation and/or discomfort in the mouth and throat and/or do not like eating alone). The patients were able to apply more than one answer at question 5. UWL was defined as a minimum of two kilos of stable weight loss (disregarding day to day change) within three months [23,24]. RFI was defined as an estimated intake less than 75% compared to usual [16,25].

2.4. Statistical analysis

REDCap (Research Electronic Data Capture) was used for data management and STATA (version STATA/MP 16.1 for Windows) was used to complete the statistical analysis. Chi^2 tests and simple logistic regression analysis were performed regarding associations between UWL and the independent variables. A significance level of 0.05 was used ($p < 0.05$). Reference group was chosen as the group with the highest number of records.

Missing data were excluded from the analysis. For descriptive statistics, number of filled-in replies (N) and percent (%), mean ± standard deviation (SD) or median ± range were presented. As the patients could give more than one answer at question 5, some of the included patients seem duplicated in the descriptive statistics. UWL was used as the only dependent variable. Independent variables were: Sex, age, BMI, Gold stage, RFI, NIS, asthma, emphysema, hospitalization, smoking, education level and civil status. All independent variables were assumed potential risk factors for UWL. BMI was categorized regarding to the WHO-definition [26]. To describe severity of COPD, data of forced expiratory volume (FEV-1) were categorized by Global Initiative for Chronic Obstructive Lung Disease (GOLD) grading system as used in former studies [27].

2.5. Ethical considerations

The study was forwarded to the ethical committee, who found that further approval was not required according to the Danish legislation. The North Jutland data protection agency approved the study, application ID 2020−119. The study was performed according to the Helsinki declaration of 2013 [28]. Patients gave written informed consent at inclusion.

3. Results

3.1. Demographic data

In this study 200 patients affiliated to a Danish University Hospital COPD outpatient clinic were included. Eighteen patients were not included in the study, which gave a response rate of 92%. Of these, eight patients did not want to be weighed or did not know or want to share information about current weight, three could not oversee participation, two were not able to provide informed written consent, and five were missed while the investigator was measuring other patients. Demographic data are presented in Table 1.

3.2. Nutritional status and weight loss

Within the included patients, a few were underweight (BMI <18.5 kg/m^2), and more than one third had a BMI of 30 or above. We found that 21.5% of the patients reported UWL within the past three months with a median weight loss of 3.5 kg (2—16 kg). Almost one fourth suffered RFI in the past week, and many of the patients with UWL also had RFI. Intended weight loss within the past three months was only seen in few. Data are presented in Table 2.

NIS were seen among 42% of patients. Shortness of breath, reduced appetite and nausea were the most pronounced NIS. Data are presented in Table 3.

3.3. Lung function and COPD related variables

Among the included patients, close to one third were categorized with moderate COPD severity and a little more with severe COPD according to GOLD stage. Asthma-COPD overlap syndrome (ACOS) was found common and many had emphysema. Within the past three months, 12.6% of the patients had been hospitalized caused by COPD exacerbation, and a little less had been hospitalized for other reasons than COPD. COPD municipality rehabilitation was noted in 196 of patient records. Of these, 155 were offered municipality rehabilitation. Between these, 49 refused, four did not take the whole program, 73 completed the entire program and 29 accepted rehabilitation but no information was provided on status for completion. Data about lung function and diagnose related variables are presented in Table 4.

3.4. Associations related to unintended weight loss

A significant association was found between UWL and BMI, RFI and NIS. Patients who were underweight had higher OR for UWL.

Table 1
Demographic data.

Variable	N (%), median (range), mean ± SD	Total = n
Sex, woman (n (%))	111 (55.5)	200
Age, years (mean ± SD)	68.7 (11.2)	200
BMI, kg/m^2 (median (range))	26.7 (12.9—61.3)	200
Education (n (%))		
Non or shorter courses	87 (43.5)	200
Short or Vocational (1—3 years)	90 (45.0)	
Medium long or long (>3 years)	23 (11.5)	
Civil status (n (%))		200
Live alone	90 (45.0)	
Cohabitant	110 (55.0)	
Smoking (n (%))		197
Never smokes	7 (3.6)	
Former smoker	156 (79.2)	
Smoker	34 (17.3)	

Table 2
Nutritional status and weight loss.

