Universidade Estadual de Londrina

FABIANE FERREIRA MONTEIRO

OBESIDADE E ATIVIDADE FÍSICA NA VIDA DIÁRIA EM PACIENTES COM DPOC

Londrina
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Dissertação apresentada ao Programa de Pós-Graduação em Ciências da Reabilitação (Programa Associado entre Universidade Estadual de Londrina [UEL] e Universidade Norte do Paraná [UNOPAR]), como requisito parcial à obtenção do título de Mestre em Ciências da Reabilitação.

Orientador: Prof. Dr. Fábio de Oliveira Pitta

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RESUMO

Objetivo: Estudar as diferenças na composição corporal de pacientes com doença pulmonar obstrutiva crônica (DPOC) fisicamente ativos e inativos; e vefificar se existe relação entre obesidade e atividade física na vida diária nesta população. **Métodos:** Composição corporal (bioimpedância elétrica) e nível de atividade física na vida diária (AFVD) (monitores de atividade física: DynaPort e SenseWear) foram avaliados em 74 pacientes com DPOC (45 homens, 65±9anos, VEF_1=40±15%pred, IMC=27±6kg.m^{-2}). Os pacientes foram inicialmente separados em 2 grupos: fisicamente ativos (> 30 minutos/dia de tempo em atividade física [TAF] de intensidade no mínimo moderada, ou TAF>moderada) e inativos (não atingiam essas recomendações). A mesma amostra foi ainda dividida com base no índice de massa corpórea (IMC) em subnutridos, eutróficos, sobrepeso e obesos; e com base no percentual de gordura corporal (%GC) em obesidade moderada, obesidade elevada e obesidade mórbida. **Resultados:** No grupo completo, TAF>moderada se correlacionou modestamente com IMC (r=-0.28; p=0.02) e com a GC (Kg) (r=-0.30; p=0.001), mas não com a massa magra corporal (MMC) (Kg) (r=-0.18; p=0.13). Os pacientes fisicamente inativos apresentavam maior peso corporal, maior GC e menor MMC em % de peso corporal quando comparados com indivíduos ativos. Os pacientes obesos (com base no IMC) tiveram pior nível de AFVD do que paciente subnutridos, eutróficos e sobrepeso. Piores níveis de AFVD também foram observados em pacientes com obesidade mórbida com base na %GC apesar da modesta correlação entre GC e TAF>moderada no grupo completo. **Conclusões:** Pacientes com DPOC fisicamente ativos na vida diária possuem proporcionalmente mais MMC e menos GC do que pacientes fisicamente inativos. Inatividade física mais acentuada é observada em pacientes obesos, apesar da composição corporal em geral não poder ser considerada um fator fortemente correlacionado aos níveis de AFVD de pacientes com DPOC.

Palavras-chave: Doença Pulmonar Obstrutiva Crônica; obesidade; composição corporal; exercício; atividade física

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ABSTRACT

Purpose: To study differences in body composition in physically active and inactive patients with cronic obstructive pulmonary disease (COPD); and to study the relationship of obesity with physical activity in daily life (PADL) in this population. **Methods:** Body composition (bioelectrical impedance analysis), and level of PADL (activity monitors DynaPort and SenseWear) were evaluated in 74 patients with COPD (45 men, 65±9years, FEV_1=40±15%pred, IMC=27±6kg.m^{-2}). Patients were separeted in 2 groups: physically active (> 30 minutes/day of time spent in physical activity [TPA] of at least moderate intensity, or TPA>moderate) and inactive (did not achieve these recommendations). The sample was also classified according to the body mass index (BMI) in underweight, normal weight, overweight and obese; and according to their percentage of fat mass (%FM) in moderate obesity, high obesity and morbid obesity. **Results:** In the whole group, TPA>moderate correlated weakly with BMI (r=-0.28; p=0.02) and FM (r=-0.30; p=0.001) but not with FFM (r=-0.18; p=0.13). Physically inactive patients had higher body weight and higher FM and lower fat free mass (FFM) in % of body weight than active patients. Obese patients (according to BMI) had worse PADL level than underweight and normal weight patients. Poorer PADL also occurred in morbidly obese patients classified according to %FM, despite the weak correlation between FM and TPA>moderate in the whole group. **Conclusion:** Physically active patients with COPD have proportionally more FFM and less FM than inactive patients. More pronounced physical inactivity occurs in obese patients, although body composition in general does not qualify as an important correlate factor of the level of PADL in patients with COPD.

Key words: Chronic obstructive, pulmonary disease; obesity; body composition; exercise, physical activity.

LISTA DE TABELAS

LISTA DE ABREVIATURAS E SIGLAS

6MWT 6-Minute Walking Test

%FM Percentage of Fat Mass

%GC Percentual de Gordura Corporal

ACSM American College of Sports Medicine

AFVD Atividade Física na Vida Diária

BIA Bioelectrical Impedance Analysis

BMI Body Mass Index

COPD Chronic Obstructive Pulmonary Disease

DAM DynaPort Activity Monitor

DPOC Doença Pulmonar Obstrutiva Crônica

FFM Fat Free Mass

FFMI Fat Free Mass Index

FM Fat Mass

GC Gordura Corpórea**GOLD** Global Initiative for Chronic Obstructive Lung Disease

HO High Obesity

IMC Índice de Massa corpórea

LFIP Laboratório de Pesquisa em Fisioterapia Pulmonar

MbO Morbid Obesity

MET Metabolic Equivalent

MMC Massa Magra Corpórea

MO Moderate Obesity

NW Normal Weight

OB Obese

OMS Organização Mundial da Saúde

OW Overweight

PADL Physical Activity in Daily Life

SAB SenseWear Armband Activity Monitor

TAF>moderada Tempo Gasto Por Dia Em Atividade Física de intensidade ao menos moderada

TPA>moderate Time Spent in Physical Activity Of At Least Moderate Intensity

TW Time Spent Walking per day

UEL Universidade Estadual de Londrina

UW Underweight

VEF_1/CVF Razão entre Volume Expiratório Forçado no Primeiro Secundo (VEF_1) e Capacidade Vital Forçada (CVF)

SUMÁRIO

1 INTRODUÇÃO

A doença pulmonar obstrutiva crônica (DPOC) é caracterizada por comprometimentos pulmonares e extra-pulmonares. Além da limitação ao fluxo aéreo e dispnéia, a doença cursa com efeitos sistêmicos como redução da capacidade de exercício, força muscular e qualidade de vida (1). Alterações na composição corporal como redução de índice de massa corpórea (IMC) e de massa magra corpórea (MMC) são comumente observados, além de serem preditores indepedentes de mortalidade na doença (2-4). No entanto, com o crescimento dos índices mundiais de obesidade, inclusive em pacientes com DPOC (5;6), maior atenção tem sido dada não somente a pacientes com DPOC caracterizados por caquexia mas também aos pacientes considerados obesos.

