

UNIVERSIDADE DE SANTA CRUZ DO SUL

CURSO DE FISIOTERAPIA

Douglas Alex Weiss Martins

**EFEITO DO TRABALHO DE CAMINHADA SOBRE A CINÉTICA *ON E OFF*
DA FREQUÊNCIA CARDÍACA EM PACIENTES COM DPOC**

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DA FREQUÊNCIA CARDÍACA EM PACIENTES COM DPOC**

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1 **EFEITO DO TRABALHO DE CAMINHADA SOBRE A CINÉTICA *ON* E *OFF***
2 **DA FREQUÊNCIA CARDÍACA EM PACIENTES COM DPOC**

3
4 **RESUMO**

5 **Introdução:** A Doença Pulmonar Obstrutiva Crônica (DPOC) apresenta interações
6 cardiopulmonares importantes no acometimento aos pacientes, as quais podem ser
7 difíceis de explorar principalmente durante o exercício. **Objetivo:** Analisar o efeito do
8 trabalho de caminhada sobre a cinética *on* e *off* da Frequência Cardíaca (FC) durante o
9 Teste de Caminhada de Seis Minutos (TC6m) em pacientes acometidos por DPOC.
10 **Métodos:** Estudo transversal, retrospectivo, tipo análise de dados secundários do banco
11 de dados de um projeto de pesquisa. Variáveis coletadas: clínicas, função pulmonar,
12 capacidade funcional (TC6m), trabalho de caminhada do TC6m por meio da equação $T = F \times D$ ($T =$ Trabalho, $F =$ Força/Peso, $D =$ Distância), cinética *on* e *off* da FC [valor
13 médio da FC no último minuto da linha de base (A0), amplitude da resposta da FC em
14 estado estacionário (A1), atraso de tempo para o início da resposta da FC (TD), constante
15 de tempo exponencial da curva (TAU) e tempo médio da resposta da FC ($TMR = TAU +$
16 TD)]. **Resultados:** Foram avaliados 11 pacientes, sexo masculino (n=6), acima do peso
17 (28,9 kg/m²), risco cardiovascular elevado (n=10) e DPOC variando entre moderado e
18 muito severo (n=11). A cinética *on* e *off* da FC apresentaram comportamento semelhante,
19 ambas com lentificação, porém sem diferença significativa. O trabalho de caminhada
20 apresentou um tamanho de efeito grande sobre todas as variáveis da cinética *on* e *off* da
21 FC. Associações entre amplitudes *on* e *off* da FC e entre o delta de variação da FCrec
22 1min e SpO₂ de repouso foram observadas. **Conclusão:** Pacientes com DPOC
23 apresentaram resposta atenuada da FC no início e ao final do exercício e esta parece estar
24

25 relacionada a baixa saturação periférica de oxigênio em repouso, inferindo um efeito
26 grande do trabalho de caminhada sobre todas as variáveis da cinética *on* e *off* da FC.

27

28 **Palavras-chave:** Doença Pulmonar Obstrutiva Crônica, Teste de caminhada, Frequência
29 cardíaca, Trabalho, Caminhada, Mortalidade.

30

31 **Lista de abreviações:**

32 DPOC: Doença Pulmonar Obstrutiva Crônica.

33 TC6m: Teste de Caminhada de Seis Minutos.

34 FC: Frequência Cardíaca.

35 **EFFECT OF WALK WORK ON *ON* AND *OFF* HEART RATE KINETICS IN**
36 **PATIENTS WITH COPD**

37

38 **ABSTRACT**

39 **Introduction:** Chronic Obstructive Pulmonary Disease (COPD) presents
40 cardiopulmonary interactions that are important for patients, which can be difficult to
41 explore mainly during exercise. **Objective:** To analyze the effect of walking work on
42 heart rate (HR) on and off kinetics during the Six-Minute Walk Test (6MWT) in patients
43 with COPD. **Methods:** Cross-sectional, retrospective, analysis of secondary data from
44 the database of a research project. Variables collected: clinics, pulmonary function,
45 functional capacity (6MWT), 6MWT walking work using the equation $T = F \times D$ ($T =$
46 $Work$, $F = Strength/Weight$, $D = Distance$), HR kinetics on and off [average HR value in
47 the last minute of the baseline (A_0), amplitude of the steady-state HR response (A_1), time
48 delay to start the HR response (TD), exponential curve time constant (TAU) and mean
49 HR response time ($TMR = TAU + TD$)]. **Results:** 11 male patients ($n=6$), overweight
50 (28.9 kg/m^2), high cardiovascular risk ($n=10$) and COPD ranging from moderate to very
51 severe ($n=11$) were evaluated. The kinetics on and off of HR showed similar behavior,
52 both with slowing, but without significant difference. The walking work had a large effect
53 size on all the variables of the kinetics on and off of HR. Associations between HR on
54 and off amplitudes and between the HRrec 1min variation delta and resting SpO_2 were
55 observed. **Conclusion:** Patients with COPD showed an attenuated HR response at the
56 beginning and at the end of the exercise and this seems to be related to low peripheral
57 oxygen saturation at rest, inferring a great effect of walking work on all the variables of
58 the HR kinetics on and off.

