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LORENA PALTANIN SCHNEIDER

**ESTUDO DO TEMPO GASTO NA VIDA DIÁRIA EM BLOCOS
DE ATIVIDADES SEDENTÁRIAS, LEVES E MODERADAS-
VIGOROSAS POR INDIVÍDUOS COM DPOC**

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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. Fabio de Oliveira Pitta
Co-orientadora: Prof. Dra. Karina Couto Furlanetto.

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Dedico este trabalho à minha família e amigos.

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***“It is the time you have wasted for your rose
that makes your rose so important”***
(Antoine de Saint-Exupéry)

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RESUMO

OBJETIVOS: Quantificar o tempo gasto em comportamento sedentário (CS), atividades físicas leves (AFL) e atividades físicas moderadas-vigorosas (AFMV) na vida diária de pacientes com doença pulmonar obstrutiva crônica (DPOC), além de verificar a relação da AFMV e AFL com CS nesta população e identificar o perfil daqueles fisicamente (in)ativos e sedentários ou não. **MÉTODOS:** Estudo transversal com 137 indivíduos diagnosticados com DPOC (75 homens, 66±8anos; VEF₁ 46[31-57]%predito; IMC 26[22-30]kg/m²), submetidos à avaliação da atividade física na vida diária (AFVD) utilizando o monitor de atividade física Sensewear Armband durante 12 horas por dia por 2 dias consecutivos da semana. A análise foi feita minuto-a-minuto do dia de cada indivíduo, sendo os blocos considerados como de intensidade ≥ 3 equivalentes metabólicos (METs) (AFMV), blocos entre 1,5 e 3METs (AFL) e blocos <1,5METs (CS). A análise da normalidade na distribuição dos dados foi realizada pelo teste de Shapiro-Wilk. De acordo com essa análise, os dados foram descritos como média±desvio padrão ou mediana[intervalo interquartilico], correlacionados pelos coeficientes de Pearson ou Spearman e comparados pelo teste de ANOVA ou Kruskal Wallis com pós teste de Bonferroni. **RESULTADOS:** Em geral, os pacientes passaram 451±125 min/dia em CS, 207±95 min/dia em AFL e 62±73 min/dia em AFMV. A duração dos blocos foi de 7[5-10]min em CS, 3[2-4]min em AFL e 2[2-3]min em AFMV. A frequência de blocos/dia foi 120±40 para CS, 138±48 para AFL e 35[15-61] para AFMV. Na amostra total, houve forte correlação entre tempo gasto em CS e AFMV (r=-0,72) e entre o CS e AFL (r=-0,81). Também ocorreu correlação entre a frequência e duração dos blocos de AFMV (r=0,52), assim como entre a frequência e duração dos blocos de CS (r=-0,55). Quatro grupos foram divididos com base na classificação em (in)ativos/(não)-sedentários: ativos+não-sedentários (A+NS;n=67), ativos+sedentários (A+S;n=9), inativos+não-sedentários (IN+NS;n=26) e inativos+sedentários (IN+S;n=35). O grupo IN+S apresentou maior idade, IMC e risco de mortalidade de acordo com o índice BODE, pior capacidade de exercício, mais blocos de atividades sedentárias, menor tempo em AFMV, número de passos/dia e gasto energético, além de menor frequência/dia e duração em blocos de MVPA do que o grupo AT+NS (P<0,05 para todos). **CONCLUSÕES:** Comportamento sedentário é negativamente relacionado com AFMV e AFL em pacientes com DPOC. Blocos contínuos de CS são mais longos do que aqueles em AFL e AFMV, e a frequência de blocos em CS e AL é consideravelmente maior do que em blocos de AFMV. Além disso, pacientes classificados como fisicamente ativos (i.e, pacientes que atingem níveis recomendados de AFMV) em combinação com um estilo de vida não-sedentário apresentam condições clínicas marcadamente melhores, apesar de alguns benefícios serem observados quando pacientes apresentam apenas um desses comportamentos positivos em relação a não apresentar nenhum deles.

Palavras-chave: Doença Pulmonar Obstrutiva Crônica. Atividade Motora. Estilo de vida sedentário.

SCHNEIDER, Lorena Paltanin. **Study of the time spent in daily life in blocks of sedentary, light and moderate-to-vigorous activities in people with COPD.** 2017. 76 p. Dissertation (Master's Degree in Rehabilitation Sciences) – Universidade Estadual de Londrina, Londrina, 2017.

ABSTRACT

OBJECTIVES: Quantify the time spent in sedentary behaviour (SB), light physical activities, moderate-to-vigorous physical activity (MVPA) in daily life in patients with chronic obstructive pulmonary disease (COPD), and, as well as verify the relationship of time spent in MVPA and light activities with SB in individuals with COPD in this population and identify the profile of those subjects who are physically in(active) and sedentary or not. **METHODS:** Cross-sectional study with 137 individuals with COPD (66 ± 8 years; FEV_1 $46[31-57]\%$ pred; BMI $26[22-30]$ kg/m²), submitted to objective assessment of physical activity in daily life (PADL) through the use of the Sensewear Armband activity monitor during 2 consecutive days for 12 hours per day. Analysis was performed minute by minute of the day of each patient, so that it was possible to quantify blocks of activities ≥ 3 metabolic equivalents (METs) (MVPA), between 1.5 to 3 METs (light activities), and < 1.5 METs (SB). Data distribution was analysed by the Shapiro-Wilk test. According to normally in distribution, data were described as mean \pm standard deviation or median (interquartile range), correlated with Pearson's or Spearman's correlation coefficient and compared with unifactorial ANOVA or Kruskal Wallis test with Bonferroni correction. **RESULTS:** In general, patients spent 451 ± 125 min/day in SB, 207 ± 95 min/day in light activities and 62 ± 73 min/day in MVPA. The duration of bouts was 7[5-10] minutes in SB, 3[2-4] minutes in light activities and 2[2-3] minutes in MVPA. Frequency of bouts/day was 120 ± 40 of SB, 138 ± 48 of light activities, and 35[15-61] of MVPA. In the total sample, there was correlation between time spent in SB and MVPA ($r=-0.72$) and between SB and time spent in light activities ($r=-0.81$). There was also correlation between frequency and duration of MVPA bouts ($r=0.52$) as well as frequency and duration of SB bouts ($r=-0.55$). Four groups were composed on the basis of the classification in Active/Non-Sedentary (A+NS; $n=67$), Active/Sedentary (A+S; $n=9$), Inactive/Non-Sedentary (IN+NS; $n=26$) and Inactive/Sedentary (IN+S; $n=35$). In comparison to A+NS, the IN+S group was older and presented higher BMI and risk of mortality according to BODE index, worse disease severity and body composition, poorer exercise capacity more time in SB, less time in MVPA, fewer steps/day and lower energy expenditure, as well as lower frequency and duration of MVPA bouts ($P<0.05$ for all). **CONCLUSIONS:** Sedentary behaviour is negatively correlated with MVPA and light physical activities in patients with COPD. Bouts of SB last longer than those of light activities and MVPA, and the frequency of bouts in SB and light activities is considerably higher than bouts in MVPA. Furthermore, patients classified as physically active (i.e., those who reach MVPA recommendations) in combination with a non-sedentary lifestyle present markedly better clinical conditions, despite some benefits in presenting only one of these positive behaviours over not presenting any of them.

Keywords: Pulmonary Disease. Chronic Obstructive. Physical Activity. Sedentary Lifestyle.

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LISTA DE ABREVIATURAS E SIGLAS

6MWT	6-Minute Walking Test
A+NS	Active/Non-sedentary
A+S	Active/Sedentary
ACSM	<i>American College of Sports Medicine</i>
AFVD	Atividade Física de Vida Diária
AVDs	Atividades de Vida Diária
BMI	Body Mass Index
COPD	Chronic Obstructive Pulmonary Disease
DPOC	Doença Pulmonar Obstrutiva Crônica
FEV1	Forced Expiratory Volume In The First Second
IMC	Índice de Massa Corporal
IN+NS	Inactive/Non-sedentary
IN+S	Inactive/Sedentary
MET	equivalente metabólico
mMRC	modified <i>Medical Research Council</i>
MVPA	Moderate-to-Vigorous Physical Activity
OMS	Organização Mundial da Saúde
PADL	<i>Physical Activity in Daily Life</i>
PAL	<i>Physical Activity Level</i>
Q	Quartis
REE	Resting Energy Expenditure
SB	<i>Sedentary Behaviour</i>
UMV	Unidade de Magnitude de Vetor

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1 INTRODUÇÃO

Um dos principais fatores de risco para desenvolver a doença pulmonar obstrutiva crônica (DPOC) é o tabagismo^{1,2}, e sabe-se que até 50% dos tabagistas de longa data desenvolvem a doença³. Segundo estimativas da Organização Mundial da Saúde (OMS), a DPOC é considerada atualmente a quarta principal causa de morte no mundo, e muito provavelmente ocupe a terceira posição dentro dos próximos anos⁴.

A DPOC é uma doença prevenível e tratável, caracterizada por sintomas respiratórios persistentes e limitação ao fluxo aéreo que acontece devido às anormalidades de vias aéreas e/ou alveolares¹. Os sintomas frequentemente relatados pelos pacientes são fadiga e/ou dispneia, que levam o indivíduo portador da doença a apresentar limitação ao exercício e, conseqüentemente, ao comprometimento das atividades de vida diária (AVDs). Deste modo, estes indivíduos passam a evitar a realização de atividades físicas com a intenção de reduzir os sintomas, tornando-se assim, cada vez mais descondicionados e menos ativos fisicamente. Por esta razão, os indivíduos que apresentam DPOC são considerados significativamente menos ativos quando comparados a idosos saudáveis^{5,6}. Além dos sintomas pulmonares, apresentam também importantes alterações extrapulmonares como inflamação sistêmica, aumento do estresse oxidativo, alterações na composição corporal, disfunção muscular e até mesmo distúrbios psicológicos como ansiedade e depressão⁷.

Sabe-se que o nível de atividade física na vida diária (AFVD) em indivíduos com DPOC é o principal preditor de mortalidade por todas as causas⁸. No entanto, a associação do comportamento sedentário com o nível de atividade física nestes indivíduos ainda não foi explorado em profundidade. O real papel do sedentarismo ainda não está claro, e apesar de estudos recentes e relevantes terem apresentado importantes evidências sobre a inatividade física em indivíduos com DPOC, pouco se sabe sobre a caracterização dos blocos contínuos de atividade física e sedentarismo nessa população⁹. Dessa forma, a presente dissertação foi desenvolvida com o propósito de contribuir com evidências científicas relacionadas à relação entre atividade física e sedentarismo em pacientes com DPOC.