Sabe-se que pacientes obesos apresentam alterações respiratórias importantes como aumento na demanda e no trabalho ventilatório, diminuição da complacência torácica e conseqüentemente maior dispnéia, tudo isso devido ao aumento de gordura acumulada em região torácica e abdominal (7). Essas alterações respiratórias associadas a problemas ortopédicos comuns da obesidade como dores articulares, lombalgias e edema, fazem com que a atividade física seja dificultada nesta população. Estudos mostram que pacientes com DPOC obesos (com base no IMC) possuem pior capacidade funcional de exercício quando comparados a pacientes com IMC normal (5;8).

As diretrizes de saúde pública a respeito da atividade física publicadas pelo American College of Sports Medicine (ACSM) recomendam que um mínimo de 30 minutos de atividade física de intensidade moderada é necessária para a manutenção ou desenvolvimento da capacidade física (9). Estudos anteriores mostraram que o nível de atividade física na vida diária (AFVD) é reduzido em pacientes com DPOC e que essa redução está associada a maiores índices de mortalidade (10).

Um estudo realizado por Park e cols (11) com mulheres saudáveis mostrou que aquelas que aprentavam maior percentual de gordura corporal apresentavam menor número de passo por dia e menos tempo em atividade física de intensidade moderada e vigorosa. O estudo discute ainda que a relação entre obesidade e atividade física diária deve ser discutida usando não apenas o IMC mas também o índice de massa de gordura corporal (GC) em kilos ou o percentual de gordura corporal (%GC), já que o IMC não expressa necessariamente a quantidade de GC. No entanto, ainda não se sabe se existe relação entre obesidade e nível de AFVD em pacientes com DPOC e se pacientes com maiores níveis de obesidade (com base no %GC) possuem piores níveis de AFVD. Sendo assim, os objetivos deste estudo foram: I) determinar se existem diferenças na composição corporal entre os pacientes com DPOC fisicamente ativos e inativos (de acordo com as recomendações da ACSM); II) verificar se os pacientes obesos (classificados pelo IMC) têm menor nível de AFVD do que pacientes subnutridos, eutróficos e sobrepeso; III) investigar se existem diferenças na capacidade funcional de exercício e nível de AFVD entre pacientes com diferentes níveis de obesidade determinada de acordo com a %GC.

2 REVISÃO DE LITERATURA – CONTEXTUALIZAÇÃO

2.1 DOENÇA PULMONAR OBSTRUTIVA CRÔNICA

Segundo o documento da **G**lobal **I**nitiative for Chronic **O**bstructive **L**ung **D**isease (GOLD), a Doença Pulmonar Obstrutiva Crônica (DPOC) é definida como uma doença prevenível e tratável com alguns efeitos extrapulmonares significantes que podem contribuir para a gravidade individualmente. A alteração pulmonar característica da doença é a limitação ao fluxo aéreo, que não é totalmente reversível. Esta limitação é geralmente progressiva e associada à resposta inflamatória anormal dos pulmões a partículas nocivas ou gases (1).

A Organização Mundial de Saúde (OMS) estima que a DPOC atinja 210 milhões de pessoas em todo o mundo, sendo dentre essas cerca de 64 milhões casos sintomáticos. A prevalência da doença é muito variável nas diferentes regiões do mundo, sendo as Américas responsáveis por 13,2 milhões dos casos sintomáticos (12). A DPOC está entre as maiores causas de morbidade e mortalidade em todo o mundo (13), e em geral está associada ao consumo do tabaco (1), sendo este responsável por cerca de 90% dos casos da doença. Segundo estimativa do Global Burden of Disease Study, devido à expansão da epidemia do tabagismo e às mudanças demográficas na maioria dos países (e.g., aumento da expectativa de vida), em 2020 a DPOC será a terceira principal causa de morte do mundo (14) e a quarta mais importante doença que leva a incapacidade física (1). O cigarro é o principal fator de risco para desenvolvimento da DPOC; no entanto, outros fatores como poluição ambiental, produtos químicos e tóxicos e até mesmo componentes genéticos podem estar associados ao desenvolvimento da doença. Devido ao seu caráter progressivo e incapacitante, acarreta um considerável impacto econômico e social, pela redução na produtividade, mortes prematuras, comprometimento do orçamento familiar, aposentadorias precoces e alto custo com o tratamento e com as internações, que são freqüentes (15). Quanto à morbidade nesses pacientes, apesar da literatura não apresentar dados claros e objetivos, estima-se que o aumento da idade e o sexo masculino estejam mais relacionados a maiores níveis de morbidade (16). No entanto, a tendência de prevalência para os homens, especialmente os mais jovens, é de estabilidade e até mesmo decréscimo, enquanto que para as mulheres é de crescimento (17). Dados de prevalência e morbidade podem ainda ser subestimados já que os pacientes são diagnosticados somente em fases mais avançadas da doença, quando os sinais clínicos começam a aparecer.