59

60 **Keywords:** Chronic Obstructive Pulmonary Disease, Walk test, Heart rate, Work, Walk,
61 Mortality.

62

63 **List of abbreviations:**

64 COPD: Chronic Obstructive Pulmonary Disease.

65 6MWT: Six-Minute Walk Test.

66 HR: Heart Rate.

67 1 INTRODUÇÃO

68

69 Devido à exposição contínua aos fatores de risco e ao envelhecimento
70 demográfico da população, a Doença Pulmonar Obstrutiva Crônica (DPOC) vem em
71 ascensão ao longo dos anos (GOLD, 2019). Atualmente, ela é considerada a 4^a principal
72 causa de morte no mundo, sendo projetada para se tornar a principal causa de mortalidade
73 ao longo dos anos, nos proporcionando uma visão mais ampliada do impacto desta doença
74 sobre a população e os custos em saúde, representando um importante desafio à saúde
75 pública (GOLD, 2019).

76

77 A condição funcional de pacientes com DPOC é amplamente avaliada e
78 monitorada por meio do Teste de Caminhada de Seis Minutos (TC6m), sendo este
79 considerado um teste de alta aplicabilidade na avaliação da gravidade e tolerância ao
80 exercício físico na DPOC (TONELLI et al., 2014). Entretanto, nos últimos anos a
81 comunidade científica concentra-se em outros parâmetros além da distância percorrida no
82 TC6m (TONELLI et al., 2014), como a altura e o peso corporal que afetam o
83 comprimento da passada e o trabalho/energia necessária para realizar a caminhada,
84 repercutindo na distância percorrida e na eficiência da deambulação (CARTER et al.,
85 2003).

86

87 Na mensuração do TC6m, o foco é a alteração fisiológica imposta pela doença,
88 amplificada por exacerbações e beneficiada por intervenções terapêuticas, incluindo
89 treinamento físico. O trabalho de caminhada leva em consideração o comprimento da
90 passada, eficiência contrátil do músculo e propriedades elásticas dos tecidos conjuntivos.
91 Entretanto, a conversão da distância da caminhada em capacidade máxima de exercício

92 não é fácil, devido a diferenças nas características do exercício e no fator de peso corporal
93 que confunde o desempenho da caminhada (CHUANG et al., 2001). Dessa forma, a
94 equação reduzida é simplesmente a equação para o trabalho, que é $T = F \times D$, onde T é
95 trabalho, F é força e D é distância (CARTER et al., 2003; CHUANG et al., 2001).

96

97 Carter et al. (2003) e Chuang et al. (2001) investigaram o uso do produto distância
98 do peso corporal (ou seja, distância percorrida x peso corporal) a pé como um método
99 alternativo para avaliar a capacidade funcional para caminhar e concluíram que a
100 distância de caminhada x produto do peso corporal é uma boa medida para relatar a
101 capacidade de exercício para o TC6m em pacientes com DPOC, pois este cálculo de
102 trabalho produz melhores coeficientes de correlação com os índices de função pulmonar
103 e de troca gasosa nos pacientes estudados.

104

105 Por vezes, as interações cardiopulmonares podem ser difíceis de explorar em
106 pacientes com DPOC, principalmente durante o exercício (DUBÉ et al., 2015). Alguns
107 parâmetros de avaliação relativamente novos incluem a análise da resposta cronotrópica
108 e da cinética da Frequência Cardíaca (FC) que respondem a exercícios de alta intensidade
109 (DUBÉ et al., 2015; TONELLI et al., 2014). A existência de cinéticas anormais da FC
110 tem implicações potencialmente negativas para o desempenho do exercício em pacientes
111 com DPOC (LAVENEZIANA et al., 2009), sendo considerada como um importante
112 marcador da gravidade da doença associada ao aumento do risco de mortalidade
113 (BRUBAKER et al., 2011), uma vez que esse dado leva em consideração a limitação ao
114 fluxo aéreo e a capacidade ao exercício reduzida relacionada a essa população (PESSOA
115 et al., 2013).

116

117 Entretanto, a repercussão do trabalho de caminhada e da cinética *on* e *off* da FC
118 durante o TC6m em pacientes com DPOC ainda carece de investigação. Nossa hipótese
119 foi de que o trabalho de caminhada possui grande repercussão sobre as variáveis da
120 cinética *on* e *off* da FC. Nesse sentido, buscamos analisar o efeito do trabalho de
121 caminhada sobre a cinética *on* e *off* da FC durante o TC6m em pacientes acometidos por
122 DPOC.

123

124 **2 MÉTODOS**

125

126 **Delineamento do estudo**

127 Foi realizado um estudo transversal, quantitativo e retrospectivo de análise de
128 dados secundários individuais (HULLEY et al., 2003), por meio do acesso ao banco de
129 dados do projeto de pesquisa “*Distúrbios do Sono, Cardiorrespiratórios e Físico*
130 *Funcionais em Portadores de Doença Pulmonar Obstrutiva Crônica: Um Estudo*
131 *Epidemiológico*”, devidamente aprovado pelo Comitê de Ética em Pesquisa da
132 Universidade de Santa Cruz do Sul sob o parecer nº 2.565.942 (CAAE -
133 86010718.4.1001.5343).