Variable	N (%)/median (range)	Total = n
BMI Groups, kg/m^2 (n (%))		200
Underweight <18.5	27 (13.5)	
Normal weight 18.5—24.9	57 (28.5)	
Pre-obesity 30.0—34.9	47 (23.5)	
Obesity ≥35	69 (34.5)	
Unintended weight loss, yes (n (%))	43 (21.5)	200
Unintended weight loss, kg (median, range)	3.5 (1—16)	42
Reduced food intake, yes (n (%))	44 (22.0)	200
Unintended weight loss + reduced food intake, yes (n (%))	17 (39.5)	44
Intended weight loss, yes (n (%))	7 (3.5)	200
Intended weight loss, kg (median, range)	2.5 (1—6)	6

Table 3
Nutrition impact symptoms.

Variable, N = 183	N (%)
Experience nutrition impact symptoms, es (n (%))	84 (42.0)
Which nutrition impact symptoms? yes (n (%))	
Shortness of breath	52 (61.9)
Reduced appetite	36 (42.9)
Nausea	21 (25.0)
Swallowing problems	14 (16.7)
Pain	11 (13.1)
Worries	11 (13.1)
Constipation	5 (6.0)
Oral problems (pain, mouth sores, fungus)	4 (4.8)
Do not like eating alone	4 (4.8)
Lack of help for cooking/shopping	2 (2.4)

Table 4
Lung function and hospitalizations.

Variable	N (%)	Total = n
Gold stage, FEV1 (%) (n (%))		164
Mild >80	14 (8.5)	
Moderate 50-80	51 (31.1)	
Severe 30-50	60 (36.6)	
Very Severe <30	39 (23.8)	
Lack of Alfa-1-antitrypsin, yes (n (%))	13 (6.6)	197
Asthma-COPD overlap syndrome, yes (n (%))	51 (26.7)	191
Emphysema (hyperinflation), yes (n (%))	118 (60.2)	196
Hospitalization COPD exacerbation in the last 3 months, yes (n (%))	25 (12.6)	199
Hospitalization other reasons in the last 3 months, yes (n (%))	21 (10.6)	199
Non-invasive ventilation at home, yes (n (%))	12 (6.0)	199

Furthermore, patients who experienced RFI and NIS had higher OR for UWL. No significant association was shown between UWL and gender, age, GOLD Stage, asthma, emphysema, smoking, hospitalization related to COPD, hospitalization for other reasons, education level or civil status. Results are presented in Table 5.

4. Discussion

This cross-sectional study accepted the hypothesis of high prevalence of UWL in COPD outpatients, and NIS and RFI as characteristics associated with UWL. Shortness of breath, reduced appetite and nausea were the most common NIS. In this study, we examined the prevalence of UWL as an initial indicator for disease related malnutrition in COPD patients in an outpatient clinic. We found that 21.5% of the included patients suffered UWL within the past three months, with a median weight loss of 3.5 kg. The

Table 5
Associations related to UWL.

Unintended weight loss (yes)		
	OR [95% CI]	p-value
Sex		0.963
Women	Reference	
Men	0.98 [0.50; 1.94]	
Age		0.932
<60	0.96 [0.37; 2.53]	
60–69	0.78 [0.34; 1.80]	
70–79	Reference	
>79	1.03 [0.37; 2.83]	
BMI		0.000*
Underweight <18.5	8.22 [2.77; 24.38]*	
Normal weight 18.5–24.9	3.46 [1.31; 9.13]*	
Pre-obesity 30.0–34.9	1.55 [0.51; 4.75]	
Obesity >35	Reference	
GOLD Stage		0.656
Mild >80	1.5 [0.34; 6.56]	
Moderate 50-80	1.0 [0.35; 2.84]	
Severe 30-50	Reference	
Very severe <30	1.8 [0.63; 5.12]	
Reduced food intake		0.003*
No	Reference	
Yes	3.15 [1.50; 6.59]	
Nutrition impact symptoms		0.002*
No	Reference	
Yes	2.96 [1.47; 5.95]	
Asthma		0.983
No	Reference	
Yes	1.01 [0.46; 2.20]	
Emphysema		0.331
No	Reference	
Yes	1.42 [0.69; 2.91]	
Smoking		0.851
Never smokes	0.58 [0.07; 4.95]	
Former smoker	Reference	
Smoker	0.89 [0.36; 2.23]	
Hospitalization related to COPD, last 3 months		0.195
No	Reference	
Yes	1.87 [0.75; 4.68]	
Hospitalization for other reasons than COPD, last 3 months		0.068
No	Reference	
Yes	2.51 [0.97; 6.53]	
Education level		0.216
Non or shorter courses	0.59 [0.28; 1.25]	
Short or Vocational (1–3 years)	Reference	
Medium long or long (>3 years)	1.35 [0.49; 3.71]	
Civil status		0.108
Living alone	1.74 [0.88; 3.44]	
Cohabitant	Reference	