2 REVISÃO DE LITERATURA – CONTEXTUALIZAÇÃO

2.1 DOENÇA PULMONAR OBSTRUTIVA CRÔNICA (DPOC)

De acordo com a literatura atual, a DPOC é definida como uma doença prevenível e tratável, caracterizada por sintomas respiratórios persistentes e limitação ao fluxo aéreo que acontece devido às anormalidades de vias aéreas e/ou alveolares usualmente causadas por exposição significativa à partículas ou gases tóxicos¹. A OMS apresenta estimativas que mostram que a DPOC é a quarta principal causa de morte no mundo, e muito provavelmente ocupará a terceira posição dentro dos próximos anos⁴. A doença é causada principalmente pelo tabagismo, mas indivíduos que não fazem uso de tabaco também podem ser acometidos pela doença por outras causas como infecções respiratórias na infância ou asma, poluição do ar, exposição ocupacional a poeiras e tabagismo passivo, entre outras^{10,11}. Devido à inflamação crônica ocorrem mudanças estruturais, estreitamento das pequenas vias aéreas, destruição do parênquima pulmonar que prejudica o recolhimento elástico dos pulmões¹. Por sua vez, essas alterações diminuem a capacidade das vias aéreas de permanecerem abertas durante a expiração¹.

A dispneia progressiva e crônica é o sintoma mais característico da DPOC, além da tosse produtiva, que está presente em 30% dos indivíduos com a doença. Estes sintomas variam dia-a-dia e podem preceder o desenvolvimento da limitação ao fluxo aéreo por muitos anos¹². Além das manifestações pulmonares, a doença apresenta importantes manifestações extrapulmonares como a inflamação sistêmica, aumento do estresse oxidativo, alterações na composição corporal, disfunção muscular e até mesmo distúrbios psicológicos como ansiedade e depressão⁷.

Apesar de sua definição estar associada ao acometimento das vias aéreas, os indivíduos com DPOC podem apresentar disfunção cardíaca, especialmente sobrecarga do ventrículo direito¹³. Outra manifestação sistêmica é a disfunção muscular periférica, que pode ser atribuída ao uso de corticoesteróides, estresse oxidativo e redução da massa muscular¹⁴. Os indivíduos com DPOC também desenvolvem anormalidades na composição corporal, como a perda de peso e a redução da porcentagem de massa magra¹⁵.

Todas estas manifestações sistêmicas da doença, juntamente com as manifestações pulmonares, contribuem para a sensação de dispneia e fadiga, sintomas relatados frequentemente pelos indivíduos em repouso ou durante a realização de atividades físicas^{9,16}. Como será discutido adiante, o conjunto de alterações que caracteriza a doença também leva seus portadores a reduzirem consideravelmente sua atividade física diária, o que traz importantes repercussões na sobrevivência dessa população.

2.2. DEFINIÇÕES

No que diz respeito à AFVD, existem termos que frequentemente geram confusão e precisam estar bem claros quanto à sua definição para facilitar a interpretação da atividade física e sedentarismo em DPOC, e conseqüentemente desta dissertação.

Atividade física é qualquer movimento corporal gerado pelos músculos esqueléticos que resultam em gasto energético acima dos níveis de repouso¹⁷. Exercício físico é uma subcategoria de atividade física, que é planejada, estruturada, repetitiva, realizada de forma proposital e se relaciona com o desempenho físico¹⁷. Já a atividade de vida diária (AVD) é outra subcategoria de atividade física e refere-se às atividades cotidianas do indivíduo e são geralmente relacionadas às atividades domésticas, de cuidados pessoais, lazer ou trabalho^{9,18}. Atividade física na vida diária (AFVD) diz respeito à totalidade de movimentos voluntários realizados pelos músculos esqueléticos no dia a dia¹⁹, seja em exercício, AVD ou qualquer tipo de atividade física leve, moderada ou vigorosa. Sedentarismo, por sua vez, é o conjunto de atividades realizadas em intensidade menor que 1,5 MET (i.e., abaixo do limiar de atividade leve, geralmente em posturas sentadas ou reclinadas)²⁰⁻²².

Tratando-se da definição de indivíduos ativos, inativos ou sedentários, também torna-se importante o esclarecimento desses termos. Visto isso, o indivíduo considerado fisicamente ativo/suficientemente ativo é aquele que atinge as recomendações mínimas estabelecidas para realização de atividade física, geralmente acima de um ponto de corte pautado em tempo mínimo de atividade física moderada a vigorosa^{17,23}. Portanto, o indivíduo que não atinge tais recomendações mínimas estabelecidas para realização de

atividade física, geralmente abaixo de um ponto de corte estipulado em tempo mínimo de atividade física moderada a vigorosa, é considerado fisicamente inativo/insuficientemente ativo^{17,23}. Por outro lado, o indivíduo sedentário é aquele que apresenta pouco movimento físico e baixo gasto energético no dia a dia, ou seja, muito tempo gasto em atividades de intensidade abaixo de 1,5 equivalentes metabólicos (METs), com comportamentos caracterizados por movimento mínimo, baixo gasto energético e descanso²³. Portanto, aquele indivíduo que não permanece muitas horas por dia em atividades abaixo de 1,5 MET é considerado não sedentário, independentemente se é ou não fisicamente ativo (i.e., independente se atinge ou não as recomendações mínimas de atividade física moderada a vigorosa).

A atual recomendação de atividade física do *American College of Sports Medicine* (ACSM) definiu atividades físicas de intensidade moderada como aquelas com uma intensidade maior ou igual a 3 METs para todas as idades²⁴. Assim, há um espectro de gasto energético associado com diferentes tipos de atividade física, e são classificadas como atividades de intensidade leve, moderada ou vigorosa^{17,25}, como podemos verificar exemplos na figura 1. Dessa forma, podemos classificar atividades leves como aquelas com intensidade relativa de 20-40% do consumo de oxigênio de reserva, ou seja, atividades que apresentam gasto energético entre 1,5 MET a 3 MET, incluindo atividades como tomar banho e passar roupa. Atividades com intensidade relativa a 40-60% do consumo de oxigênio de reserva, são consideradas moderadas, e as que apresentam intensidade maior ou igual a 60% do consumo de oxigênio de reserva são classificadas como atividades vigorosas. Relativamente, atividades moderadas e vigorosas são aquelas que representam gasto energético maior ou igual a 3 METs²⁵.

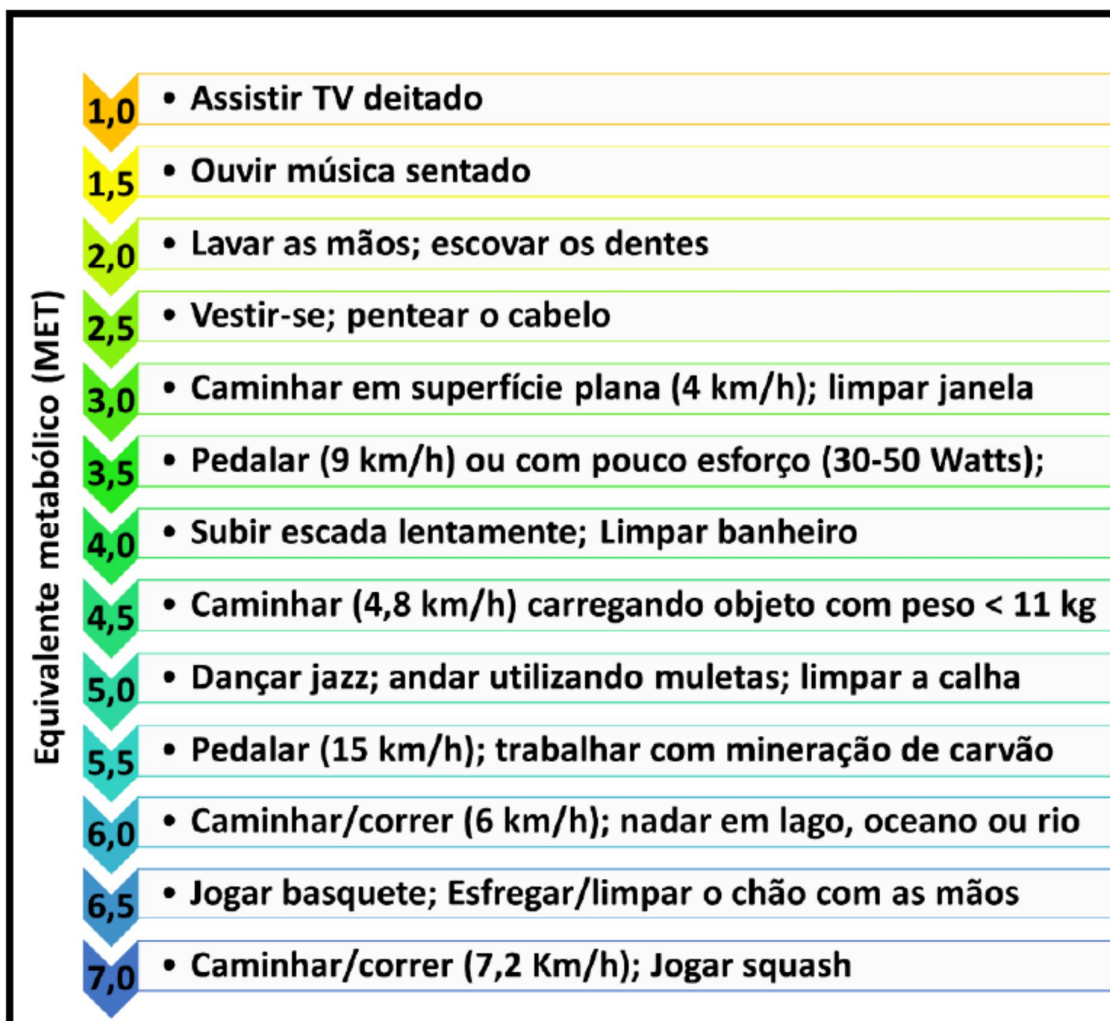


Figura 1. Equivalentes metabólicos (METs) para cada tipo de atividade de acordo com o compêndio de atividade física²⁵.

2.3 ATIVIDADE FÍSICA NA VIDA DIÁRIA E SEDENTARISMO EM DPOC

Atividade física é um comportamento complexo que pode ser caracterizado por tipo, intensidade e duração^{17,26}. De forma complementar, AFVD é a totalidade de movimentos produzidos pelos músculos esqueléticos durante atividades cotidianas¹⁹, resultando na quantificação da totalidade de atividade física realizada no dia-a-dia.

A literatura recomenda para indivíduos saudáveis que realizem pelo menos 30 minutos de atividade física de moderada intensidade durante no mínimo 5 dias na semana, ou pelo menos 20 minutos de atividade física de intensidade vigorosa no mínimo 3 dias da semana¹⁷. Essa atividade pode ser

realizada de forma contínua ou em blocos de atividade física (*bouts*) de pelo menos 10 minutos, quando o indivíduo apresenta dificuldade em realizar em forma contínua¹⁷. Nessas mesmas recomendações, sugere-se que indivíduos menos condicionados fisicamente podem realizar blocos menores que 10 minutos de atividade física e se beneficiar de volumes menores de atividade¹⁷. Torna-se assim clara a importância de atingir um limiar de atividade para se obter benefícios; porém, sabe-se que indivíduos considerados inativos fisicamente já obtêm benefícios a partir de uma quantidade abaixo do recomendado.

Uma metanálise evidenciou que atingir 30 minutos de atividade moderada-vigorosa por dia durante pelo menos 5 dias na semana, avaliados por meio de entrevistas ou questionários autorrelatados, está associado com redução de 19% do risco de mortalidade²⁷. Em um estudo de Waschki e colaboradores em pacientes com DPOC, a AFVD foi quantificada por meio de um índice chamado *Physical Activity Level (PAL) index* (definido pelo gasto energético total dividido pela taxa metabólica basal), e concluíram que a avaliação da AFVD por meio do índice PAL é o preditor independente mais forte de mortalidade por todas as causas nesta população⁸. Metas diárias de 30 minutos ou mais de atividades de intensidade moderada ou vigorosa realizadas continuamente ou em blocos e um PAL index atingindo 1.7 são comumente utilizados como recomendações de atividade física pela OMS²⁸.