134

135 **Crítérios de inclusão e exclusão**

136 Foram incluídos na pesquisa todos os dados dos indivíduos com DPOC, de ambos
137 os sexos, que possuíam informações pessoais, informações clínicas e informações do
138 TC6m completas no banco de dados do projeto de pesquisa. Foram excluídos da pesquisa
139 todos os indivíduos acometidos por DPOC que apresentaram informações aberrantes
140 referente aos resultados dos voluntários frente ao TC6m, erros de digitação e dados
141 incompletos no banco de dados do projeto de pesquisa.

142 **Procedimentos metodológicos**

143 **I) Avaliação clínica:** A avaliação clínica foi realizada por meio do banco de dados
144 composto por informações de identificação, sexo, idade, peso, altura, índice de massa
145 corporal, etnia, comorbidades, estilo de vida, status tabágico, medicações em uso,
146 circunferência da cintura, circunferência do quadril e a relação cintura-quadril.

147

148 **II) Avaliação da função pulmonar:** A avaliação da função pulmonar foi
149 realizada por meio das informações coletadas mediante espirometria e retiradas do banco
150 de dados, sendo o Volume Expiratório Forçado no primeiro segundo e o predito (VEF_1 e
151 $\%VEF_1$), Capacidade Vital Forçada e o predito (CVF e $\%CVF$), relação entre o Volume
152 Expiratório Forçado no primeiro segundo e a Capacidade Vital Forçada e o predito
153 (VEF_1/CVF e $\%VEF_1/CVF$) e o estadiamento da doença de acordo com a classificação
154 da GOLD.

155

156 **III) Avaliação da capacidade funcional:** A avaliação da capacidade funcional
157 foi realizada através da coleta das variáveis referentes ao TC6m no banco de dados, sendo
158 incluídas a Distância Percorrida no TC6m ($dTC6m$) e o predito para a Distância
159 Percorrida no TC6m ($\%TC6m$), além das variáveis vitais que foram coletadas nos
160 momentos pré, pico e recuperação no primeiro minuto e quinto minuto do TC6m, como
161 a Frequência Cardíaca (FC) e a Saturação Periférica de Oxigênio (SpO_2).

162

163 **IV) Avaliação do trabalho de caminhada:** A avaliação do trabalho de
164 caminhada foi realizada por meio da análise das variáveis Peso e $dTC6m$ na seguinte
165 equação: $T = F \times D$, onde T é trabalho, F é força e D é distância, de acordo com Carter et
166 al. (2003) e Chuang et al. (2001). O trabalho de caminhada é uma boa medida para relatar

167 a capacidade de exercício para o TC6m em pacientes com DPOC, pois este cálculo de
168 trabalho considera as diferenças de peso corporal e, portanto, estima o trabalho e o gasto
169 de energia, produzindo melhores coeficientes de correlação com os índices de função
170 pulmonar e de troca gasosa nos pacientes acometidos por DPOC (CARTER et al., 2003;
171 CHUANG et al., 2001).

172

173 **V) Avaliação da cinética *on* e *off* da frequência cardíaca:** A avaliação da
174 cinética *on* e *off* da FC foi realizada por meio da análise do registro de cada batimento da
175 FC continuamente monitorada utilizando um cardiofrequencímetro (POLAR®, Modelo
176 810), durante todo o período de realização do TC6m (300 segundos). A análise da cinética
177 *on* e *off* da FC foi realizada pelo ajuste de uma função monoexponencial após interpolação
178 dos valores a uma frequência de 1 batimento.min⁻¹ (IMAI et al., 1994).

179

180 Os ajustes foram realizados utilizando a seguinte equação: $f_{(t)} = a_0 + a(1 - e^{-(t - TD)/\tau})$, onde “ $f_{(t)}$ ” ($F_{(t)}$) representa FC a qualquer momento; “ a_0 ” (A_0) é o valor médio da
181 FC no último minuto da linha de base do período de exercício; “ a ” (A_1) é a amplitude,
182 isto é, a magnitude da resposta da FC em estado estacionário; (TD) é o atraso de tempo
183 para o início da resposta da FC; “ τ ” (TAU) é a constante de tempo exponencial da curva,
184 que é o tempo necessário para atingir 63% da resposta em estado estacionário (ou seja, a
185 taxa de adaptação) e o (TMR) é o tempo médio de resposta que foi calculado por meio da
186 soma de (TD) + (TAU) (BELTRAME et al., 2012; BORGHI-SILVA et al., 2012;
187 PESSOA et al., 2013).

189

190 Para obter a FC de recuperação, foi realizado o cálculo da diferença entre a FC de
191 pico e a FC no primeiro minuto de recuperação, respectivamente ($FC_{rec} = FC_{pico}$ -

192 FC1min). Esta avaliação permite observar as reações dos sistemas de controle fisiológico
 193 sobre a atividade física, além de fornecer informações úteis a respeito do controle do
 194 sistema cardiovascular, sendo a diminuição tardia da FC após o exercício sugerido como
 195 um poderoso preditor de mortalidade (JAVORKA et al., 2003).