* Statistical significance.

prevalence of UWL in this study is consistent with the results from previous studies regarding various settings, where 10–45% of the COPD patients were found malnourished [12,15]. Since one out of five in this study experienced UWL and 13.5% were underweight, and the prevalence is confirmed by former studies from other settings and countries, we find it realistic to assume that risk of malnutrition would also be found by screening among the majority of patients identified by UWL. Nutritional screening does not take place in the outpatient clinic, and even though some COPD municipality rehabilitation programs take care of nutritional screening and intervention when relevant, this is inconsistent, and even more, our data showed that less than half our patients completed municipality rehabilitation [29]. Aiming at early intervention before the onset of sarcopenia and cachexia (2, 4, 10, 12), we therefore find there is a need to have focus on early identification of nutritional risk among COPD patients in the outpatient clinics.

We also investigated possible characteristics among the COPD patients with UWL. COPD patients that were already underweight

had higher odds for UWL ($p < 0.05$). Existing evidence found that underweight and weight loss contribute to the risk of exacerbations and progress stage of COPD [15,30], and RFI may lead to loss of body weight [9]. In the present study, patients with a GOLD stage <30 had higher OR of having UWL, although the association was not statistically significant. Mete et al. found an association between FEV1 and Medical Research Council Dyspnoea Scale (MRC) and malnutrition measured by Mini nutritional assessment (MNA) among 105 patients [12]. We however did not use full screening, as our approach was to use a tool likely to implement by nurses in the clinical setting. Therefore, an association might have been found if we had used full nutrition screening and other indicators for COPD severity. A firm association was found between RFI and UWL ($p < 0.05$). These results are consistent with previous studies [9,15,30]. In this study, we did not investigate, for how long the patients had the disease diagnosis, and a few were yet in the investigation phase. This may affect the results regarding the prevalence of patients, that had experienced an UWL, as patients especially seem to lose weight around the time of diagnosis and on times of exacerbations and other disease events [31–33]. This was not shown in the associations between UWL and hospitalizations ($p > 0.05$), although patients with one or more hospitalizations within the past three months had higher OR of having UWL, however not statistically significant.

This study found a great variation of BMI, mean 26.7 (12.9–61.3) kg/m^2 [26]. Among the included patients, 34.5% of the patients were obese (BMI$\geq$30 kg/m^2), but there were no significant association between UWL and the obesity group. The very high prevalence of obesity indicates that obesity may require consideration upon physiological risk factors among those caring for COPD patients. Obesity is known to contribute to respiratory illness, such as sleep apnea, asthma and pulmonary embolism [34,35]. Furthermore, obesity in COPD patients has been associated with increased risk of development of comorbidities including diabetes, metabolic syndrome and cardiovascular disease even increasing the risks of the general population [36–38]. Furthermore, sarcopenic obesity may influence pulmonary as well as physical function [39]. In that view, early recognition of the need for a thorough nutritional assessment and intervention are not only important looking at the risks of negative associated consequences for COPD patients who are underweight but also for COPD patients with obesity. We did not investigate how patients with an intended weight loss lost weight e.g., by dietetic guidance, training as for instance in pulmonary rehabilitation programs or cutting down on foods, but it is certain that weight loss in patients with inflammatory diseases such as COPD, should be guided by professionals like trained dieticians, in order not to lose muscle mass. Results of this study highlights the necessity for early recognition of UWL as well as increasing obesity among COPD patients, in order to enhance optimal pulmonary function, and maybe even reduce further exacerbations and development of comorbidities.