O nível de AFVD foi comparado por Pitta e colaboradores entre pacientes com DPOC e idosos saudáveis europeus, evidenciando-se que os pacientes caminhavam praticamente metade do tempo que os idosos saudáveis, além de permanecerem três vezes mais tempo deitados e quase metade do tempo em pé em comparação aos idosos saudáveis⁵. Em 2009, Hernandez e colaboradores traçaram o perfil de AFVD em pacientes com DPOC brasileiros, e mostraram que pacientes brasileiros também são marcadamente menos ativos em comparação à idosos saudáveis⁶. O nível de AFVD de indivíduos com DPOC na Europa Central (Áustria) é menor que no Brasil, embora de forma geral portadores de DPOC são menos ativos na vida diária que idosos saudáveis²⁹. Um recente estudo mostrou que as variações climáticas do verão para o inverno influenciam o comportamento de atividade física dos indivíduos que moram no Brasil e na Bélgica, o qual apresenta uma significativa redução no tempo gasto

em atividade em ambos os países, embora mais acentuado nos indivíduos brasileiros. Porém, mesmo com a influência da variação climática, os indivíduos brasileiros são considerados mais ativos que os belgas, independentemente da estação do ano e ajustado para as variáveis climáticas³⁰. Porém, apesar dos benefícios à saúde de um estilo de vida saudável, cerca de 31% dos indivíduos em todo o mundo não atinge as recomendações existentes e são considerados inativos fisicamente³¹.

O nível reduzido de atividade física na vida diária é um importante preditor de mortalidade em indivíduos com DPOC^{8,32-34}, e sabe-se que o comportamento sedentário resulta em efeitos deletérios na saúde em geral^{17,23}. Efeitos deletérios do sedentarismo podem incluir a redução da densidade mineral óssea, maior risco de doenças cardiovasculares e metabólicas com aumento em triglicerídeos e redução da sensibilidade à insulina, o que está associado à obesidade²³. Este alto nível de inatividade e sedentarismo contribui significativamente para o aumento dos custos de saúde, desenvolvimento de alguns tipos de câncer, demência e distúrbios de humor, como a depressão^{17,35}.

Uma parte considerável dos adultos, cerca de 46 a 59%, gastam seu tempo acordado prioritariamente em comportamento sedentário³⁵. O comportamento sedentário não é incluso durante o período de sono do indivíduo, somente durante seu tempo acordado, i.e., durante o trabalho, lazer e atividades domésticas. Alguns comportamentos que acontecem em sedentarismo incluem assistir televisão, ler, dirigir e utilizar computador, por exemplo²⁰. É importante ressaltar que um indivíduo pode apresentar-se como fisicamente ativo, de acordo com as recomendações do ACSM, e também sedentário, o que é denominado na literatura como *'the active couch potato'*³⁶. Estudos entre indivíduos de diversos países reportaram que o aumento no tempo assistindo televisão está fortemente associado ao aumento na prevalência de síndrome metabólica, mesmo entre aqueles que são considerados ativos fisicamente, com maior prevalência em mulheres³⁷⁻³⁹. Do mesmo modo, um estudo com adultos australianos evidenciou que aqueles que passam mais de 4 horas assistindo televisão por dia apresentam um índice de massa corporal (IMC) maior, mesmo quando considerados fisicamente ativos³⁷.

Recentemente, Furlanetto e colaboradores⁴⁰ propuseram um ponto de corte de sedentarismo determinado por variáveis avaliadas de forma objetiva com valor prognóstico para classificar os indivíduos com DPOC como sedentários ou não. Portanto, indivíduos com DPOC que gastam 8,5 horas/dia ou mais em atividades que requerem menos de 1,5 MET apresentam 4,09 vezes maior risco de mortalidade. Garcia-Rio e colaboradores³⁴ também concluíram que a redução da atividade física está associada ao maior risco de mortalidade, porém classificaram os indivíduos com DPOC por meio de quartis (Q) de unidades de magnitude de vetor (Q1: <130 UMV; Q2: 130-200 UMV; Q3: 200-270 UMV; Q4: >270 UMV).

Períodos de interrupção de comportamento sedentário com qualquer atividade de intensidade leve ou moderada tem sido associada benéficamente com biomarcadores de doenças crônicas⁴¹. Por outro lado, longos e contínuos períodos de inatividade tem sido associados com resistência à insulina aumentada e pobre controle glicêmico^{42,43}. Isso tem auxiliado a desenvolver recomendações para minimizar a quantidade de tempo gasto prolongado sentado e “quebrá-lo” mais frequentemente^{17,44}. Embora não haja evidência robusta para essa recomendação, uma mensagem prática é que devemos levantar a cada 30 minutos de posição sentada durante o dia²⁰.

2.4 MONITORIZAÇÃO DA ATIVIDADE FÍSICA E DO SEDENTARISMO NA DPOC

A quantificação da AFVD e do sedentarismo pode ser realizada por meio de observação direta, pela mensuração do gasto energético, por meio de questionários e utilização de sensores de movimento⁴⁵. A observação direta é realizada por observadores que realizam ou assistem a gravações de atividades realizadas, é a que melhor reflete a realidade das características de performance de AFVD pelos indivíduos, porém exige tempo longo para realização e de certa forma invade a privacidade do indivíduo⁴⁶. Os métodos para mensurar o gasto energético incluem calorimetria direta ou indireta⁴⁷ e água duplamente marcada⁴⁸, os quais são considerados “padrão ouro”. Porém, a energia gasta em atividade depende de alguns fatores, como eficiência de movimento e massa corporal. Além disso, algumas limitações importantes para realização destes métodos como seu alto custo e sua manipulação complexa dificultam sua

aplicabilidade⁴⁵.

A monitorização subjetiva, ou seja, por meio de questionários ou diários são métodos de baixo custo e fácil aplicação, que podem ser aplicados em estudos populacionais. Porém, dependem de fatores que podem induzir inacurácia ou viés nas avaliações, como depender da memória do paciente e até mesmo do *design* do questionário, de fato que estas limitações influenciam na confiabilidade dos dados⁴⁵. Além disso, indivíduos com DPOC são capazes de relatarem corretamente suas limitações e sintomas por meio de questionários, porém podem não ser capazes de relatar acuradamente o que diz respeito à duração, intensidade e frequência das atividades realizadas no dia a dia. Sendo assim, podem ser úteis para estimar nível de AFVD de um determinado grupo, mas inacurados quando a estimativa é individual^{45,49}. Por todos estes motivos, torna-se maior o interesse pela monitorização por meio dos sensores de movimento, que detectam os movimentos corporais e quantificam o nível de AFVD.

Sensores de movimento são instrumentos utilizados para detectar movimento corporal, que podem ser usados para quantificar AFVD por um determinado período de tempo⁴⁵. Dentre os sensores de movimento distinguem-se basicamente os pedômetros e os acelerômetros⁴⁹. Os pedômetros são monitores simples, acessíveis financeiramente, pequenos, que registram o número de passos realizados por um indivíduo⁴⁵. São utilizados usualmente na cintura, porém atualmente também podem ser comumente encontrados em aplicativos para telefone celular. Foram desenhados para detectar movimento vertical, podendo acontecer registro equivocado como um passo em determinados movimentos no plano vertical⁵⁰. Os acelerômetros são tecnologicamente mais avançados e permitem quantificar a duração e a intensidade dos movimentos. São dispositivos capazes de armazenar dados por um longo período de tempo, e podem ser utilizados sem a interferência nos padrões normais de atividades¹⁹. Podem ser de dois tipos: uniaxiais ou multiaxiais⁴⁵. Os acelerômetros uniaxiais detectam o movimento em apenas um plano, porém com a vantagem sobre os pedômetros de registrarem a intensidade do movimento e permitirem uma análise mais detalhada⁴⁵. Os multiaxiais podem detectar movimento em dois ou mais planos, permitindo registros ainda mais detalhados em comparação aos uniaxiais e até mesmo

diferenciar atividades e posturas realizadas pelos indivíduos^{45,51}. Apesar da tecnologia mais avançada e por apresentarem maior custo que os pedômetros, os acelerômetros também podem registrar movimentos de maneira equivocada, como por exemplo vibrações durante a locomoção dentro de um veículo^{45,52}. A colaboração dos indivíduos é fundamental quanto ao uso dos sensores de movimento, devido à necessidade de seguir o horário de colocação e o posicionamento adequado do dispositivo, além de evitar colisões do dispositivo com outras estruturas e realizar anotações em um diário⁴⁵.

Atualmente, há uma diversidade de monitores de atividade física no mercado, e os acelerômetros são preferíveis para avaliação de pacientes com doenças crônicas que caminham mais lentamente⁵³. Existem alguns monitores de atividade física que são validados para a população com DPOC⁵⁴⁻⁵⁷. Dois monitores de atividade física são acurados e amplamente utilizados para indivíduos com DPOC: o *Sensewear Armband* (Body Media, EUA) e *Dynaport MoveMonitor* (Mc Roberts, Holanda)⁵⁴. O *Dynaport* é um acelerômetro triaxial, utilizado na região posterior da cintura (Figura 2A), viabilizando a detecção do movimento realizado durante todo o dia de avaliação e estimando o tempo gasto em diferentes posturas e atividades, como o tempo deitado, sentado, em pé e andando, além do gasto energético, intensidade e/ou aceleração dos movimentos. Dessa forma, o tempo em atividade e sedentarismo é identificado de acordo com as posturas adotadas pelos indivíduos, sendo este método validado e bem aceito pelos indivíduos com DPOC⁵⁵. Outro aparelho frequentemente utilizado para avaliar o sedentarismo e atividade física é o *Sensewear Armband*, utilizado no braço direito do indivíduo, na região de tríceps braquial (Figura 2B). Este sensor de movimento possui acelerômetro biaxial associado a sensores fisiológicos, que detectam resposta galvânica da pele e estimam de forma acurada, junto aos algoritmos gerados pelo monitor, o tempo gasto em atividades de diferentes intensidades (leve, moderada, vigorosa ou muito vigorosa) e o gasto energético, que são suas principais variáveis⁵⁶⁻⁵⁸. Embora recomendações internacionais indiquem o uso dos monitores por cerca de 4 dias para uma medida mais acurada, a literatura traz estudos prévios a estas recomendações que se utilizaram dos monitores por dois dias em pacientes com DPOC moderada-grave e atingiram resultados suficientemente confiáveis^{5,9}.