196

197 **Análise estatística**

198 Os dados coletados foram inseridos e analisados no programa computadorizado
 199 *Statistical Package for the Social Science (SPSS – versão 25.0)*. Os dados foram
 200 apresentados de acordo com medidas de tendência central e dispersão, média e desvio
 201 padrão e/ou mediana e intervalo de variação mínima e máximo. A distribuição das
 202 variáveis ocorreu conforme a normalidade da amostra verificada pelo teste de *Shapiro*
 203 *Wilk*. A correlação de Spearman foi realizada no *SPSS* para verificar a associação entre
 204 as variáveis coletadas. O tamanho do efeito de *D-Cohen* foi verificado utilizando apenas
 205 o programa Excel versão 2016. Foi considerado um nível de significância de $p \leq 0,05$.

206

207 **4 RESULTADOS**

208

209 Foram incluídos no estudo 11 pacientes com DPOC, cuja as características
 210 clínicas estão descritas na Tabela I. Observa-se em nossa amostragem uma discreta
 211 predominância do sexo masculino, sujeitos acima do peso e com risco cardiovascular
 212 elevado, bem como doença pulmonar sintomática variando o estadiamento entre DPOC
 213 moderado e muito severo.

214

Tabela I. Características clínicas dos pacientes com DPOC.

| Variáveis | Pacientes (n=11) |
|-----------------------|-------------------------|
| Idade, anos | 66,7±9,4 |
| Sexo masculino, n (%) | 6 (54,5) |

| | |
|--------------------------------------|------------|
| Etnia, n (%) | |
| Caucasiana | 8 (72,7) |
| Parda | 3 (27,3) |
| Status tabágico, n (%) | |
| Ex-fumante | 10 (90,9) |
| Fumante | 1 (9,1) |
| Comorbidades, n (%) | |
| Sim | 6 (54,5) |
| Betabloqueador, n (%) | |
| Não | 11 (100,0) |
| IMC, kg/m² | 28,9±5,9 |
| Classificação IMC, n (%) | |
| Eutrófico | 2 (18,2) |
| Sobrepeso | 4 (36,4) |
| Obesidade | 5 (45,5) |
| RCQ, cm | 0,9±0,1 |
| Classificação RCQ | |
| Baixo | 1 (9,1) |
| Moderado | 4 (36,4) |
| Alto | 3 (27,3) |
| Muito alto | 3 (27,3) |
| Dados espirométricos | |
| VEF ₁ , l/s | 1,3±0,5 |
| VEF ₁ , % predito | 45,0±17,5 |
| CVF, l/s | 2,5±0,8 |
| CVF % predito | 63,3±14,8 |
| VEF ₁ /CVF, l/s | 54,1±15,9 |
| VEF ₁ /CVF, % predito | 69,3±18,5 |
| Estadiamento da doença, n (%) | |
| GOLD II | 5 (45,5) |
| GOLD III | 5 (45,5) |
| GOLD IV | 1 (9,1) |

Dados expressos em Média ± Desvio padrão; N: Número amostral; (%): Frequência; DPOC: Doença pulmonar obstrutiva crônica; IMC: Índice de massa corporal; RCQ: Relação cintura-quadril; VEF₁: Volume de ar expirado no primeiro segundo; CVF: Capacidade vital forçada; VEF₁/CVF: Relação volume de ar expirado no primeiro segundo e Capacidade vital forçada; GOLD: Global initiative for chronic obstructive lung disease; cm: Centímetros; l/s: Litros por segundo;

215

216 A avaliação do TC6m pela distância percorrida e as variáveis de sinais vitais, bem
217 como do trabalho de caminhada dos pacientes com DPOC estão descritas na Tabela II. A
218 análise dos resultados do TC6m revelou que grande parte dos pacientes caminharam mais
219 de 350 metros (n=8) e o trabalho de caminhada suportado pelos pacientes foi em média
220 29.911,5 kg/m². Quanto ao comportamento da recuperação da FC em 1 minuto,

221 observamos uma média de redução de 12,2 batimentos no pós teste imediato, que denota
 222 uma resposta inadequada de recuperação da FC nos pacientes DPOC avaliados (n=7).
 223

Tabela II. Teste de caminhada de seis minutos e trabalho de caminhada dos pacientes com DPOC.