Em geral, a DPOC costuma ser diagnosticada por volta da quinta ou sexta década de vida (18) e o diagnóstico é feito com base em variáveis espirométricas. A razão volume expiratório forçado no primeiro segundo (VEF_1) / capacidade vital forçada (CVF), ou VEF_1/CVF <70% do predito em combinação com VEF_1 <80% do predito (pós-broncodilatador) em indivíduos que apresentam tosse produtiva, dispnéia ou exposição a fatores de risco confirmam o diagnóstico(1). No entanto, a avaliação da DPOC exclusivamente pela alteração pulmonar tem sido vista pela literatura como insuficiente, já que esta é reconhecidamente uma doença que cursa com alterações extrapulmonares significativas (19). Além da dispnéia, tosse, sibilância, produção de secreção e infecções respiratórias de repetição, consequências sistêmicas tais como descondicionamento, fraqueza muscular, inatividade física na vida diária, perda de peso, e desnutrição são frequentemente observadas (20;21). Problemas emocionais como depressão, ansiedade e isolamento social também são comumente encontrados em pacientes com DPOC (22). Os preditores de mortalidade na DPOC são maior idade e histórico tabágico, hipoxemia dispnéia e hipersecreção crônica mais acentuadas, maior redução na capacidade de exercício, atividade física na vida diária, massa e força muscular, baixo índice de massa corpórea e perda de peso excessiva (23).

2.2 Obesidade

A Organização Mundial de Saúde define a obesidade como o excesso de gordura corporal que gera implicações negativas para a saúde (24). A obesidade é uma condição complexa de dimensões sociais, biológicas e psicossociais consideráveis, podendo eventualmente afetar qualquer pessoa de qualquer idade ou grupo socioeconômico, em qualquer parte do mundo. É hoje considerada um fenômeno global que aumenta consideravelmente a morbidade e diminui expectativa de vida (7), sendo seu impacto mais pronunciado na morbidade do que na mortalidade (25).

Segundo a OMS, a prevalência da obesidade mais que dobrou desde 1980. Em 2008, 1,5 bilhões de adultos acima de 20 anos foram considerados sobrepeso, e dentre estes, mais de 200 milhões de homens e aproximadamente 300 milhões de mulheres foram considerados obesos (24). Dados mais recentes da OMS, mostram que 11,1% dos brasileiros adultos são considerados obesos (IMC≥30 $Kg.m^{-2}$) (26).

A obesidade é causada por um desequilíbrio entre ingestão e consumo calórico. Está relacionada a fatores genéticos, que são considerados não modificáveis, e fatores modificáveis como consumo calórico excessivo, sedentarismo e fatores psicológicos. Algumas doenças como hipotireoidismo, Síndome de Cushing e até mesmo medicações como esteróides e antidepressivos podem predispor o indivíduo a desenvolver obesidade.

A obesidade está fortemente relacionada a diversas comorbidades como hipertensão, doença arterial coronariana, câncer, apnéia obstrutiva do sono e osteoartrose, contribuindo diretamente para maior gravidade destas (27-29). É considerada ainda o maior fator de risco para doenças crônicas incluindo doenças cardiovasculares, cerebrovasculares e diabetes mellitus (30). O sistema respiratório também é bastante prejudicado pela obesidade. Resumidamente, a obesidade pode reduzir um terço da complacência torácica devido ao acúmulo de gordura torácica e abdominal (31), gerando aumento do trabalho respiratório e conseqüentemente ocasional dispnéia (32).

A forma mais comum de se graduar a obesidade é por meio da utilização do índice de massa corpórea (IMC). Este índice é internacionalmente conhecido (33) e amplamente utilizado em estudos epidemiológicos tendo sido incorporado à prática clínica devido à sua simplicidade e praticidade. No entanto, o IMC é uma relação simples entre peso corporal e altura, e portanto não é capaz de distinguir a gordura corporal da massa muscular (34). Sabendo-se que a massa muscular não causa prejuízo algum à saúde do indivíduo e que somente a gordura corporal está relacionada aos efeitos deletérios da obesidade (35), a medida exclusiva da gordura corporal parece ser melhor preditiva de obesidade do que o IMC, que leva em consideração apenas o peso corporal como um todo. Além disso, a literatura mostra que o IMC é considerado impreciso para detectar o percentual de gordura especialmente em populações com diferentes idades e tipos corporais (36). No entanto, apesar de todas essas limitações, o IMC continua sendo a ferramenta mais utilizada para classificar a obesidade devido à sua praticidade.

2.3 NÍVEL DE ATIVIDADE FÍSICA NA VIDA DIÁRIA

A atividade física é definida como qualquer movimento corporal produzido pelos músculos esqueléticos que resulta em gasto energético maior do que os níveis de repouso (37). Segundo a Organização Mundial de Saúde, a prática de atividade física regular reduz o risco de mortes prematuras, doenças do coração, acidente vascular cerebral, diabetes tipo II e câncer de cólon e de mama (38). Atua também na prevenção ou redução da hipertensão arterial, previne o ganho de peso (diminuindo o risco de obesidade), auxilia na prevenção ou redução da osteoporose, promove bem-estar, reduz o estresse, a ansiedade e a depressão. Especialmente em crianças e jovens, a atividade física interage positivamente com as estratégias para adoção de uma dieta saudável, desestimula o uso do tabaco, álcool e drogas, reduz a violência e promove a integração social (38). A atividade física regular está associada ainda à redução nos índices de morbidade e mortalidade, menor limitação funcional assim como menor número de quedas em idosos (39). Um estudo realizado pelo European Community Respiratory Health Survey II (ECRHS-II) mostrou que a inatividade física é um importante fator de risco para desenvolvimento de hiperresponsividade brônquica na população adulta em geral (40).

O sedentarismo é hoje considerado um problema mundial de saúde e está relacionado a altos custos com tratamentos, inclusive e principalmente hospitalares. Segundo dados do Centers for Disease Control and Prevention, só no ano de 2000 nos Estados Unidos o sedentarismo foi responsável pelo gasto de 76 bilhões de dólares com custos médicos, mostrando assim que seu combate merece prioridade na agenda de saúde pública (41). Segundo dados da OMS (42), a inatividade física é o quarto principal fator de risco para mortalidade.