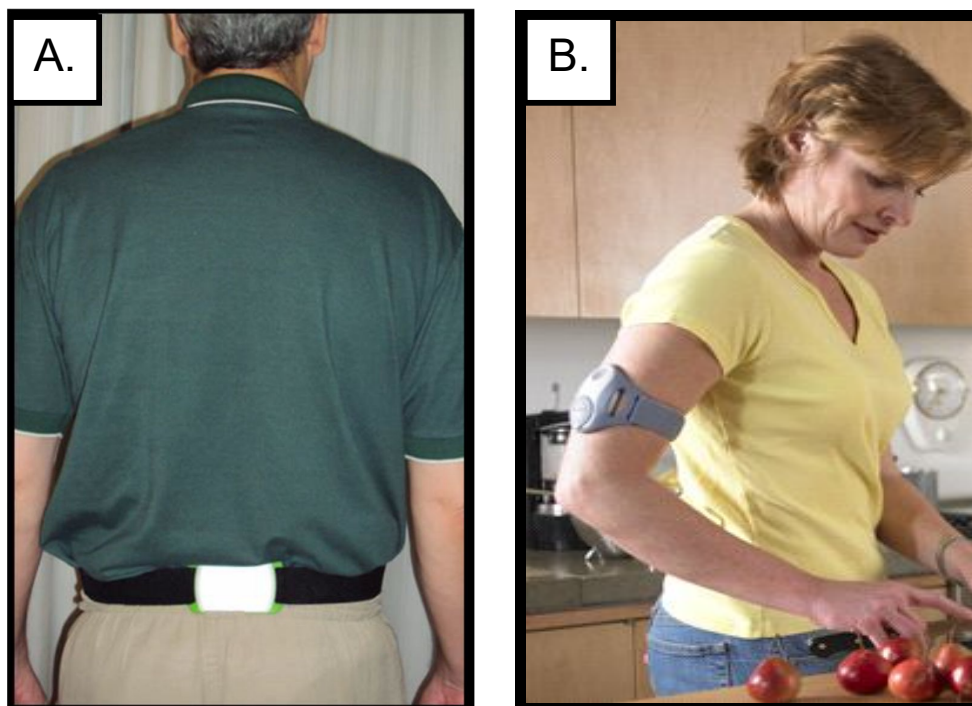


Figura 2. Sensores de movimento: A) *Dynaport MoveMonitor*, B) *Sensewear Armband*

Atualmente a literatura ainda apresenta algumas divergências quanto aos pontos de corte utilizados para identificar atividade leve, moderada ou vigorosa, e, da mesma forma ocorre com o comportamento sedentário. Dessa maneira, a Figura 3 apresenta valores fixos para definir as intensidades de atividade, porém são valores que são eventualmente questionáveis devido ao fato dos indivíduos com DPOC apresentarem padrão marcadamente inativo e, em algumas condições, apresentaram um gasto energético maior devido à gravidade da doença durante algumas situações que são indispensáveis, como a respiração⁵⁹. Existem algumas evidências de que o ponto de corte de 2 METs pode ser mais sensível que o de 3 METs para avaliar atividade física de intensidade moderada nos indivíduos com DPOC⁶⁰. Essa falta de padronização leva à necessidade de uma análise mais minuciosa do dia a dia do indivíduo com DPOC, com o intuito de caracterizar em detalhes o tempo gasto de fato em diferentes intensidades, seja no que diz respeito à atividade física ou ao comportamento sedentário.

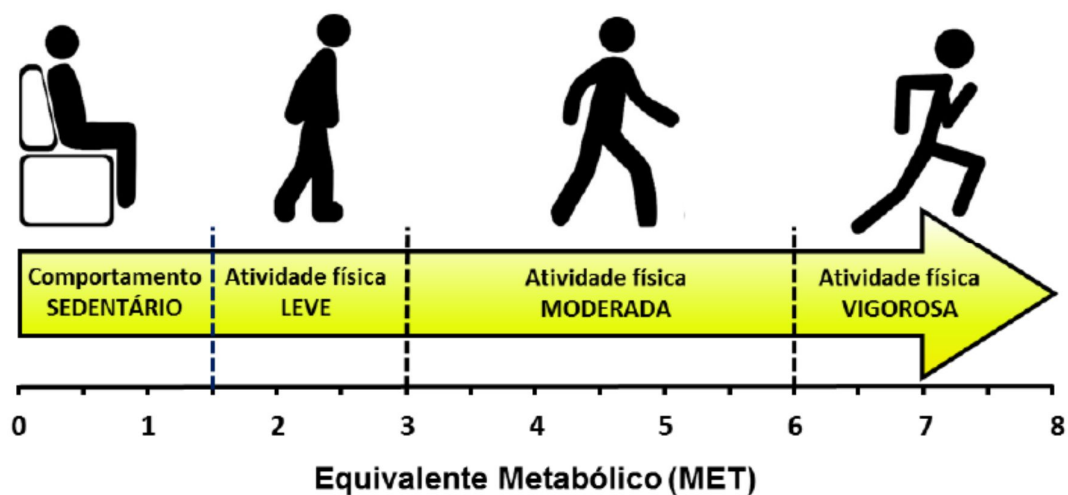


Figura 3. Valores fixos para intensidades de atividades (METs). Adaptado de <http://www.sedentarybehaviour.org/what-is-sedentary-behaviour>. – Tese de Doutorado de Karina Furlanetto, 2016.

ARTIGO

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**SEDENTARY BEHAVIOUR AND PHYSICAL INACTIVITY IN PATIENTS WITH
COPD:
TWO SIDES OF THE SAME COIN?**

Short Title: Sedentary behaviour and physical inactivity

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Conflict of interest

LPS has no conflict of interest to disclose; KCF has no conflict of interest to disclose; AR has no conflict of interest to disclose; JRL has no conflict of interest to disclose; NAH has no conflict of interest to disclose; FP has no conflict of interest to disclose.

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ABBREVIATION LIST

6MWD = 6-Minute Walking Distance

6MWT = 6-Minute Walking Test

A+NS = Active+Non-sedentary

A+S = Active+Sedentary

ATS/ERS = American Thoracic Society/European Respiratory Society

BMI = Body Mass Index

COPD = Chronic Obstructive Pulmonary Disease

FEV₁: Forced Expiratory Volume In The First Second

IN+NS = Inactive+Non-sedentary

IN+S = Inactive+Sedentary

MET = metabolic equivalent task

mMRC = modified Medical Research Council

MVPA = Moderate-to-Vigorous Physical Activity

PA = Physical Activity

PADL = Physical Activity in Daily Life

SB = Sedentary Behaviour

ABSTRACT

BACKGROUND: Despite the growing interest in sedentarism, there is no available information on the profile of patients with COPD according to sedentary behaviour (SB) and with a detailed analysis of minute-by-minute bouts. Hence, the aims of this study were to quantify the time spent in SB, light activities and moderate-to-vigorous physical activities (MVPA) and to verify the relationship of MVPA and light activities with SB in individuals with COPD, as well as to identify the profile of those physically (in)active and (non)-sedentary.

METHODS: Cross-sectional study in which physical activity in daily life (PADL) was objectively assessed through the use of SenseWear Pro 2 Armband (BodyMedia) during 2 consecutive weekdays, 12 hours/day. Analysis was performed minute-by-minute for each day of each patient. MVPA comprised time spent >3 metabolic equivalents (MET), whereas light activities corresponded to time spent between 1.5 and 3 MET and SB to time spent <1.5 MET.

RESULTS: 137 subjects with COPD (66 ± 8 years; FEV_1 $46[31-57]\%$ pred; BMI $26[22-30]$ kg/m²) were analysed. Time spent in MVPA and light activities with SB presented strong negative correlation ($r=-0.72$ and $r=-0.81$, $P<0.001$). Minute-by-minute analysis showed that patients with COPD spend most of their time in SB. SB accounted for 40% of all bouts >1 minute, whereas only 14% these bouts concern MVPA. Patients combining two positive characteristics (physically active and non-sedentary) have better clinical profile than others.

CONCLUSIONS: Sedentary behaviour is negatively correlated with MVPA and light activities in patients with COPD. Furthermore, patients classified as physically active (i.e., those who reach MVPA recommendations) in combination with a non-sedentary lifestyle present markedly better clinical conditions.

Key words: Pulmonary Disease, Chronic Obstructive; Sedentary Lifestyle; Motor Activity

INTRODUCTION

The level of physical activity in daily life (PADL) is the main predictor of mortality for all causes in subjects with Chronic Obstructive Pulmonary Disease (COPD)¹. Patients with COPD are considered less active in daily life than healthy older adults, and a sedentary lifestyle is related to dyspnea and fatigue^{2,3}. Furthermore, it is well established that physical inactivity is linked to higher risk to developing cancer, cardiovascular disease, type II diabetes and many other health effects⁴.

Physical inactivity and sedentarism are not synonyms. Being physically (in)active refers to achieving (or not) a recommended amount of physical activity (PA), generally that proposed by the American College of Sports Medicine (ACSM), i.e., at least 30 minutes/day of moderate-to-vigorous physical activities (MVPA) in bouts of at least 10 minutes, during at least 5 days of the week, or 20 minutes in vigorous activity at least 3 times per week⁴. Moreover, ACSM recommendations also suggest that individuals with worse physical condition can perform PA bouts shorter than 10 minutes when presenting difficulty to perform it continuously. On the other hand, sedentarism has two most common definitions: one based solely on low intensity PA (activities performed at an intensity <1.5 metabolic equivalent of task [MET]) and another which combines low intensity PA (≤ 1.5 MET) with large proportion of the day spent in the seated or reclined posture⁵. Therefore, to be sedentary refers to spending most of the day in activities requiring minimal energy expenditure or sitting/lying, regardless whether the subject has achieved or not the minimum recommended MVPA⁶⁻¹⁰.

Sedentary time is not considered during the subject's period of sleep but only during awake time, which therefore includes work, leisure and housework activities. Most individuals with COPD spend their time awake in sedentary

behaviour (SB)^{8,9,11}. However, it is important to note that a subject can be considered physically active according to ACSM recommendations, but at the same time accumulate large amounts of sedentary behaviour by spending the whole rest of the day in marked sedentarism¹¹. Therefore, these two negative concepts (physical inactivity and sedentarism) may (or not) be present in the same individual.

It is worthwhile to mention that Furlanetto et al.¹² recently proposed a cut-off of objectively assessed SB with prognostic value for patients with COPD, which classifies them as severely sedentary or not. According to that study, individuals with COPD who spend >8.5 hours/day in activities requiring <1.5 MET present a mortality risk more than 4 times higher in comparison to those who do not reach this cut-off¹².

Despite the growing interest in this field, there is no available study investigating the profile of patients with COPD according to the above mentioned definition of SB and with a detailed analysis of minute-by-minute bouts of MVPA or SB. Hence, the aims of this study were (1) to investigate the association between time spent in SB and MVPA in subjects with COPD; (2) to identify the pattern of bouts (i.e., frequency and duration) of continuous MVPA, light activities or SB in a minute-by-minute analysis; and (3) to identify the profile of those physically (in)active and (non)-sedentary.

METHODS

Study Population

This was a cross-sectional study which involved subjects with the following inclusion criteria: diagnosis of COPD according to GOLD criteria¹³ clinical stability

(i.e., no infections and exacerbations within the last 3 months before the study); not performing either pulmonary rehabilitation or any kind of high intensity regular exercise training in the last year; and absence of severe and/or unstable cardiac disease and musculoskeletal comorbidities that could interfere with the assessments. This study concerns a retrospective analysis of baseline assessment data from patients recruited for an unrelated study performed in the same laboratory. The study was approved by the ethics committee of the University and all patients provided informed consent prior to inclusion. Exclusion criteria were: technical problems with the PADL assessment, patients who did not achieve the pre-established minimum wearing time (at least 10 hours of use per day) and occurrence of osteoneuromuscular complication or acute exacerbation during the assessment period.