| Variáveis | Pacientes (n=11) |
|--|-------------------------|
| Distância percorrida | |
| TC6m, m | 372,0±52,4 |
| TC6m, % predito | 78,4±16,2 |
| Distância percorrida 350 m | |
| <350 m, n (%) | 3 (27,3) |
| >350 m, n (%) | 8 (72,7) |
| Trabalho de caminhada, kg/m² | 29.911,5±8507,7 |
| Sinais vitais no repouso | |
| FC, bpm | 79,4±7,5 |
| SpO ₂ , % | 94,1±1,9 |
| Sinais vitais no pico do TC6m | |
| FC, bpm | 100,4±14,4 |
| SpO ₂ , % | 93,6±2,7 |
| Sinais vitais no 1º min da rec do TC6m | |
| FC, bpm | 88,2±13,1 |
| SpO ₂ , % | 94,4±3,2 |
| Sinais vitais no 5º min da rec do TC6m | |
| FC, bpm | 79,0±9,7 |
| SpO ₂ , % | 95,6±2,9 |
| Recuperação da FC no 1º min pós TC6m | |
| ΔFCrec, bpm | 12,2±5,8 |
| ≤14 bpm, n (%) | 7 (63,6) |
| >14 bpm, n (%) | 4 (36,4) |

Dados expressos em Média ± Desvio padrão; N: Número de sujeitos; % = Frequência; DPOC: Doença pulmonar obstrutiva crônica; FC: Frequência cardíaca; TC6m: Teste de caminhada de seis minutos; 1º min: Primeiro minuto; 5º min: Quinto minuto; SpO₂: Saturação periférica de oxigênio; ΔFCrec: Delta da frequência cardíaca de recuperação; rec: Recuperação mmHg; Milímetros de mercúrio; m: Metros; bpm: Batimentos por minuto.

224
 225 O comportamento da cinética *on* (transição repouso-exercício) e *off* da FC
 226 (transição exercício-recuperação) proveniente do TC6m estão descritos na Tabela III. O
 227 comportamento da cinética *on* apresentou valores mais elevados do Tempo de Atraso do
 228 Sinal (TD), da Constante de Tempo Exponencial da Curva (TAU) e do Tempo Médio da
 229 Resposta (TMR) quando comparados a cinética *off*, respectivamente, porém, sem

230 diferença significativa, exceto para a variável A0, o que é esperado, uma vez que na
 231 cinética *on* o A0 representa a FC de repouso e na cinética *off* representa a FC de pico.
 232

Tabela III. Análise da cinética *on* e *off* da frequência cardíaca dos pacientes com DPOC.

| Pacientes (n=11) | | | |
|-------------------------|------------------------|-------------------------|---------------|
| Variáveis | FC <i>on</i> | FC <i>off</i> | p≤0,05 |
| A0, bpm | 80,5±10,8 (64,0-95,3) | 105,5±12,6 (88,5-131,2) | 0,003* |
| A1, bpm | 24,1±10,7 (9,4-39,2) | 24,3±10,4 (8,6-38,0) | 0,929 |
| TD, s | 19,6±8,7 (10,1-42,2) | 18,9±15,2 (6,2-56,5) | 0,328 |
| TAU, s | 57,2±26,2 (15,7-89,0) | 46,4±32,1 (12,3-98,6) | 0,182 |
| TMR, s | 76,8±27,0 (38,7-106,7) | 65,3±35,5 (22,1-115,4) | 0,248 |

Dados expressos em Média ± Desvio padrão, (Mínimo-Máximo); N: Número amostral; DPOC: Doença pulmonar obstrutiva crônica; FC: Frequência cardíaca; A0: Amplitude do sinal no tempo inicial da curva; A1: Amplitude do sinal no tempo final da curva; TD: Tempo de atraso do sinal de cada fase; TAU: Constante de tempo exponencial da curva; TMR: Tempo médio da resposta; bpm: Batimentos por minuto; s: Segundos; *: p≤0,05.

233

234 O tamanho do efeito de *d-Cohen* do trabalho de caminhada sobre as variáveis A0,
 235 A1, TD, TAU e TMR da cinética *on* e *off* da FC estão descritas na Tabela IV. O tamanho
 236 do efeito das variáveis da cinética *on* e *off* da FC nos revelou um tamanho de efeito grande
 237 do trabalho de caminhada sobre todas as variáveis da cinética analisadas.

238

Tabela IV. Análise do tamanho do efeito do trabalho de caminhada sobre a cinética *on* e *off* da frequência cardíaca dos pacientes com DPOC.

| Pacientes (n=11) | |
|-------------------------|------------------------------|
| Variáveis | Trabalho de caminhada |
| A0 <i>on</i> , bpm | 4,959 (efeito grande) |
| A0 <i>off</i> , bpm | 4,955 (efeito grande) |
| A1 <i>on</i> , bpm | 4,968 (efeito grande) |
| A1 <i>off</i> , bpm | 4,968 (efeito grande) |
| TD <i>on</i> , s | 4,969 (efeito grande) |
| TD <i>off</i> , s | 4,969 (efeito grande) |
| TAU <i>on</i> , s | 4,963 (efeito grande) |
| TAU <i>off</i> , s | 4,964 (efeito grande) |
| TMR <i>on</i> , s | 4,959 (efeito grande) |