Aproximadamente 3,2 milhões de mortes por ano são atribuídas aos baixos níveis de atividade física. O rápido crescimento das doenças crônicas associadas à inatividade física vem sendo registrado tanto nos países desenvolvidos como nos países em desenvolvimento, sendo que a maioria dos adultos nos países desenvolvidos é considerada inativa (42). A atividade física regular tem sido considerada como um dos principais componentes na prevenção do crescimento global de doenças crônicas.

As diretrizes de saúde pública a respeito da atividade física publicadas pelo American College of Sports Medicine (ACSM) (9) preconizam que sessões de trinta minutos de atividades físicas de intensidade moderada por dia, na maior parte dos dias da semana, desenvolvidas continuamente ou mesmo em períodos cumulativos de 10 minutos, já são suficientes para a manutenção ou para o desenvolvimento da aptidão física, independentemente da idade. Indivíduos que não atingem estes padrões mínimos são considerados insuficientemente ativos e apresentam um maior risco de morbi-mortalidade.

Um estudo feito nos EUA em 2005 mostrou que menos da metade dos adultos (41,9%) atingiram as recomendação de atividade física recomendadas pelo ACSM e que os homens cumpriam mais as recomendações em comparação com as mulheres (50,7% e 47,9%, respectivamente). Além disso, o estudo mostra que os jovens foram mais ativos que os mais velhos e que pessoas com nível de escolaridade maior são os que mais atingem as recomendações (41). Pessoas que não atingem as recomendações mínimas (ACSM) possuem 20 a 30% mais chance de mortalidade. Em 2008, mundialmente, 31% dos adultos com idade superior a 15 anos foram considerados inativos (28% dos homens e 34% das mulheres), sendo a região das Américas e Leste do Mediterrâneo as com maior prevalência de inatividade física. Em todos os países, os homens foram mais ativos que as mulheres. No Brasil, 49,4 % dos indivíduos foram considerados insuficientemente ativos (43).

Existem diversas formas de se quantificar o nível de atividade física na vida diária (AFVD). As principais formas são os questionários de auto-relato, os sensores de movimento como acelerômetros e pedômetros e métodos que mensuram diretamente o gasto energético como a técnica *doubly labeled water*

(44;45). Os questionários de auto-relato são bastante suscetíveis a viés, já que dependem da memória do avaliado. A literatura mostra que os questionários se correlacionam fracamente com a quantificação objetiva da AFVD (46;47) e não fornecem dados precisos de gasto energético (45). Pedômetros são sensores de movimento portáteis, baratos e de fácil manuseio; no entanto, fornecem somente informações básica como contagem de número de passos e não são eficazes na detecção de passos em intensidades baixas de movimento, fazendo com que seu uso seja questionável para determinadas populações (48), como pacientes com DPOC. Já os acelerômetros multiaxiais como o DynaPort (McRoberts, Holanda) e SenseWear Armband (BodyMedia, Estados Unidos da América), apesar de apresentarem um custo mais elevado, fornecem informações detalhadas sobre o padrão, tempo e intensidade da atividade física (47;49). Além disso, os sensores de movimento multiaxiais são mais úteis para avaliação de populações mais inativas, já que são mais sensíveis na avaliação de movimentos de baixa intensidade (44).

2.4 RELAÇÃO ENTRE DPOC, OBESIDADE E NÍVEL DE ATIVIDADE FÍSICA NA VIDA DIÁRIA

Tanto a obesidade como a inatividade física são fatores de risco modificáveis para diversas doenças crônicas e estão associados ao alto grau de inflamação sistêmica, o que pode potencializar efeitos negativos sobre a saúde e bem estar dos portadores destas doenças (50). Alterações na composição corporal e no nível de AFVD são preditores independentes de morbi-mortalidade em pacientes com DPOC (3;51-53). Assim como na população geral, estudos têm demonstrado que a obesidade vem crescendo exponencialmente em pacientes com DPOC (5;6). A obesidade está relacionada a diversas alterações respiratórias como aumento da demanda e do trabalho ventilatório, redução na complacência torácica e conseqüentemente maior grau de dispnéia (7). Um estudo publicado por Naimark e Cherniack mostrou que a complacência torácica em indivíduos obesos é reduzida a dois terços de um indivíduo normal, e tal fato é decorrente principalmente do acúmulo de gordura torácica e abdominal (31). A fraqueza muscular respiratória também está comumente presente na obesidade e tem sido atribuída à ineficiência muscular decorrente da redução da complacência torácica, do volume pulmonar ou ambos (54;55). Alterações respiratórias associadas a problemas ortopédicos, como por exemplo dor articular, que está comumente presente na obesidade, faz com estes paciente reduzam sua capacidade de exercício. Ramachandram e cols (5), realizaram um estudo com pacientes com DPOC obesos e demonstraram que apesar destes pacientes serem encaminhadas para reabilitação em estágios mais iniciais da doença (de acordo com o GOLD), estes apresentam pior capacidade funcional de exercício, maior grau de comprometimento funcional e maiores níveis de fadiga. No entanto, este mesmo estudo mostra que apesar de apresentarem piores valores basais, pacientes com DPOC considerados obesos se beneficiam igualmente do programa de reabilitação pulmonar. Seres e cols (56) atribuem essa redução da capacidade de exercício à necessidade de maior gasto energético para mover a massa corporal aumentada. Sabe-se ainda, que pacientes com DPOC apresentam menores níveis de AFVD quando comparados a indivíduos saudáveis pareados pela idade (21) e que na população geral o baixo nível de atividade física está entre os principais fatores predisponentes à obesidade. Apesar de diversos estudos terem mostrado que pacientes com DPOC obesos possuem pior capacidade de exercício, ainda não se sabe se esta mesma relação se aplica ao nível de AFVD.

4 ARTIGO

OBESITY AND PHYSICAL ACTIVITY IN DAILY LIFE IN PATIENTS WITH COPD

(Em revisão no periódico *LUNG*)

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Chronic obstructive, pulmonary disease; obesity; body mass index; body composition; exercise, physical activity.