Assessments

Spirometry was performed using the SpiroBank G (Medical International Research, Rome, Italy) according to the ATS/ERS guidelines¹⁴ and reference values by Pereira et al¹⁵. The 6-minute walking test (6MWT) was performed according to the standards by Holland et al.¹⁶ and reference values by Britto et al.¹⁷ were used. Dyspnea in daily life was assessed by the modified Medical Research Council scale¹⁸.

PADL was objectively assessed using a validated^{19,20} multisensor PA monitor (SenseWear Pro 2 Armband, BodyMedia, Pittsburgh, USA). Subjects were instructed to wear the monitor during awake time of two consecutive routine weekdays for 12 hours/day^{2,21}. A valid assessment day was considered a day

with at least 10 hours of wearing time, in agreement with the existing literature^{22,23}.

Time spent in SB, light activities and MVPA were analysed minute-by-minute in each day of each patient as follows: MVPA were performed at intensity >3 MET, light activities at intensity between 1.5 and 3 MET and SB at intensity <1.5 MET. Meticulous minute-by-minute analysis looked for each bout of continuous MVPA, light activity or SB. A bout was considered a period of at least 1 minute (or more) of continuous activity at the same intensity.

A posteriori, four groups were composed: Active+Non-Sedentary (A+NS), Active+Sedentary (A+S), Inactive+Non-Sedentary (IN+NS) and Inactive+Sedentary (IN+S). Physically active subjects were those who achieved >30 minutes/day of MVPA⁴, whereas those classified as physically inactive did not reach this recommendation. In addition, sedentary subjects were those who spent ≥8.5 hours/day in sedentary activities (i.e. activities of intensity < 1.5 METs)¹², whereas non-sedentary subjects were those who did not reach this cut off.

Statistical Analysis

Data distribution was analysed by the Shapiro-Wilk test. According to normality in data distribution, data were described as mean±standard deviation or median (interquartile range), correlated with Pearson's or Spearman's coefficient and compared with one-way ANOVA or Kruskal-Wallis test with Bonferroni correction. Statistical analyses were carried out using SPSS 22 (SPSS, Chicago,

Illinois) and GraphPad Prism 6.0 (GraphPad Software, La Jolla, California), and the significance level was set at $P < 0.05$.

RESULTS

Baseline Characteristics

Out of 186 patients who were included, 49 were excluded due to technical problems with the analysis of PADL data. Baseline characteristics of the remaining 137 patients are shown in Table 1. In general, the sample had normal-to-overweight BMI, moderate-to-severe airflow obstruction and relatively preserved exercise capacity. There were only two subjects (1.5%) on long term oxygen therapy.

SB, light activities and MVPA in the minute-by-minute analysis

Results presented in table 2 show that patients with COPD spent the vast majority of time in SB and light activities, therefore spending little time in MVPA. Median wearing time of the activity monitor was 721(718-725) minutes• day, corresponding to 12 hours of assessment per day. In total, 41238 bouts >1 minute were identified. Noteworthy, SB bouts presented longer duration than bouts in light activities and MVPA. The frequency of bouts/day of SB, light activities and MVPA corresponded to 40%, 46% and 14% of all bouts, respectively. Moreover, the proportion of number of breaks (i.e. frequency of bouts/total time) according to each intensity was different among MVPA (90[65-126]%), light activities (70[57-92]%) and SB (29[19-38]%).

MVPA and SB had a strong negative correlation ($r=-0.72$, $P<0.001$) which is depicted in Figure 1. Similarly, light activities and SB were also strongly and negatively correlated ($r=-0.81$; $P<0.001$) (Figure 2). In addition, there was positive correlation between frequency and duration of bouts/day of MVPA ($r=0.52$; $P<0.001$), and similar but negative correlation for bouts/day of SB ($r=-0.55$; $P<0.001$).

Comparison among groups

Out of the 137 patients, 67 were classified as A+NS, 9 as A+S, 26 as IN+NS and 35 as IN+S. Table 3 shows that group IN+S was older, presented higher BMI and worse disease severity, mortality risk, dyspnea sensation and exercise capacity in comparison to A+NS. Interestingly, IN+NS also presented worse dyspnea sensation and exercise capacity in comparison to A+NS while the group A+S presented worse exercise capacity in comparison to A+NS. There were almost no differences between A+S and IN+NS groups.

Comparisons regarding the minute-by-minute PADL analysis among the groups are shown in table 4. Group A+NS presented higher time in MVPA, steps/day, energy expenditure and less time in SB in comparison to all the other groups. A+S and IN+NS presented similar steps/day and duration of bouts of light activities. Finally, both non-sedentary groups (IN+NS and A+NS) presented similar duration and frequency of SB bouts and light activities bouts, whereas both active groups (A+NS and A+S) presented higher duration of MVPA bouts in comparison to IN+S.

DISCUSSION

The present study provides a novel and detailed analysis of bouts of time spent in sedentarism, light and moderate-to-vigorous activities. In general, patients with COPD spend the vast majority of time in SB and light activities. Noteworthy, there was strong and negative correlation between MVPA and SB. Additionally, bouts of SB presented longer duration than bouts of light activities and MVPA, and there was higher frequency of bouts of SB and light activities than of MVPA. Finally, comparisons among the four groups analysed according to the presence of (in)activity and (non)-sedentarism showed that patients combining two positive characteristics (i.e., physically active and non-sedentary) had better clinical profile than others.

It has been suggested that healthy adults, spend approximately 46-59% of the day in sedentary activities and 37-46% of the day in light activities²⁴. In line with these results, the present study showed that patients with COPD spend approximately 62.6% of the day in sedentary activities and 28.8% of the day in light activities. In fact, it is well known that patients with COPD walk less time/day than healthy elderly without the disease². However, part of the current challenge in the PA field is about breaking sedentary bouts and turning this into increase in MVPA bouts or even in light activities bouts. Since a greater quantity of low-intensity PA already leads to lower risk of COPD hospitalisations²⁵, detailed results pertaining the frequency and duration of bouts of light intensity activity become even more relevant.

Interestingly, patients spend longer duration of bouts at SB intensity, but slightly higher frequency in bouts of light activities. Therefore, it is important to consider the proportion of breaks according to the total time spent in each intensity. For

instance, MVPA breaks occurred in lower quantity but, proportionally, patients spent markedly less time performing high intensity activities. Thus, it is likely that the higher the intensity of activity, the higher the number of interruptions that will occur. Perhaps this happens because patients naturally break periods of activities due to symptoms of the disease²⁶. In this line of reasoning, the present study demonstrated that the intensity of activity is associated with the number of breaks since frequency and duration of bouts were positively associated for MVPA whereas negatively associated for SB.

The strong negative correlation between time spent in SB and MVPA, despite somewhat intuitive, was never previously shown and features that there is a direct link between longer time in sedentary activities and less MVPA. It is known that accumulating MVPA leads to important health benefits, whereas interrupting longer periods of SB with any mild or moderate intensity may also be beneficial⁴⁻²⁷⁻²⁹. These findings have helped to develop recommendations to minimize the amount of continuous time spent in prolonged sitting or reclining by breaking this SB more often^{4,30}. Different strategies have been used to modify PA in patients with COPD, however leading these patients to reduce their time in sedentary activities (such as television viewing and others) in order to replace them by light activities may be a feasible first initiative²². In fact, strategies to increase light intensity PA rather than focusing solely on increasing MVPA are a novel feature in the literature^{6,31-32}. The strong negative correlation between time spent in light activities and SB confirms the fact that the increase in light activities may reduce SB. However, the present results also highlighted that increasing the duration and frequency of MVPA bouts should not be left aside, as discussed ahead.

The present study was the first to present a comparison among four groups according to a minute-by-minute analysis of patterns of physical activity and sedentarism, combining these positive and negative characteristics. By performing this analysis, it was possible to show that the group of subjects combining two negative characteristics (physically inactive and sedentary) had the worse profile, whereas the group combining two positive characteristics (physically active and non-sedentary) had the best profile. Of note, group A+NS presented better results of dyspnea and exercise capacity in comparison to group IN+NS, highlighting the importance of being physically active. On the other hand, it seems reasonable to encourage patients to reduce sedentary behaviour despite achieving 30 minutes of MVPA, since exercise capacity was also worse in the A+S group in comparison to A+NS. Previous studies using different ways to identify inactive or sedentary patients suggested that, in general, worse clinical conditions (e.g., worse airway obstruction, dyspnoea and exercise capacity, as well as higher BMI and scores in the BODE index) are associated with inactivity and or sedentarism³³⁻³⁵.

Results shown in table 4 reinforce the message to focus on being both physically active and non-sedentary as the optimal goal for patients with COPD. Although patients who have only one positive characteristic (IN+NS and A+S) have similar number of steps/day, it is better to present the two positive characteristics since results of time in MVPA and SB, energy expenditure and also steps/day were better in the A+NS group. On the other hand, based on the present results, avoiding sedentarism (even in an inactive patient) or avoiding inactivity (even in a sedentary patient) present some benefits. For instance, there was similar pattern for duration and frequency of bouts between A+NS and IN+NS, whereas A+S

presented similar pattern of MVPA bouts in comparison to A+NS. In fact, sedentary behaviour and physical inactivity have been separately associated with worse prognosis for patients with COPD^{1,12,36}. Therefore, an ideal goal would be to have as many patients as possible being physically active and non-sedentary; however, if this is not possible, patients may benefit from presenting at least one of these positive characteristics, avoiding the worse profile (i.e., physically inactive and sedentary).

Some methodological strengths and limitations need to be taken into account. The assessment of minute-by-minute bouts of SB, light activities and MVPA is an important novel feature of this study, due to the scarce previous literature in this topic. The classification of patients in four groups according to the characterization as physically active/inactive and sedentary/non-sedentary is also novel and provides further insight to the current literature. Potential limitations include the fact that group comparison may have been hindered by the small sample of the A+S group, although this imbalance could also be a characteristic of the COPD population in case this is replicated in larger samples in the future. Furthermore, exacerbation history, presence of comorbidities, daylight time and climatic variations were not assessed, and these outcomes could provide valuable further insights in future studies. And finally, it was not possible to identify the time spent sleeping during the day (i.e., during the 12 hours of assessment per day), and it was therefore regarded as sedentary activity.

In conclusion, sedentary behaviour is negatively correlated with MVPA in patients with COPD. Bouts of SB last longer than those of light activities and MVPA, and the frequency of bouts in SB and light activities is considerably higher than bouts in MVPA. Furthermore, patients classified as physically active (i.e., those who

reach MVPA recommendations) in combination with a non-sedentary lifestyle present markedly better clinical conditions, despite some benefits in presenting only one of these positive behaviours over any of them.

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TABLES

Table 1. Baseline characteristics

Characteristics	
Gender (M/F)	75/62
Age (years)	66±8
BMI (kg/m²)	26[22-30]
FEV₁ (L)	1,1[0,8-1,5]
FEV₁ (%pred)	46[31-57]
FEV₁/FVC	54[42-65]
mMRC	3[2-3]
6MWD (m)	452[403-510]
6MWD (%pred)	83[73-95]
BODE index	4[3-5]

M: Male; F: Female; BMI: Body Mass Index; Kg/m²: kilogram per square meter; FEV₁: Forced Expiratory Volume in first second; L: Liter; %predicted: % of the predicted value; mMRC: modified Medical Research Council scale; 6MWD: 6-minute walking distance; BODE Index: Body Composition, Obstruction, Dispnea and Exercise index.