4.1. Study strengths and limitations

In this study, some data is missing due to the lack of possibility to find sufficient data in all patients' medical records. Therefore, a few associations related to UWL were not calculated on full cases and eventual patterns in missing data may have affected the results. Questionnaires were based on patient reported data, providing the risk of recall bias for those who were not weighed on sight but claimed to be sure of their current weight. However, the majority of patients who are past 65 years of age, measure and enter weight data in the community database weekly. These data are reported every Monday morning, and since the COPD outpatient clinic is confined to Mondays, the weight was measured and reported on

the same morning. Unfortunately, this study did not investigate body composition, as patients due to the inclusion method, were not able to follow the strict guidelines for fasting before measuring. Furthermore, we were informed that functional measures of 30-sec chair stand test and 6 min walking test were to be found in patient records. However many of these measurements were very old, and we did not find it gave meaning to include them. A larger follow-up study including body composition measured by bio impedance and physical function measures is upcoming and should reveal the association between these factors and morbidity and comorbidity outcomes.

5. Conclusion

This study found a 21.5% prevalence of nutritional risk measured by UWL as the initial indicator for the need for further nutritional screening and assessment in COPD outpatients. COPD patients who were underweight, and those with NIS and RFI, had higher OR for UWL. Shortness of breath, reduced appetite and nausea were the most common NIS. Among the included patient, 13.5% were underweight and 34.5% were obese, which indicate that nutritional screening and guidance is important for both COPD patients who are underweight and obese, as underweight as well as sarcopenic obesity may have significant negative consequences for the patients as well as for the community. A broader perspective on health issues related to malnutrition, including also obesity and physical function is needed. UWL measured by nurses in the outpatient clinic, at least in those who are underweight or complain about NIS, seems feasible as well as safe and cost effective. Intuitive screening regarding obesity seems obvious. Referral possibilities to clinical dietician would enable the clinical perspective of early intervention upon the hereby recommended initial screening for disease related malnutrition and obesity.