Abstract

Purpose: To study differences in body composition in physically active and inactive patients with COPD; and to study the relationship of obesity with physical activity in daily life (PADL) in this population. **Methods:** Body composition (bioelectrical impedance analysis), and level of PADL (activity monitors DynaPort and SenseWear) were evaluated in 74 patients with COPD (45 men, 65±9years, FEV_1=40±15%pred, IMC=27±6kg.m^{-2}). Patients were separateded in 2 groups: physically active (> 30 minutes/day of time spent in physical activity [TPA] of at least moderate intensity, or TPA>moderate) and inactive (did not achieve these recommendations). The sample was also classified according to the body mass index (BMI) in underweight, normal weight, overweight and obese; and according to their percentage of fat mass (%FM) in moderate obesity, high obesity and morbid obesity. **Results:** In the whole group, TPA>moderate correlated weakly with BMI (r=-0.28; p=0.02) and FM (r=-0.30; p=0.001) but not with FFM (r=-0.18; p=0.13). Physically inactive patients had higher body weight and FM and lower fat free mass (FFM) in % of body weight than active patients. Obese patients (according to BMI) had worse PADL level than underweight and normal weight patients. Poorer PADL occurred in morbidly obese patients, despite the weak correlation between FM and TPA>moderate in the whole group. **Conclusion:** Physically active patients with COPD have proportionally more FFM and less FM than inactive patients. More pronounced physical inactivity occurs in obese patients, although body composition does not qualify as an important correlate factor of the level of PADL in patients with COPD.

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is characterized by airflow limitation, dyspnea and reduction in exercise capacity, muscle strength and quality of life[1]. Patients with COPD frequently also present alterations in their body composition such as weight loss and fat-free mass depletion, and it is known that reduced body mass index (BMI) and fat free mass index (FFMI) are independent predictors of mortality in these patients[2-5]. On the other hand, recent studies indicate that obesity has been increasingly common in patients with COPD[6-8]. The body mass index (BMI) is the most used tool to identify obesity in any population. It is an internationally known index, used in clinical practice due to its low cost and simplicity. However, the BMI does not distinguish fat mass (FM) from fat free mass (FFM) since it is just a simple ratio between body weight and height squared. Therefore, since obesity is usually considered as the excess of FM, the quantification of FM is another option for the identification of obesity, The major respiratory complications of obesity include an increased ventilatory demand and work of breathing, respiratory muscle inefficiency and reduced respiratory compliance[9], all contributing to an increase in dyspnea. These respiratory changes associated with muscle loss, joint pain and skin friction are important determinants of decreased exercise capacity and disability in obese patients with COPD[9]. Despite previous studies suggesting that obese patients with COPD have lower functional exercise capacity[6], there are no studies that show the relationship between obesity and level of physical activity in daily life (PADL) in these patients. PADL is normally reduced in patients with COPD[10;11] and as described for the alterations in body composition, reduction in PADL is a modifiable morbi-mortality risk factor[12;13].

Public health guidelines regarding physical activity published by the American College of Sports Medicine (ACSM) recommend that a minimum of 30 minutes of physical activity of moderate intensity (e.g., walking) is necessary for the maintenance or development of physical fitness[14]. It is yet unknown whether patients with COPD who are physically active according to these recommendations have different body composition in comparison to the physically inactive ones. Therefore, the present study had three aims: to determine if there are differences in body composition between active and inactive patients with COPD (according to the ACSM recommendations); to verify whether obese patients (according to BMI) have lower level of PADL than underweight, normal weight and overweight patients; and to investigate if there are differences in functional exercise capacity and PADL between levels of obesity according to the percentage of fat mass.

Methods

Sample, inclusion and exclusion criteria

Ninety patients with COPD (55 men, 66±9 years, forced expiratory volume in the first second (FEV_1) = 42±16%pred, BMI=27±8kg.m^{-2}) were initially included in this cross-sectional retrospective study. Patients were recruited during the procedure of admission to a Pulmonary Rehabilitation Program of a University Hospital (State University of Londrina, Brazil). Since 16 subjects did not have complete data of the PADL, they were not included at the analysis. Diagnosis of COPD was based on the Global Initiative for Chronic Obstructive Lung Disease spirometry criteria[1], i.e., post-bronchodilator (Aerolin®) ratio between FEV_1 and forced vital capacity (FVC) < 0.70. As inclusion criteria, patients should be in stable condition (no exacerbations in the last three months that required a change in medication or hospital admission); should not have participated in any exercise training program in the last year before admission to the study; and could not present other pathological conditions which could impair their performance, such as cerebro-vascular, orthopedic or rheumatic disease. Exclusion criteria were the occurrence of severe acute exacerbation requiring hospitalization during the assessment period; and the inability to understand or cooperate with the assessment methods. The ethics committee of Londrina University Hospital approved the research protocol and a written consent form was obtained from each patient.

Assessments

Pulmonary function (spirometry) was performed using a Pony Graphics® spirometer (Cosmed, Rome, Italy) according to international recommendations[15]. Reference values used were those of Pereira et al[16].

Functional exercise capacity was evaluated by the 6-minute walking test (6MWT), in accordance with standards of the American Thoracic Society[17]. Reference values were those described by Troosters et al[18].

Body composition analysis was performed by bioelectrical impedance (Biodynamics 310, Biodynamics, BR) (BIA), using the technique described by Lukaski et al[19]. Reference values used were those described specifically for patients with chronic lung disease by Kyle et al[20]. Body mass index (BMI) was calculated by dividing weight by height squared, and fat free mass index (FFMI) by dividing the weight of fat free mass (obtained by BIA) by height squared.