Table 2. Characteristics of physical activity in daily life (PADL) in the study sample.

PADL Characteristics	
Wearing Time (min)	721[718-725]
Time spent in SB (min)	451±125
Time spent in light activities (min)	207±95
Time spent in MVPA (min)	62±73
Steps/Day	4859[2498-7887]
Total energy expenditure/day (kcal)	1174[1003-1529]
Average MET/day	1.8[1.7-2.1]
Frequency of SB bouts (bouts/day)	120±40†
Frequency of light activities bouts (bouts/day)	138±48†
Frequency of MVPA bouts (bouts/day)	35[15-61]†
Duration of SB bouts (min)	7[5-10]*
Duration of light activities bouts (min)	3[2-4]*
Duration of MVPA bouts (min)	2[2-3]*

SB: sedentary behaviour; MVPA: moderate-to-vigorous physical activity; min: minutes; Kcal:

Kilocalories; MET: metabolic equivalents of task; bouts/day: periods of continuous activity (> 1 minute) at a given intensity (sedentary, light or moderate-to-vigorous);

* $P < 0.001$ vs duration of bouts; † $P < 0.001$ vs frequency of bouts.

Table 3. Comparison among groups concerning variables of demographic data, lung function, dyspnea in daily life, exercise capacity and BODE index.

Variables	A+NS	A+S	IN+NS	IN+S	P value
Gender (M/F)	39/28	5/4	11/15	21/14	0.51
Age (years)	64±8	70±7	66±7	70±9*	0.003
BMI (kg/m ²)	25[21-28]	20[19-31]	27[23-31]	27[23-33]*	0.04
FVC (L)	2.4[1.8-3.1]	2.1[1.2-2.6]	2[1.2-2.4]	1.9[1.5-2.3]*	0.004
FVC (%pred)	72±15	62±19	62±15	62±17*	0.01
FEV ₁ (L)	1.24[0.94-1.63]	0.84[0.67-1.34]	1.06[0.84-1.46]	0.89[0.68-1.08]*	0.002
FEV ₁ (%pred)	48[37-58]	35[23-49]	46[26-55]	38[26-54]	0.08
FEV ₁ /FVC	54[43-67]	51[34-62]	55[42-63]	50[40-61]	0.68
mMRC	2[1-3]	3[2-4]	3[3-3]*	3[2-3]*	0.003
6MWD (m)	500[445-535]	420[408-435]*	437[393-479]*	381[340-465]*	<0.0001
6MWD (% pred)	90[82-100]	78[70-83]*	82[73-92]*	72[66-83]*	<0.0001
BODE index	4[2-5]	3[3-5]	5[3-6]	5[4-6]*	0.009

A+NS: Active and non-sedentary; A+S: Active and sedentary; IN+NS: Inactive and non-sedentary; IN+S: Inactive and sedentary; M: Male; F: Female; BMI: Body Mass Index; FVC: Forced Vital Capacity; L: Liter; % pred: % of the predicted value; FEV₁: Forced Expiratory Volume in the first second; mMRC: modified *Medical Research Council* scale; 6MWD: 6-minute walking distance; BODE Index: Body Composition, Obstruction, Dyspnea and Exercise index.

* $P < 0.05$ vs A+NS.

Table 4. Comparison among groups concerning variables of physical activity in daily life.

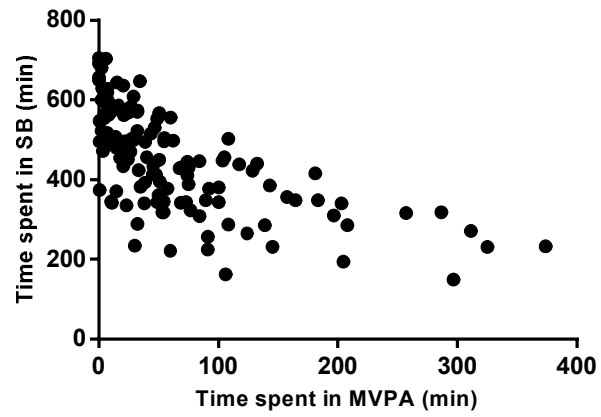
Variables	A+NS	A+S	IN+NS	IN+S	P value
Time spent in SB (min)	357±85	559±39*	459±56 * †	598±51 * † #	<0.0001
Time spent in light activities (min)	254±85	118±38*	244±58†	112±50 * #	<0.0001
Time spent in MVPA (min)	84[54-139]	43[32-50]*	16[11-24] * †	7[3-17] * † #	<0.0001
Steps/day	7895[5839-10488]	3939[1437-4608]*	3774[2935-4965] *	1946[1360-2770] **	<0.0001
Total daily energy expenditure (kcal)	1433[1171-1605]	1038[825-1221]*	1150[1006-1217] *	962[792-1108] * #	<0.0001
Average MET	2[1.9-2.3]	2[1.8-2.1]	1.7[1.6-1.8] * †	1.6[1.4-1.7] †	<0.0001
Frequency of SB bouts (bouts/day)	131±32	101±45	142±35 †	88±32 * #	<0.0001
Frequency of light activities bouts (bouts/day)	162±37	100±45 *	153±34 †	91±35 **	<0.0001
Frequency of MVPA bouts (bouts/day)	61[43-88]	35[14-54] *	17[13-25] * †	9[4-16] * † #	<0.0001
Duration of SB bouts (min)	6[4-7]	10[8-19] *	6 [5 -9] †	13[10-20] * #	<0.0001
Duration of light activities bouts (min)	3[2-4]	2[1-3]	3[3-4]	2[2-3] *	0.01
Duration of MVPA bouts (min)	3[2-4]	3[1-7]	2[2-2] *	2[1-2] *†	<0.0001

A+NS: Active and non-sedentary; A+S: Active and sedentary; IN+NS: Inactive and non-sedentary; IN+S: Inactive and sedentary. SB: sedentary behaviour; MVPA: moderate-to-vigorous physical activity; Kcal: kilocalories; MET: metabolic equivalents of task; bouts/day: periods of continuous activity (> 1 minute) at a given intensity (sedentary, light or moderate-to-vigorous).

* $P < 0.05$ vs A+NS; † $P < 0.05$ vs A+S; # $P < 0.05$ vs IN+NS.

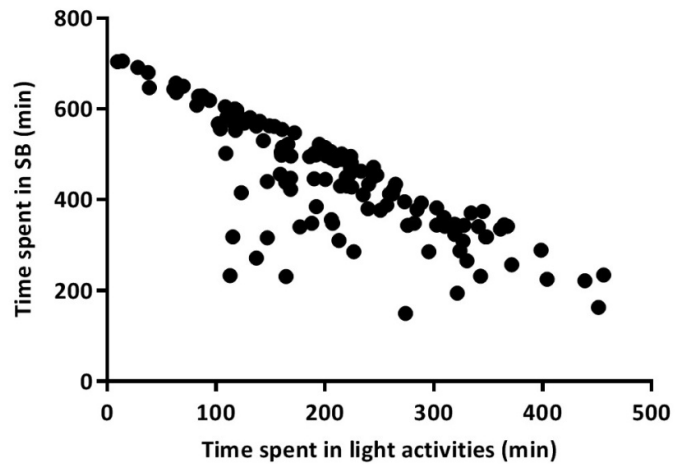
FIGURES

FIGURE 1



MVPA: time spent in moderate-to-vigorous physical activities (≥ 3 metabolic equivalents of task (MET));
SB: time spent in sedentary behaviour (activities requiring <1.5 MET). $r=-0.72$, $P<0.001$.

FIGURE 2



Light activities (activities requiring between 1.5 to 3 METs); SB: time spent in sedentary behaviour (activities requiring <1.5 MET). $r=-0.81$, $P<0.0001$.

FIGURE LEGENDS

Figure 1. Correlation of time spent in sedentary behaviour and time spent in moderate-to-vigorous physical activities in patients with COPD.

Figure 2. Correlation of time spent in sedentary behaviour and time spent in light physical activities in patients with COPD.

CONCLUSÃO GERAL

A presente dissertação acrescenta à literatura achados científicos quanto ao estudo dos blocos em atividades sedentárias, leves e moderadas-vigorosas em indivíduos com DPOC. Pode-se inferir com este estudo que o tempo em atividades sedentárias está correlacionado negativamente com o tempo em atividades moderada-vigorosa e que os indivíduos com DPOC dispõem grande parte do tempo em blocos contínuos de atividades com intensidades muito baixas (<1.5 METs) do que em blocos de atividades com maiores intensidades (≥ 3 METs), visto que esta possivelmente seria uma intensidade muito alta e com maior sintomatologia ao indivíduo. Além disso, os indivíduos que são considerados ativos e não sedentários são os que apresentam uma melhor condição clínica. Portanto, uma meta ideal seria ter o maior número possível de pacientes sendo fisicamente ativos e não-sedentários; no entanto, caso isso não seja possível, os pacientes podem se beneficiar de apresentar ao menos uma das duas características, evitando o pior perfil (ou seja, fisicamente inativo e sedentário).

Dessa maneira, é importante ressaltar a importância de discriminar o perfil do indivíduo com DPOC com melhores condições clínicas para que possamos aprimorar o cuidado e meios de melhora das condições daquele que não apresenta tais condições.

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APÊNDICES

APÊNDICE A

Termo de Consentimento Livre e Esclarecido

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Prezado(a) Senhor(a):

O(A) Sr(a) está sendo convidado para participar de um projeto de pesquisa chamado “*Efeitos de um programa de exercício físico de longa duração sobre aspectos pulmonares e sistêmicos em pacientes com Doença Pulmonar Obstrutiva Crônica (DPOC)*”, cujos pesquisadores responsáveis são Prof. Dr. Fábio de Oliveira Pitta e Nidia A. Hernandez, do Departamento de Fisioterapia da Universidade Estadual de Londrina (UEL). O estudo analisará principalmente as melhoras obtidas após 6 meses de treinamento utilizando-se dois tipos diferentes de exercício físico.

Justificativa: O presente estudo contribuirá para solucionar uma questão não resolvida e que tem sido alvo de grande debate: levando em conta que a longa duração do programa de treinamento físico é fundamental no processo de conscientizar pacientes com DPOC a aumentar sua atividade física diária, será necessário que o treinamento físico realizado durante esse programa de longa duração seja feito em alta intensidade, ou um programa de baixa intensidade de treinamento já atingiria o objetivo? Se programas de longa duração, porém com baixa intensidade de treinamento, trouxerem benefícios importantes no aumento da atividade física diária, isso poderá trazer mudança no entendimento atual sobre protocolos de exercício em pacientes com DPOC, que hoje são realizados sob alta intensidade de treinamento.

Objetivo: Comparar os efeitos de dois protocolos de treinamento físico em um programa de reabilitação de longa duração (6 meses) em pacientes com DPOC: um protocolo de alta intensidade (baseado em treinamento de endurance e força) e um protocolo de baixa intensidade (baseado em exercícios respiratórios e de readequação do complexo tóraco-pulmonar).