References

[1] Cederholm T, Jensen GL, Correia MITD, Gonzalez MC, Fukushima R, Higashiguchi T, et al. GLIM criteria for the diagnosis of malnutrition — a consensus report from the global clinical nutrition community. J Cachexia Sarcopenia Muscle 2019;10:207—17. https://doi.org/10.1002/jcsm.12383.
[2] Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. Clin Nutr 2008;27:5—15. https://doi.org/10.1016/j.clnu.2007.10.007.
[3] Barker LA, Gout BS, Crowe TC. Hospital malnutrition: prevalence, identification and impact on patients and the healthcare system. Int J Environ Res Publ Health 2011;8:514—27. https://doi.org/10.3390/ijerph8020514.
[4] Ingeman A, Andersen G, Thomsen RW, Hundborg HH, Rasmussen HH, Johnsen SP. Lifestyle factors and early clinical outcome in patients with acute stroke: a population-based study. Stroke 2017;48:611—7. https://doi.org/10.1161/STROKEAHA.116.015784.
[5] Saunders J, Smith T. Malnutrition: causes and consequences. Clin Med J Roy Coll Phys Lond 2010;10:624—7. https://doi.org/10.7861/clinmedicine.10-6-624.
[6] Fernández AC, Casariego AV, Rodríguez IC, Pomar MDB. Malnutrición en pacientes hospitalizados receptores de dietas nutricionalmente completas: prevalencia y repercusión. Nutr Hosp 2014;30:1344—9. https://doi.org/10.3305/nh.2014.30.6.7901.
[7] Aapro M, Arends J, Bozzetti F, Fearon K, Grunberg SM, Herrstedt J, et al. Early recognition of malnutrition and cachexia in the cancer patient: a position paper of a European School of Oncology Task Force. Ann Oncol 2014;25:1492—9. https://doi.org/10.1093/annonc/mdu085.
[8] Marshall S, Bauer J, Isenring E. The consequences of malnutrition following discharge from rehabilitation to the community: a systematic review of current evidence in older adults. J Hum Nutr Diet 2014;27:133—41. https://doi.org/10.1111/jhn.12167.
[9] Jung J-W, Yoon SW, Lee G-E, Shin H-G, Kim H, Shin JW, et al. Poor nutritional intake is a dominant factor for weight loss in chronic obstructive pulmonary disease. Int J Tubercul Lung Dis 2019;23:631—7. https://doi.org/10.5588/ijtld.18.0456.
[10] Kwan HY, Maddocks M, Nolan CM, Jones SE, Patel S, Barker RE, et al. The prognostic significance of weight loss in chronic obstructive pulmonary disease-related cachexia: a prospective cohort study. J Cachexia Sarcopenia Muscle 2019;10:1330—8. https://doi.org/10.1002/jcsm.12463.
[11] Nguyen HT, Collins PF, Pavey TG, Nguyen NV, Pham TD, Gallegos DL. Nutritional status, dietary intake, and health-related quality of life in outpatients with COPD. Int J COPD 2019;14:215—26. https://doi.org/10.2147/COPD.S181322.
[12] Mete B, Pehlivan E, Gülbaş G, Günen H. Prevalence of malnutrition in COPD and its relationship with the parameters related to disease severity. Int J COPD 2018;13:3307—12. https://doi.org/10.2147/COPD.S179609.
[13] Grigsby MR, Siddharthan T, Pollard SL, Chowdhury M, Rubinstein A, Miranda JJ, et al. Low body mass index is associated with higher odds of COPD and lower lung function in low- and middle-income countries. COPD J Chronic Obstr Pulm Dis 2019;16:58—65. https://doi.org/10.1080/15412555.2019.1589443.
[14] de Blasio F, Di Gregorio A, de Blasio F, Bianco A, Bellofiore B, Scalfi L. Malnutrition and sarcopenia assessment in patients with chronic obstructive pulmonary disease according to international diagnostic criteria, and evaluation of raw BIA variables. Respir Med 2018;134:1—5. https://doi.org/10.1016/j.rmed.2017.11.006.
[15] Hsieh MJ, Yang TM, Tsai YH. Nutritional supplementation in patients with chronic obstructive pulmonary disease. J Formos Med Assoc 2016;115:595—601. https://doi.org/10.1016/j.jfma.2015.10.008.
[16] Kondrup J, Ramussen HH, Hamberg O, Stanga Z, Camilo M, Richardson R, et al. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. Clin Nutr 2003;22:321—36. https://doi.org/10.1016/S0261-5614(02)00214-5.
[17] Abe Vicente M, Barão K, Donizetti Silva T, Forones NM, Tewksbury C, Crowley N, et al. Rapid and reliable self-screening for nutritional risk in hospital outpatients using an electronic system. Nutr Hosp 2013;28:1271—6. https://doi.org/10.3305/nh.2013.28.3.6413.
[18] Matkovic Z, Cvetko D, Rahelic D, Esquinas C, Zarak M, Miravitlles M, et al. Nutritional status of patients with chronic obstructive pulmonary disease in relation to their physical performance. COPD J Chronic Obstr Pulm Dis 2017;14:626—34. https://doi.org/10.1080/15412555.2017.1386643.
[19] Keogh E, Mark Williams E. Managing malnutrition in COPD: a review. Respir Med 2021;176:106248. https://doi.org/10.1016/j.rmed.2020.106248.
[20] Danish National board of Health. National Clinical Guideline for rehabilitation in Patients with COPD (National klinisk retningslinje for rehabilitering af patienter med KOL 2018). 2018. p. 1—77.
[21] Mette H, Nina Z, Trine Ø, Sabina M. Disease related malnutrition in hospital outpatients, - time for action. Int J Food Sci Nutr Res 2019;1. https://doi.org/10.31546/ijfsnr.1002.
[22] Holst M, Rasmussen HH, Bruun KS, Otten RE, Geisler L. Nutritional risk in pulmonology outpatients and health Professionals`Professionals`Perspectives on nutritional practice, vol. 1; 2019.
[23] Socialstyrelsen. Faglige anbefalinger og beskrivelser af god praksis for ernæringsindsats til ældre med uplanlagt vægttab. 2015.
[24] Sundhedsstyrelsen. Oplæg om ernæringsindsatser for den ældre medicinske patient. 2017.