Assessment of physical activity in daily life was performed simultaneously by two activity monitors: the accelerometer-based DynaPort Activity Monitor, or DAM (McRoberts BV; The Hague, the Netherlands) and the multisensor SenseWear Armband, or SAB (BodyMedia Inc., Pittsburgh, PA, USA). The DAM consists of a small, lightweight box enclosed in a belt worn around the waist and a leg sensor (total weight, 375 g). The DAM was shown to be as accurate as video recordings (criterion method) in order to assess time spent in different activities in patients with COPD, such as the time spent walking/day (TW)[21]. Technical specifications about the DAM can be found elsewhere[21]. The SAB is a lightweight (80g) activity monitor, worn on the triceps brachial bulk of the right arm. The device estimates energy expenditure based on a biaxial accelerometer and physiologic sensors that detect galvanic skin response, heat flux and skin temperature in a manufacturer algorithm. It also provides the duration of activities performed above a determined level of intensity (e.g. time spent per day in activities of at least moderate intensity, or TPA>moderate). The SAB was already validated for the estimative of energy expenditure in patients with COPD[22-25]. Main outcomes of the PADL assessment were TW (from the DynaPort) and TPA>moderate (from the SenseWear), since these outcomes are complementary and provide together an overall view of the patient's PADL level, both regarding time and intensity. Assessments with both activity monitors were performed during 2 consecutive weekdays, for 12 hours per day (from wake-up time to 12h after awaking). The mean of the two assessment days was used for statistical analysis, and the minimal number of days needed to obtain a reliable assessment of daily physical activity was determined in a previous study[10]. For analysis, patients were first divided into two groups, according to the minimum recommendation of daily physical activity determined by the ACSM[14]: active (performed more than 30 minutes/day of TPA>moderate) and inactive (did not achieve these recommendation). Threshold of metabolic equivalents (METs) to characterize an activity as being of at least moderate intensity was also suggested by the ACSM: above 4.8 METs for subjects aged 28-39 years; above 4.0 METs for 40-60 years; above 3.2 METs for 65-79 years and above 2.0 METs for subjects over 80 years old[14]. Secondarily, the same group was divided according to the BMI classification suggested for patients with COPD by the ATS-ERS Statement of Pulmonary Rehabilitation[26] into underweight [UW] (BMI<21 $Kg.m^{-2}$), normal weight [NW] (21≤BMI<25$Kg.m^{-2}$), overweight [OW] (25≤BMI<30$Kg.m^{-2}$) and obese [OB] (BMI>30$Kg.m^{-2}$). Finally, the group was separated according to the percentage of fat mass (%FM) into non-obese (women [W]: <25%FM; men [M]: <15%FM); mild obesity (W: 25≤%FM<30; M: 15≤%FM<20); moderate obesity [MO] (W: 30≤%FM<35; M: 20≤ %FM<25), high obesity [HO] (W: 35≤%FM<40; M: 25≤%FM<30) and morbid obesity [MbO] (W: %FM≥40; M: %FM≥30)[27].

Statistical Analysis

Statistical analysis was performed using the SPSS statistical package software version 17.0 (SPSS inc., Chicago IL) and GraphPad Prism 3.0 (GraphPad Software, San Diego, CA, USA) programs. Kolmogorov-Smirnov test was used to check for normal distribution. Comparisons between groups were performed using Student t test or Mann-Whitney test; and one-way ANOVA or Kruskal-Wallis, followed by a post-hoc test (Bonferroni or Dunns, respectively). Correlations were studied using the Pearson or Spearman coefficient, according to the normality in data distribution. To verify the similarity in gender between the groups, the chi-square test was used. A significance level of $p \leq 0.05$ was adopted.

Results

Sixteen subjects were excluded since complete data of the PADL assessment could not be obtained due to technical problems or misuse of the device by the patient. Therefore, for the statistical analysis, the sample was composed by 74 subjects.

According to the ACSM guidelines, 70% of the 74 patients included in the study were classified as physically inactive (52 *versus* 22 physically active). Results of the whole group and differences in body composition between physically active and inactive subgroups are shown in Table 1. Physically active and inactive patients with COPD had important differences in their body composition. Inactive patients had higher body weight (p=0.002), BMI (p=0.001) and FM (p=0.0005). Due to the higher body weight, the inactive group had higher absolute values of FFM (p=0.05). However, when FFM was corrected for body weight (%FFM = [FFM in Kg X 100] / body weight in Kg), the inactive group had significantly lower values (p=0.03).

In the whole group, TPA>moderate correlated weakly and negatively with weight (r=-0.29; p=0.02), BMI (r=-0.28; p=0.02) and FM (r=-0.30; p=0.001), but not with FFM (r=-0.18; p=0.13). Correlation between BMI and %FM was r=0.47; p<0.0001. The 6MWT was significantly lower in inactive patients, whereas the active and inactive subgroups did not differ in their airway obstruction (table 1).

When the whole group was divided according to BMI, 19% of the patients were UW; 23% were NW; 30% were OW; and 28% were OB. Table 2 shows that, when comparing the level of PADL between the four groups, OB had significantly lower TW than UW and NW and significantly lower TPA>moderate than UW (p<0.05 for all). No differences were found between OW with the other three groups (UW, NW and OB). Despite the differences in PADL between OB *versus* UW and NW, the groups did not differ significantly in the 6MWT, despite an average difference of 54 meters between OB and UW and 41 meters between OB and NW.

As for the classification according to the %FM, no subject in the present sample could be classified as non-obese. Three patients had mild obesity and were therefore excluded from the subsequent analysis. Table 3 offers a detailed overview of the differences between MO, HO and MbO in patients with COPD. Concerning PADL, significant differences were found in TW (MbO *vs* MO and *vs* HO) and TPA>moderate (MO *vs* MbO and *vs* HO). Poorer 6MWT occurred in morbidly obese patients (table 3).

Two retrospective (*post-hoc*) power calculations were performed based on the observed differences in the two main outcomes of physical activity in daily life (TPA>moderate and TW) between the obese (n=21) and underweight groups (n=14) (table 2). Taking into consideration an alpha of 0.05, a difference of 31 minutes in TPA>moderate and 27 minutes in TW between the groups and a standard deviation of 28 minutes (for both outcomes), the study had a power of 87% to detect a significant difference in TPA>moderate and 78% to detect a significant difference in TW.