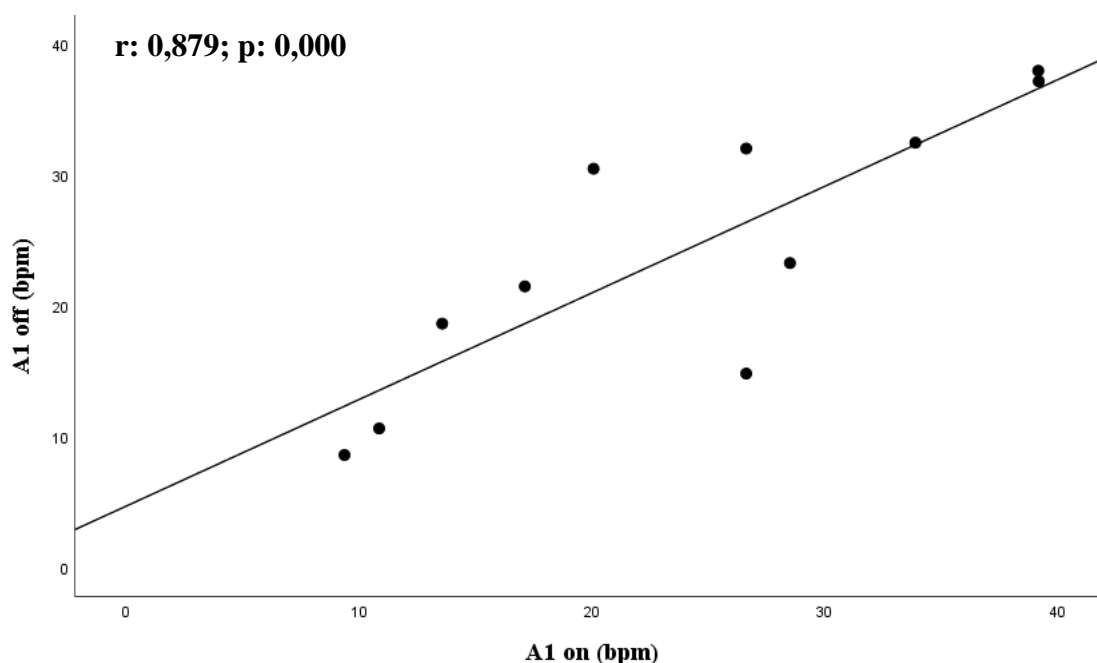
TMR *off*, s 4,961 (efeito grande)

DPOC: Doença pulmonar obstrutiva crônica; N: Número amostral; A0 = Amplitude do sinal no tempo inicial da curva; A1 = Amplitude do sinal no tempo final da curva; TD: Tempo de atraso do sinal de cada fase; TAU: Constante de tempo exponencial da curva; TMR: Tempo médio da resposta; bpm: Batimentos por minuto; s: Segundos.

239

240 No entanto, nenhuma correlação foi encontrada entre o trabalho de caminhada e
241 as variáveis da cinética *on* e *off* da FC, porém outras associações interessantes foram
242 observadas entre A1 *on* e A1 *off* e entre o delta da FC_{rec} com a SpO₂ de repouso
243 (FIGURAS 1 e 2).

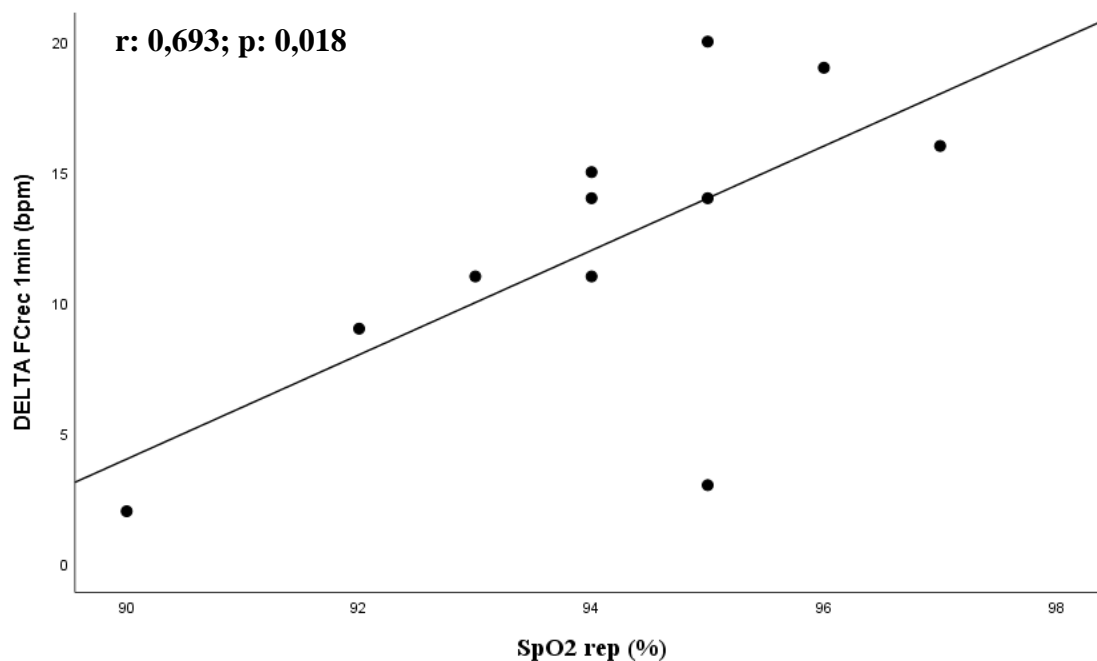
244



245

246 **Figura 1: Correlação entre o comportamento das variáveis A1 *on* e A1 *off* dos**
247 **pacientes DPOC submetidos ao TC6m.** A0: Amplitude do sinal no tempo inicial da
248 curva; A1: Amplitude do sinal no tempo final da curva; DPOC: Doença pulmonar
249 obstrutiva crônica; TC6m: Teste de caminhada de seis minutos; bpm: Batimentos por
250 minuto. Correlação de Spearman, com nível de significância ($p \leq 0,05$).