Procedimentos: Os pacientes incluídos realizarão uma série de testes que incluirá avaliação da função pulmonar, capacidade máxima e funcional de exercício, força muscular periférica e respiratória, atividade física na vida diária, composição corporal, função autonômica cardíaca, qualidade de vida, estado funcional e sensação de dispnéia. A realização dos testes requer uma visita de aproximadamente 2 horas ao Hospital Universitário Regional Norte do Paraná, em Londrina, além do uso do pequeno aparelho na cintura durante dois dias (12 horas por dia, apenas durante o dia e não de noite). Após a avaliação inicial, os pacientes serão divididos em dois grupos: um grupo realizará um programa de exercícios físicos direcionado ao aumento da mobilidade torácica realizado 3 vezes por semana, durante 24 semanas; e outro grupo realizará um programa de treinamento de endurance e força de membros superiores e inferiores realizado 3 vezes por semana, durante 24 semanas. Ao final do programa de treinamento, os participantes serão reavaliados seguindo os mesmos testes realizados na avaliação inicial.

Custos: A pesquisa é gratuita e portanto não envolve qualquer custo por parte dos indivíduos. Não haverá qualquer gratificação financeira pela participação. No entanto, em caso de eventuais danos ocorridos exclusivamente por causa deste estudo, o Sr(a) terá direito a tratamento médico completo oferecido pela instituição.

Riscos: Nenhum dos procedimentos utilizados constitui risco direto para a integridade física ou moral dos participantes. Além disso, os participantes poderão abandonar o estudo a qualquer momento que se achar conveniente, sem qualquer prejuízo em nenhum sentido.

Sigilo: Embora os resultados da pesquisa possam ser divulgados em publicações e eventos científicos, a identidade dos participantes será sempre preservada de maneira sigilosa, ou seja, em segredo.

Caso o(a) Sr(a) aceite esse convite e concorde voluntariamente em participar do estudo assinando este termo de consentimento, consideramos que o Sr(a) acredita que foi suficientemente informada pela pesquisadora Nidia Aparecida Hernandez sobre a pesquisa, os procedimentos envolvidos nela, assim como os possíveis riscos e benefícios decorrentes dessa participação. Ressaltamos novamente que o Sr(a) pode retirar seu consentimento a qualquer momento, sem que isto leve a qualquer prejuízo em nenhum sentido.

Local e data: _____

Nome do participante: _____

Assinatura do participante ou responsável: _____

Assinatura do pesquisador: _____

Colocamo-nos à disposição para qualquer esclarecimento que se fizer necessário nos telefones (43) 3371-2477 ou pessoalmente no Ambulatório de Fisioterapia Respiratória do Hospital Universitário Regional Norte do Paraná: Av. Robert Koch, 60 – Vila Operária – Londrina – PR (perguntar pelo Professor Fábio de Oliveira Pitta).

Atenciosamente,

Prof. Fábio de Oliveira Pitta
Coordenador do Projeto

ANEXOS

ANEXO A

Parecer do Comitê de Ética em Pesquisa



COMITÊ DE ÉTICA EM PESQUISA ENVOLVENDO SERES HUMANOS
 Universidade Estadual de Londrina/ Hospital Universitário Regional Norte do Paraná
Registro CONEP 268

Parecer Nº 123/09 CAAE Nº 0093.0.268.000-09 FOLHA DE ROSTO Nº 257672	Londrina, 14 de setembro de 2009.
PESQUISADOR: FABIO DE OLIVEIRA PITTA PROPPG (Processo 12955/09)	
Prezado(a) Senhor(a)	
<p style="text-align: center;">O “Comitê de Ética em Pesquisa Envolvendo Seres Humanos da Universidade Estadual de Londrina/ Hospital Universitário Regional Norte do Paraná” de acordo com as orientações da Resolução 196/96 do Conselho Nacional de Saúde/MS e Resoluções Complementares, avaliou o projeto:</p> <p style="text-align: center;">“EFEITOS DE UM PROGRAMA DE EXERCÍCIO FÍSICO DE LONGA DURAÇÃO SOBRE ASPECTOS PULMONARES E SISTÊMICOS EM PACIENTES COM DOENÇA PULMONAR OBSTRUTIVA CRÔNICA (DPOC)”</p> <p style="text-align: center;">Informamos que deverá ser comunicada, por escrito, qualquer modificação que ocorra no desenvolvimento da pesquisa, bem como deverá apresentar ao CEP/UEL relatório final da pesquisa.</p>	
Situação do Projeto: APROVADO	
<p>Atenciosamente,</p> <p><i>10/09/09</i> Prof.ª Dra. Ester M. O. Dalla Costa Coordenadora Comitê de Ética em Pesquisa - CEP/UEL</p>	

ANEXO B

Normas de formatação do periódico *Chest*

When submitting to *CHEST*, authors will be asked to separately upload several distinct files through ScholarOne Manuscripts. The following list includes the types of files that may be required. More detailed information on each element is provided in the following structured and labeled sections.

1. Cover letter (either entered as text or uploaded to the Cover Letter area)
2. Manuscript file (uploaded as Main Document), inclusive of:
 - Title page
 - Abbreviations list
 - Abstract
 - Text
 - Acknowledgments
 - References
 - Tables
 - Figure legends
3. Figure files
4. Supplemental material files for online only publication (upload as Online Content Only)
5. Permissions for republication or survey use (where applicable, upload as Supplemental File)
6. Patient consent for publication (where applicable, upload as Supplemental File)

Abbreviation List

An alphabetical list of all abbreviations used in the paper, followed by their full definitions, should be provided on submission. Each abbreviation should be expanded at first mention in the text and noted parenthetically after expansion. Abbreviations should only be used for terms that appear more than three times in text. To aid readers, please use abbreviations sparingly.

Abstract

For Original Research studies (clinical trials, interventional studies, cohort studies, case-control studies, epidemiologic assessments, surveys, systematic reviews, and meta-analyses), the abstract should consist of the following sections:

- Background
- Methods
- Results
- Conclusions
- Clinical Trial Registration (registrar, website, and registration number), where applicable;

The sections should briefly describe, respectively, the problem being addressed in the study, how the study was performed (including numbers of patients or laboratory subjects), the significant results, and what the authors conclude from the results. For all other manuscript types requiring abstracts, *CHEST* requires a narrative (unstructured) abstract. More information is available in Guidance for Specific Article Types.

Acknowledgments

The acknowledgments section will vary slightly by article type. Possible elements include:

- **Guarantor** statement, naming one author who takes responsibility for (is the guarantor of) the content of the manuscript, including the data and analysis (**Original Research**)
- **Author contributions** should define the individual contributions each author made to the development of the manuscript and should include at minimum the three criteria required for **Authorship** as defined by *CHEST* (required for **Original Research**). If several authors made the same type of contributions, it is acceptable to combine them. An example author contribution line is: "MLM had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis, including and especially any adverse effects. MLM, MT, NAW, DRG, VAD, and EG contributed substantially to the study design, data analysis and interpretation, and the writing of the manuscript."
- **Financial/nonfinancial disclosures** should match those provided on the title page
- **Role of the sponsors** should detail what input or contributions, if any, were provided by the funding sources in the development of the research and manuscript

Other contributions

Audioslides (Content Innovation)

The Journal encourages authors to create an AudioSlides presentation with their published article. AudioSlides are brief, webinar-style presentations that are shown next to the online article on ScienceDirect. This gives authors the opportunity to summarize their research in their own words and to help readers understand what the paper is about. More information and examples are available at <http://www.elsevier.com/audioslides>. Authors of this journal will automatically receive an invitation e-mail to create an AudioSlides presentation after acceptance of their paper.

Figures

Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other

sites) in addition to color reproduction in print. For further information on the preparation of electronic artwork, please see <http://www.elsevier.com/artworkinstructions>.

Radiologic or other diagnostic examination figures or other diagnostic testing figures should have all patient-related numbering (including test date or medical record numbers) or wording removed prior to submission.

Virtual Microscope (Content Innovations)

The journal encourages authors to supplement in-article microscopic images with corresponding high resolution versions for use with the Virtual Microscope viewer. The Virtual Microscope is a web-based viewer that enables users to view microscopic images at the highest level of detail and provides features such as zoom and pan. This feature for the first time gives authors the opportunity to share true high resolution microscopic images with their readers. More information and examples are available at <http://www.elsevier.com/about/content-innovation/virtual-microscope>. Authors of this journal will receive an invitation e-mail to create microscope images for use with the Virtual Microscope when their manuscript is first reviewed. If you opt to use this feature, please contact virtual_microscope@elsevier.com for instructions on how to prepare and upload the required high resolution images.

3D Radiological Data (Content Innovations)

You can enrich your online article by providing 3D radiological data in DICOM format. Radiological data will be visualized for readers using the interactive viewer embedded within your article and will enable them to: browse through available radiological datasets; explore radiological data as 2D series, 2D orthogonal MPR, 3D volume rendering and 3D MIP; zoom, rotate, and pan 3D reconstructions; cut through the volume; change opacity and threshold level; and download the data. Multiple datasets can be submitted. Each dataset will have to be zipped and uploaded to the online submission system via the "3D radiological data" submission category. The recommended size of a single uncompressed dataset is 200 MB or less. Please provide a short informative description for each dataset by filling in the "Description" field when uploading each ZIP file. Note: all datasets will be available for download from the online article on ScienceDirect. So please ensure that all DICOM are **anonymized** prior to submission. For more information, see <http://www.elsevier.com/about/content-innovation/radiological-data>.

Figure Legends

All illustrations must be cited in consecutive numerical order within the text of the manuscript. A legend for each illustration should be provided on a separate page of the manuscript, not on the figure itself. Stains and magnifications for all photomicrographs should be included in the legend. Any image manipulation (eg, splicing) should be described in the legend. Permissions for any republished figures and any required patient consent lines for identifiable images also should be noted in the legend.

Graphical abstract

Although a graphical abstract is optional, its use is encouraged as it draws more attention to the online article. The graphical abstract should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide

readership. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: Please provide an image with a minimum of 531 × 1328 pixels (h × w) or proportionally more. The image should be readable at a size of 5 × 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. You can view Example Graphical Abstracts on our information site.

Authors can make use of Elsevier's Illustration Services to ensure the best presentation of their images and in accordance with all technical requirements.

References

Authors are responsible for the accuracy and completeness of citations. In text, references must be given as superscript numerals, numbered consecutively in the order in which they appear in the text. If the first (or only) mention of a reference appears in a Table, place the reference number after the Table call out in text. For example, if a reference is in Table 3 and has not been called out any earlier in the text, then the text call out should be, eg, "Table 3²⁷...". This will preserve numbering in citation management software. The full citations must be listed in numerical order at the end of the text. Each reference must contain, in order, the following:

- **Authors** (last name initials), listing all when there are up to six; first three followed by et al in the case of more than six authors
- **Title** of article (sentence case, no quotation marks)
- **Publication** source (italicized), when referring to a journal, the journal name should be abbreviated according to *Index Medicus*
- **Year** of publication
- **Volume** number
- **Issue** number
- **Page** numbers (inclusive)

No spaces should be used from the year of publication through the final page number. References to published abstracts may be included but must be noted as such. Please note that no periods should be used after authors initials or after journal abbreviations; however, periods should be inserted after the publication name and at the end of each reference. Examples of commonly used reference types are noted below.