Discussion

This study showed that despite physically active and inactive patients with COPD have similar age, airway obstruction and gender proportion, inactive patients have less FFM and more FM (in % of body weight) than their active counterparts. In addition, time spent in activities of at least moderate intensity (as classified by the ACSM) has weak correlation with BMI and absolute values of FM but no correlation with FFM. Almost 30% of the patients were obese according to the classification based on the BMI. On the other hand, when using %FM to classify obesity, 100% of patients were classified as obese, either mildly, moderately, highly or morbidly. Obese patients presented worse level of daily physical activity than underweight and normal weight patients. Moreover, patients with higher degrees of obesity (according to %FM) had more impaired PADL and worse functional exercise capacity.

It is widely known that patients with COPD have important alterations in body composition and this is an independent predictor of mortality[4]. We now observed that inactive patients with COPD had higher body weight and BMI, and this was mainly caused by higher weight of fat mass. The inactive subgroup had higher absolute values of FFM, but this was due to the fact that these subjects had higher body weight, since FFM in % of body weight was significantly lower in this group. Moreover, although weakly, fat mass was better correlated with the level of PADL than did fat free mass. These results suggest that, in COPD, obesity may be somewhat better linked to physical inactivity than loss of FFM, although none of the two factors appear to be a strong correlate of the level of PADL in this population. This corroborates previous findings by Watz et al[28], who studied the determinants of objectively measured physical activity in patients with COPD. These authors also concluded that BMI was not a determinant factor for PADL level. Other studies also did not find BMI to be a strong correlate of the level of physical activity in daily life in patients with COPD[10;29;30].

Obesity is known as an important issue in COPD and BMI is yet the most used variable to identify obesity in these patients. Literature reported obesity prevalence (according to BMI) in COPD as ranging between 18%[31] to 54%[32]. In the present study 28% of the patients were obese according to their BMI. Our results showed that obese patients (BMI≥30Kg.m^{-2}) are less active in comparison to underweight and normal-weight patients with COPD, but not in comparison to overweight patients. Similar results were found in a study with older healthy adults, in which obesity but not overweight was associated with lower levels of physical activity[33].

Although differences in the 6MWT between the groups classified according to BMI did not reach statistical significance, our data showed that obese patients walked on average 54 meters less than underweight patients and 41 meters less than normal weight patients, which are both well above the two values of minimal clinically important difference recently suggested for the 6MWT in the literature (25 meters and 35 meters) [34;35]. Therefore, despite not reaching statistical significance, a worse functional exercise capacity in obese patients appears to be clinically relevant. The previous literature has shown that higher BMI is associated with lower functional exercise capacity[8;9;36] and this is likely the result of the increase in energy expenditure associated with weight bearing exercise[37].

The BMI is the most used outcome to classify obesity, although does not provide clear information about the distribution of FM and FFM. Patients with COPD commonly develop cachexia which is caused by different factors such as increased metabolic rate, hypoxaemia, sympathetic upregulation, inactivity, oxidative stress, inflammation and anabolic hormone insufficiency[38]. This reduction in percentage of FFM leads to higher proportion of fat mass, even though the patient's weight is not necessarily high. This explains the fact that 100% of the present sample was classified as obese based on the % of FM, being 42% of them classified as morbidly obese. A study by Park et al.[33], which verified the relation of body composition with PADL in adult women, suggested that the relationship between obesity and daily physical activity should be discussed using not only BMI but also fat mass index or %FM since these two variables were related to the physical activity level, what was corroborated by the present results. Obesity is defined as excessive accumulation of fat mass, and patients with COPD present high %FM, despite not having high body weight. In addition, our data showed that more pronounced levels of obesity (i.e., morbid obesity) denote lower levels of PADL and lower exercise capacity in comparison to moderate obesity. Corroborating these results, a study by Park et al. in older women showed that those with more pronounced obesity (according to %FM) have less number of steps per day and less moderate and vigorous physical activity[33]. We believe that this is not necessarily caused only by changes due to excessive weight, but also by a reduction in the percentage of muscle mass.

It was interesting to observe that, similarly to BMI, the correlation between %FM and PADL in our sample of patients with COPD was weak. Studies concerning other populations already reported that PADL appears to be negatively associated with FM[39;40]. On the other hand, classification of obesity according to %FM yielded that all subjects with COPD in our sample were obese, which might be misinterpreted as an indication that patients with COPD do not present cachexia. It is likely that the cutoff points for %FM, which are widely used in many populations, are inappropriate for patients with COPD. In fact, FFMI value was indicative of depletion in 23 patients (32%) from the present sample (FFMI<16 Kg/m^2 for men and FFMI <15 Kg/m^2 for women) [41]. Therefore, both options (BMI and %FM) present clear limitations when used to reflect body composition in this population, as well as to reflect their level of physical activity. On the other hand, the level of PADL in COPD is known to have has multidimensional characteristics, being influenced by several determining factors (e.g., physical, psychosocial and environmental, and not only nutritional) [42;43]. This is likely the reason why body composition variables are not strongly related to PADL in this population, despite the fact that patients with higher degree of obesity had more marked reduction in the level of PADL.

One may argue that assessment of body composition should ideally be performed with Dual-energy X-ray absorptiometry (DEXA) and not with bioimpedance, and this can be considered as a limitation of the present study. However, electrical bioimpedance has been widely and successfully used in this population, and has provided useful and reliable information concerning body composition of patients with COPD, especially when a specific formula for these patients is used [20;44;45]. Furthermore, although the study had power enough to yield significant differences between the obese and underweight groups concerning the main outcomes (TW:87% and TPA>moderate:78%), a larger sample could have provided higher power to detect other potentially significant differences in PADL, such as between the obese and normal weight groups (see table 2). Moreover, the relatively small sample size of the present study for an investigation of such nature could lead to lack of power in certain secondary variables, such as the 6MWT (see table 2). In this sense, a larger sample could have yielded more solid results, although this would not interfere directly in the main conclusions of the study.

In conclusion, despite the high prevalence of physical inactivity in patients with COPD, those who are active in daily life have proportionally more fat free mass and less fat mass than inactive patients. More pronounced physical inactivity occurs in obese patients, although in general the correlations between body composition and PADL are weak. This suggests that body composition does not qualify as a determinant factor of the objectively assessed level of PADL in patients with COPD.