251



252

253 **Figura 2: Correlação entre o comportamento das variáveis SpO₂ rep e Delta FCrec**254 **1min dos pacientes DPOC submetidos ao TC6m.** SpO₂ rep: Saturação periférica de

255 oxigênio no repouso; Delta FCrec 1min: Delta da frequência cardíaca de recuperação em

256 1 minuto; DPOC: Doença pulmonar obstrutiva crônica; TC6m: Teste de caminhada de

257 seis minutos; %: Porcento; bpm: Batimentos por minuto. Correlação de Spearman, com

258 nível de significância ($p \leq 0,05$).

259

260 **5 DISCUSSÃO**

261

262 Os principais achados desse estudo são: a) a análise da cinética *on* e *off* da FC

263 apresentou um comportamento de lentificação semelhante entre TD, TAU e TMR, sendo

264 mais expressivo na cinética *on*, porém sem diferença significativa; b) o trabalho de

265 caminhada apresentou um tamanho de efeito grande sobre todas as variáveis da cinética

266 *on* e *off* da FC quando submetidos ao TC6m; c) associações entre as amplitudes *on* e *off*267 da FC (A1 *on* e A1 *off*) e entre o delta de variação da FCrec 1min e SpO₂ de repouso268 foram observadas (FCrec 1min e SpO₂).

269 O comportamento lentificado das variáveis TD, TAU e TMR da cinética *on* e *off*
270 da FC revela que os pacientes com DPOC estudados apresentaram um atraso ainda mais
271 acentuado para aumentar a FC na cinética *on*, que para recuperar a FC na cinética *off*.
272 Nossos achados vêm ao encontro de Borghi-Silva et al. (2012) que ao estudar
273 o comportamento da cinética *on* da FC em pacientes DPOC, foi possível verificar maior
274 atenuação com valores maiores de TD, TAU e TMR quando comparados a adultos
275 saudáveis durante um teste de esforço de velocidade constante (BORGHI-SILVA et al,
276 2012). Pessoa et al. (2013) ao avaliar a relação da capacidade de exercício e gravidade da
277 doença com o consumo de oxigênio (VO_2) e a cinética *on* da FC nos pacientes com
278 DPOC, destacou que o retardo da cinética *on* do VO_2 e, especialmente da FC, podem ser
279 um dos principais marcadores de gravidade da doença (PESSOA et al., 2013).

280

281 Dubé et al. (2015) destacaram que a existência de cinética ventilatória, de troca
282 gasosa pulmonar e de FC anormais possui implicações potencialmente negativas para o
283 desempenho do exercício e qualidade de vida em pacientes com DPOC (DUBÉ et al.,
284 2015). A captação mais lenta de oxigênio e a cinética *on* da FC podem refletir no ajuste
285 da entrega de oxigênio e no metabolismo muscular durante o exercício físico, bem como
286 no desempenho da capacidade funcional nesses pacientes (BORGHI-SILVA et al., 2012).
287 A obstrução do fluxo aéreo e a capacidade reduzida de exercício estão associadas a uma
288 atenuação da cinética *on* da FC em pacientes DPOC (PESSOA et al., 2013). Vasilopoulou
289 et al. (2012) e Grupta et al. (2013) destacaram que quanto maior a gravidade da DPOC
290 maior é a disfunção cardiovascular e deterioração da condição física e pior a resposta
291 cardiovascular pós-exercício nesses pacientes (GRUPTA et al., 2013; VASILOPOULOU
292 et al., 2012). Diante do exposto, ao avaliarmos o tamanho do efeito do trabalho de

293 caminhada sobre a cinética da FC observamos que o trabalho de caminhada exerce um
294 grande efeito sobre todas as variáveis da cinética da *on* e *off* da FC provenientes do TC6m.