[25] Holst M, Beermann T, Mortensen MN, Skadhauge LB, Lindorff-Larsen K, Rasmussen HH. Multi-modal intervention improved oral intake in hospitalized patients. A one year follow-up study. Clin Nutr 2015;34. https://doi.org/10.1016/j.clnu.2014.05.001.

[26] World Health Organization (WHO). Body mass index - BMI. 2021.

[27] Laudisio A, Costanzo L, Di Gioia C, Delussu AS, Traballesi M, Gemma A, et al. Dietary intake of elderly outpatients with chronic obstructive pulmonary disease. Arch Gerontol Geriatr 2016;64:75—81. https://doi.org/10.1016/j.archger.2016.01.006.

[28] World Medical Association. WorldMedical association declaration of Helsinki ethical principles for medical research involving human subjects. 2013. p. 2191—4.

[29] Holst M, Beck AM, Rasmussen HH, Lange P. Insufficient intake of energy and protein is related to physical functional capacity among COPD patients referred to municipality based pulmonary rehabilitation. Clin Nutr ESPEN 2019;30:35—41. https://doi.org/10.1016/j.clnesp.2019.02.009.

[30] Hallin R, Koivisto-Hursti UK, Lindberg E, Janson C. Nutritional status, dietary energy intake and the risk of exacerbations in patients with chronic obstructive pulmonary disease (COPD). Respir Med 2006;100:561—7. https://doi.org/10.1016/j.rmed.2005.05.020.

[31] Ingadottir AR, Beck AM, Baldwin C, Weekes CE, Geirsdottir OG, Ramel A, et al. Two components of the new ESPEN diagnostic criteria for malnutrition are independent predictors of lung function in hospitalized patients with chronic obstructive pulmonary disease (COPD). Clin Nutr 2017;37:1323—31. https://doi.org/10.1016/j.clnu.2017.05.031.

[32] Vermeeren MAP, Schols AMWJ, Wouters EFM. Effects of an acute exacerbation on nutritional and metabolic profile of patients with COPD. Eur Respir J 1997;10:2264—9. https://doi.org/10.1183/09031936.97.1010 2264.

[33] Marco E, Sánchez-Rodríguez D, Dávalos-Yerovi VN, Duran X, Pascual EM, Muniesa JM, et al. Malnutrition according to ESPEN consensus predicts hospitalizations and long-term mortality in rehabilitation patients with stable chronic obstructive pulmonary disease. Clin Nutr 2019;38:2180—6. https://doi.org/10.1016/j.clnu.2018.09.014.

[34] Mancuso P. Obesity and lung inflammation. J Appl Physiol 2010;108:722—8. https://doi.org/10.1152/japplphysiol.00781.2009.

[35] McClean KM, Kee F, Young IS, Elborn JS. Obesity and the lung: 1 · epidemiology. Thorax 2008;63:649—54. https://doi.org/10.1136/thx.2007.0 86801.

[36] Park SK, Larson JL. Metabolic syndrome and associated factors in people with chronic obstructive pulmonary disease. West J Nurs Res 2014;36:620—42. https://doi.org/10.1177/0193945913512423.

[37] Hanson C, Rutten EP, Wouters EFM, Rennard S. Influence of diet and obesity on COPD development and outcomes. Int J COPD 2014;9:723—33. https://doi.org/10.2147/COPD.S50111.

[38] Feary JR, Rodrigues LC, Smith CJ, Hubbard RB, Gibson JE. Prevalence of major comorbidities in subjects with COPD and incidence of myocardial infarction and stroke: a comprehensive analysis using data from primary care. Thorax 2010;65:956—62. https://doi.org/10.1136/thx.2009.128082.

[39] Schneider LP, Sartori LG, Machado FVC, Dala Pola D, Rugila DF, Hirata RP, et al. Physical activity and inactivity among different body composition phenotypes in individuals with moderate to very severe chronic obstructive pulmonary disease. Braz J Phys Ther 2021;25:296—302. https://doi.org/10.1016/j.bjpt.2020.07.005.