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Conflict of Interest: None

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TABELAS

Table 1. Results from the general group of patients with Chronic Obstructive Pulmonary Disease (COPD) and the physically active and inactive subgroups according to American College of Sports Medicine (ACSM) minimum recommendations of daily physical activity.

Characteristics	**Total n=74**	**Active n=22**	**Inactive n=52**	**p (act *vs* inact)**
Age (years)	65±9	65±12	65±7	0.90
Gender (M/F)	45/29	15/7	30/22	0.86
Weight (Kg)	69±16	61±12	73±16	0.002
Height (cm)	160±9	161±10	160±7	0.82
FEV_1 (%pred)	40±15	44±15	39±14	0.18
BMI (Kg/m^2)	27±6	23±4	28±6	0.001
FFMI (Kg/m^2)	18±3	16±2	18±4	0.009
FFM (Kg)	46±11	42±11	47±10	0.05
FM (Kg)	23±8	18±6	25±8	0.0005
FFM (% of BW)	67±8	70±8	65±7	0.03
FM (% of BW)	33±8	30±8	35±7	0.03
Metabolic rate (Kcal)	1396±322	1285±308	1442±319	0.05
6MWT (m)	428±94	454±113	416±84	0.04
6MWT (%pred)	72±16	74±18	71±15	0.21

Subgroup Active: achieves at least 30 minutes per day of physical activity of at least moderate intensity, in accordance with the ACSM recommendations; Subgroup Inactive: does not achieve these minimum recommendations. Data are expressed as mean (standard deviation). FEV_1 = forced expiratory volume in the first second; BMI = body mass index; FFMI = fat free mass index; FFM = fat free mass; FM = fat mass; BW = body weight; 6MWT = 6-minute walking test.

Table 2. Comparison of patients with Chronic Obstructive Pulmonary Disease (COPD) classified according to the body composition based on the body mass index (BMI)

	Underweight n=14	**Normal weight** n=17	**Overweight** n=22	**Obese** n=21
Age (years)	65±11	66±11	66±8	65±6
Gender (M/F)	10/4	11/7	14/8	10/11
BMI ($Kg.m^{-2}$)	19±1	23±1*	28±1°	35±4#
FEV_1 (%pred)	36±14	35±15	40±14	47±13 *
6MWT (m)	460±61	447±95	410±115	406±83
TPA>mod (min/day)	42±43	31±33	23±36	11±12 *
TW (min/day)	73±31	69±34	53±30	46±26 * +

Data are expressed as mean ± standard deviation. FEV_1 = forced expiratory volume in the first second; 6MWT = 6-minute walking test; TPA>mod = time spent per day in physical activities of at least moderate intensity; TW = time spent walking per day. Underweight: BMI<21 $Kg.m^{-2}$; Normal weight: 21≤BMI<25$Kg.m^{-2}$; Overweight: 25≤BMI<30$Kg.m^{-2}$ and Obese: BMI>30$Kg.m^{-2}$.

* p <0.05 versus underweight

° p <0.05 versus underweight and normal weight

# p <0.05 versus underweight, normal weight and overweight

+ p <0.05 versus normal weight

Table 3. Comparison of patients with Chronic Obstructive Pulmonary Disease (COPD) classified according to the body composition based on the percentage of fat mass (FM%).

	Moderate Obesity n=11	High Obesity n=30	Morbid Obesity n=30
Age (years)	65±10	62±7	69±8 [+]
Gender (M/F)	7/4	15/15	20/10
FEV_1 (%pred)	35±14	44±14	38±14
6MWT(m)	475±75	445±88	389±98*
TPA>mod (min/day)	47±45	19±20 *	20±26 *
TW (min/day)	72±36	62±29	43±27 * [+]

Data are expressed as mean ± standard deviation. FEV_1 = forced expiratory volume in the first second; 6MWT = 6-minute walking test; TPA>mod = time spent per day in physical activities of at least moderate intensity; TW = time spent walking per day. Moderate obesity: Women: 30≤%FM<35 - Men: 20≤%FM<25; high obesity: W: 35≤ %FM<40 - M: 25≤%FM<30 and morbid obesity: W: %FM≥40 - M: %FM≥30.

* p<0.05 versus Moderate Obesity

[+] p <0.05 versus High Obesity

4 CONCLUSÕES GERAIS

Pacientes com DPOC, que são fisicamente ativos na vida diária têm proporcionalmente mais massa magra e menos massa de gordura do que os pacientes fisicamente inativos. Maiores níveis de inatividade física ocorrem em pacientes obesos, embora em geral as correlações entre a composição corporal e AFVD sejam fracas. Isto sugere que a apesar da composição corporal de pacientes ativos ser diferente da dos inativos e de pacientes obesos possuírem pior AFVD, a composição corporal de forma geral não se qualifica como fator determinante do nível de AFVD avaliado objetivamente em pacientes com DPOC. Estes resultados nos levam a crer que, apesar da literatura sugerir que a obesidade é protetora em pacientes com DPOC, atenção especial deve ser dada ao nível de atividade de física de pacientes obesos, já que estes são os principais acometidos pela inatividade física.

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ANEXOS

ANEXO A

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- Methods
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Acknowledgments

Acknowledgments of people, grants, funds, etc. should be placed in a separate section before the reference list. The names of funding organizations should be written in full.

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- Please use the standard mathematical notation for formulae, symbols etc.:

Italic for single letters that denote mathematical constants, variables, and unknown quantities

Roman/upright for numerals, operators, and punctuation, and commonly defined functions or abbreviations, e.g., cos, det, e or exp, lim, log, max, min, sin, tan, d (for derivative)

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1. Negotiation research spans many disciplines [3].

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- Book

South J, Blass B (2001) The future of modern genomics. Blackwell, London

- Book chapter

Brown B, Aaron M (2001) The politics of nature. In: Smith J (ed) The rise of modern genomics, 3rd edn. Wiley, New York, pp 230-257

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