Journal Article

1. Sillen MJH, Speksnijder CM, Eterman R-MA, et al. Effects of neuromuscular electrical stimulation of muscles of ambulation in patients with chronic heart failure: a systematic review of the English-language literature. *Chest*. 2009;136(1):44-61.
2. Barker E, Haverson K, Stokes CR, Birchall M, Baily M. The larynx as an immunological organ: immunological architecture in the pig as a large animal model. *Clin Exp Immunol*. 2006;143(1):6-14.

In-Press Journal Article

Annane D, Sebille V, Charpentier C, et al. Effect of treatment with low doses of hydrocortisone and fludrocortisone on mortality in patients with septic shock. *JAMA*. In press. doi:10.1001/jama.288.7.862

Book

1. Shields TW, LoCicero J III, Reed CE, Feins RH. *General Thoracic Surgery*. 7th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2009:200-232.

Book Chapter

1. Stone AC, Klinger JR. The right ventricle in pulmonary hypertension. In: Hill NS, Farber HW, eds. *Pulmonary Hypertension*. New York, NY: Humana Press; 2008:93-126.

Abstract

Garg N, Garg G, Christensen G, Singh A. Acute coronary syndrome caused by coronary artery mycotic aneurysm due to methicillin-resistant staphylococcus aureus [abstract]. *Chest*. 2008;134(suppl):1001S.

For assistance in formatting other types of references, please refer to the [American Medical Association Manual of Style](#).¹

References:

JAMA and Archives Journals. *American Medical Association Manual of Style: a guide for authors and editors*. 10th ed. New York, NY: Oxford University Press.

Data References

This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

Supplemental Material/Appendices

Authors may submit supplemental material (ie, material that will be published only with the online version of the journal) if it enhances a study. The main text must stand alone, and the use of supplemental material should be judicious.

The same standards for ethics, copyright, permissions, and publication quality for the full-text article apply to all supplemental material. Tables and figures for the main article should be integrated with the main manuscript. The inclusion of a single table and/or figure as supplemental material is not acceptable; that element should be integrated into the text. References in supplemental material should be numbered consecutively beginning with 1; if a reference appears in the main article, it must also be included in the supplemental material and will likely have a different reference number. Supplemental material should be thought of distinctly in this regard.

If any of the material included as supplemental material has been previously published, the authors are responsible for obtaining the required permissions and attributing the source material.

Appendices will no longer appear in *CHEST* articles, but may be included as supplemental material, labeled e-Appendix. Lists of study participants, multicenter institutional review board data, and the like are appropriate for e-Appendices.

Numbering

Each component of the supplemental material should be numbered and cited in consecutive order in the text of the article. Authors should not intersperse supplemental material consecutively with material for the print edition. The following convention should be used for labeling and numbering material:

- **e-Table:** number as e-Table 1, e-Table 2, etc
- **e-Figure:** number as e-Figure 1, e-Figure 2, etc
- **e-Appendix:** number as e-Appendix 1, e-Appendix 2, etc
- **Audio:** number as Audio 1, Audio 2, etc
- **Video:** number as Video 1, Video 2, etc (note, if shorter videos are combined into a single file, label each portion, eg, Video 1A, Video 1B, etc.)

Example: The distribution of missed bronchoscopy skills data points across centers and bronchoscopy milestones are depicted in e-Figure 1.

Formats

The manuscript title, author list, and heading Supplemental Material should be included at the beginning of each file. The following formats can be uploaded as Online Content Only in ScholarOne Manuscripts:

Video: Quicktime (.mov), Windows media (.wmv), Audio Video Interleave (.avi), animated GIF (.gif), .mpeg, and .mp4. All movie clips should be provided at the desired size and length (10 MB or 5 min maximum). Before submitting, authors should verify that clips are viewable in Quicktime or Windows Media Player. In addition, a brief text description should be provided in a word processing document explaining the video. Authors are encouraged to supply a still image of the video file for inclusion as reference in the print version of the article

Audio: .mp3, .wav, .au. In addition, a brief text description should be provided in a word processing document explaining the audio file.

Tables: Must be provided as Word files. The total size of the document cannot exceed 8.5 x 11 inches.

Figures: .tiff, .png, .jpeg, and .gif. One word processing file should be provided that contains brief captions for all figures.

Text: Microsoft Word (.doc, .docx), .rtf, and .txt files.

AudioSlides

The journal encourages authors to create an AudioSlides presentation with their published article. AudioSlides are brief, webinar-style presentations that are shown next to the online article on ScienceDirect. This gives authors the opportunity to summarize their research in their own words and to help readers understand what the paper is about. More information and examples are available. Authors of this journal will automatically receive an invitation e-mail to create an AudioSlides presentation after acceptance of their paper.

3D radiological data

You can enrich your online article by providing 3D radiological data in DICOM format. Radiological data will be visualized for readers using the interactive viewer embedded within your article, and will enable them to: browse through available radiological datasets; explore radiological data as 2D series, 2D orthogonal MPR, 3D volume rendering and 3D MIP; zoom, rotate and pan 3D reconstructions; cut through the volume; change opacity and threshold level; and download the data. Multiple datasets can be submitted. Each dataset will have to be zipped and uploaded to the online submission system via the '3D radiological data' submission category. The recommended size of a single uncompressed dataset is 200 MB or less. Please provide a short informative description for each dataset by filling in the 'Description' field when uploading each ZIP file. Note: all datasets will be available for download from the online article on ScienceDirect. So please ensure that all DICOM files are **anonymized** prior to submission.

Virtual Microscope

The journal encourages authors to supplement in-article microscopic images with corresponding high resolution versions for use with the Virtual Microscope viewer. The Virtual Microscope is a web based viewer that enables users to view microscopic images at the highest level of detail and provides features such as zoom and pan. This feature for the first time gives authors the opportunity to share true high resolution microscopic images with their readers. More information and examples. Authors of this journal will receive an invitation e-mail to create microscope images for use with the Virtual Microscope when their manuscript is first reviewed. If you opt to use the feature, please contact virtualmicroscope@elsevier.com for instructions on how to prepare and upload the required high resolution images.

Tables

Tables should be self-explanatory and should not duplicate text material. They must be numbered and cited in consecutive order in the text. Each must have a succinct title, column and row headings, and (where appropriate) a legend describing abbreviations and lettered footnotes at the bottom of the table. Tables should not contain any shading or special symbols and any special formatting (bold, italics) must be explained in the legend. Tables consisting of more than 10 columns are unacceptable and will not be published. Tables should be provided as word processing documents, not in a spreadsheet file format or as an image file. Tables may be added at the end of the main document file.

Permissions for any republished tables should be noted in the legend. See References for guidance on how to number and cite references that 1) appear

only in tables or 2) are first cited in tables that are called out before other references. Tables used to describe or compare literature should include a column with the following information from the source publication: lead author last name, year of publication, and a numbered citation that corresponds to the full reference in the manuscript reference list.

Text

Subheadings Within Articles

No more than 8 subheadings per article (in addition to headings such as Methods, Results, Discussion). Each subheading can consist of only 5 words, including words such as a, an, the, and, and.

Subheadings should be explanatory, but there is no need to repeat the title in every heading.

Sample Original

What Is Interdisciplinary Collaboration? | Why Should We Embrace the Concept of Interdisciplinary Collaboration in Delivering Health Care? | Can an Interdisciplinary Collaborative Model of Critical Care Be Successfully Implemented in a Large Academic Medical Center, and Will It Be Associated With Favorable Outcomes? | What Is Our Story? | What Was the New Philosophy and Model of Critical Care That Emerged? | What Were the Building Blocks of Our Critical Care Model? | What Were the Outcomes Associated With the Implementation of Our Interdisciplinary Collaborative Model of Critical Care?

Sample Revised

Interdisciplinary Collaboration | Interdisciplinary Collaboration in Health-Care Delivery | Implementing Collaborative Models | Our Story | New Philosophy and Model | Building Blocks | Outcomes

The Guidance for Specific Article Types section provides more detail on how to format the text.

Title Page

The title page should be submitted as the first page of the main text word processing file and should include the following elements:

- **Word counts** for the text and abstract in the upper left-hand corner
- **Title** and short title/running head (of 50 characters or less)
- **Author list**, showing all names in the order and format that they are to appear on publication. Also, include any middle initials and the highest degree obtained, as well as institutional affiliations. NOTE: Complete author information, including names, e-mail addresses, and institutional affiliations must also be entered in ScholarOne Manuscripts to facilitate the collection of the required forms.
- **Corresponding author information**, with full mailing address and e-mail address (will appear on publication). Do not include phone or fax numbers on the title page.
- **Summary conflict of interest statements** for each author (or a statement indicating no conflicts exist for the specified author[s])
- **Funding information**, including any **NIH grant numbers** where applicable
- **Notation of prior abstract publication/presentation**, including the name, date, and location of the relevant meeting

GUIDANCE FOR SPECIFIC ARTICLE TYPES

In addition to following the general manuscript preparation instructions, authors should refer to the specific instructions for the type of article they are submitting.

Section Title	Consider Unsolicited (Y/N ^a)	Abstract (wd max)	Text ^d (wd max)	Reference (no. max)
Ahead of the Curve	N	250	2,500	50
Case Reports (Selected Reports)	Y	150	750	20
Case Series	Y	150	1,600	20
Chest Imaging & Pathology for Clinicians	Y	none	1,600	20
CHEST Guidelines	Y	250	tbd	tbd
Commentary	Y	250	2,500	50
Consensus Statements ^a	N	250 ^c	3,800	75
Contemporary Reviews in Critical Care Medicine	N	250	3,500	75
Contemporary Reviews in Sleep Medicine	N	250	3,500	75
Correspondence	Y	none	400	5
Editorials	N	none	1,000	12
Errata	Y	none	400	n/a
Medical Ethics	Y	250	3,500	75
Original Research	Y	250 ^b	2,500	75
Point/Counterpoint Editorials	N	none	1,000	12
Pulmonary, Critical Care, and Sleep Medicine Pearls	Y	none	1,200	10
Recent Advances in Chest Medicine	N	250	3,500	75
Retractions	N	none	400	n/a
Special Features ^a	Y	250	3,500	75
Topics in Practice Management	N	250	2,500	50
Training, Education, and Career Hub (TEaCH)	N	none	2,500	30
Translating Basic Research Into Clinical Practice	N	250	2,500	50
Ultrasound Corner	Y	none	1,200	10

^aThese article types are solicited, but authors with ideas for topics are encouraged to contact *CHEST* with their proposal via the Contact Us form.

- ^b Original Research articles must have a structured abstract.
- ^c Consensus Statements must also be submitted with an executive summary.
- ^d Text word counts exclude abstract, references, figure legends, and tables.
- ^e For case reports or commentaries follow instructions for those sections.

Ahead of the Curve

Article Element Requirements

Abstract length 250 words, narrative format

Text length 2,500 words

Reference count 50 references

Ahead of the Curve papers serve to provide glimpses into research that may, in coming years, impact clinicians. They will be published in the Commentary Section, under the subtopic of "Ahead of the Curve." Topics in this section are developed and invited by the *CHEST* Section Editors and Editor in Chief. Authors with suggestions for a topic are encouraged to contact CHEST.