295

296 Interessantemente, em nosso estudo encontramos associações entre a SpO₂ de
297 repouso com o delta da FCrec 1min, ou seja, quanto pior a oxigenação periférica de
298 repouso pior é seu desempenho na recuperação da FC após o exercício. Uma recuperação
299 tardia da FC após o exercício está associada ao aumento da mortalidade e diminuição de
300 sobrevida nesses indivíduos, representando um marcador prognóstico facilmente
301 mensurável em pacientes com DPOC (LACASSE et al., 2005). A média de SpO₂ de
302 repouso nos pacientes do nosso estudo foi de 94,1% e vem ao encontro dos achados de
303 Rodríguez et al. (2017) que encontraram uma lentificação da cinética *off* da FC em 101
304 pacientes com DPOC com média de SpO₂ de repouso de 95% (RODRÍGUEZ et al.,
305 2017). No estudo de Grupta et al. (2013), os pacientes DPOC apresentaram uma falha em
306 atingir a FC alvo no exercício e uma recuperação tardia da FC após o exercício quando
307 comparado a sujeitos idosos saudáveis, o que vem ao encontro do nosso estudo ao
308 observarmos amplitudes (A1) reduzidas da FC tanto no momento da cinética *on* quanto
309 no momento da cinética *off* (GRUPTA et al., 2013).

310

311 **5.6 Limitações do estudo**

312 Em primeiro lugar, devemos reconhecer que a análise batimento a batimento é a
313 melhor maneira de avaliar o comportamento da FC frente a uma demanda metabólica. O
314 número amostral limitado não permite muitas estratificações e análises estatísticas mais
315 robustas. Análises de variáveis como força muscular respiratória e periférica poderiam
316 ser inseridas para análises buscando encontrar associações entre tais parâmetros com o
317 trabalho de caminhada e a cinética *on* e *off* da FC.

318 **5.7 Relevância do estudo**

319 Esses achados ressaltam a importância clínica da necessidade de incluir
320 ferramentas abrangentes como o trabalho de caminhada e a sua repercussão na cinética
321 *on e off* da FC, bem como a resposta de recuperação da FC no 1º minuto pós teste. À vista
322 disso, uma vez identificado respostas atenuadas da FC nos pacientes DPOC, podemos
323 inferir que esta população necessita de um tempo maior de aquecimento para iniciar um
324 exercício físico e da mesma forma um tempo de desaquecimento maior para recuperar a
325 FC.

326

327 **CONCLUSÃO**

328

329 Pacientes com DPOC moderada a grave apresentam um tamanho de efeito grande
330 do trabalho de caminhada sobre as variáveis da cinética *on e off* da FC quando submetidos
331 ao TC6m. Estes pacientes apresentam uma resposta atenuada da FC tanto no início quanto
332 no final do exercício e as mesmas parecem estar relacionadas a baixa saturação periférica
333 de oxigênio em repouso.

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PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: DISTÚRBIOS DO SONO, CARDIORRESPIRATÓRIOS E FÍSICO FUNCIONAIS EM PORTADORES DE DPOC: UM ESTUDO EPIDEMIOLÓGICO

Pesquisador: Andréa Lúcia Gonçalves da Silva

Área Temática:

Versão: 1

CAAE: 86010718.4.1001.5343

Instituição Proponente: Universidade de Santa Cruz do Sul - UNISC

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 2.565.942

Apresentação do Projeto:

a) Título: Distúrbios do sono, cardiorrespiratórios e físico funcionais em portadores de DPOC: um estudo epidemiológico; b) Áreas do Conhecimento: Ciências Biológicas e da Saúde; c) Linha de Pesquisa: Vigilância, Prevenção e Reabilitação em Doenças Cardiorrespiratórias; d) Departamentos: Educação Física e Saúde; e) Período de Execução: Janeiro de 2018 a Dezembro de 2019; f) Local de Execução: Hospital Santa Cruz - HSC/RS e Universidade de Santa Cruz do Sul - UNISC/RS.

Objetivo da Pesquisa:

6.1 Geral Quantificar a frequência e influência dos distúrbios do sono e cardiorrespiratórios sobre o desempenho físico funcional, e capacidade de exercício e morbimortalidade em sujeitos acometidos em portadores de DPOC. 6.2 Objetivos específicos - Caracterizar os aspectos epidemiológicos, clínicos e antropométricos dos pacientes com DPOC e/ou ICC; - Avaliar os volumes pulmonares e força muscular respiratória dos pacientes com DPOC e/ou ICC; - Identificar a presença de distúrbios do sono nos pacientes com DPOC e/ou ICC; - Estudar a prevalência da coexistência de ICC+DPOC em pacientes com diagnóstico de DPOC e ICC, bem como o prognóstico e a mortalidade em seguimento de tempo de 2 anos; - Avaliar a capacidade funcional

| | |
|--|-------------------------------------|
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Continuação do Parecer: 2.565.942

dos pacientes com DPOC e/ou ICC; - Avaliar o grau de dispneia em repouso e durante o exercício dos pacientes com DPOC e/ou ICC; - Identificar as alterações de variabilidade da frequência cardíaca (VFC dos pacientes com DPOC e/ou ICC); - Avaliar se o uso da pressão expiratória positiva melhora o desempenho nos testes de capacidade de dos pacientes com DPOC; - Correlacionar os distúrbios do sono e cardiorrespiratórios com a capacidade funcional e de exercício físico dos pacientes com DPOC e/ou ICC.

Avaliação dos Riscos e Benefícios:

Riscos: O presente projeto não apresenta nenhum risco, apenas pode vir a causar certo constrangimento em algumas perguntas dos questionários, bem como algum desconforto muscular de curta duração após os testes funcionais.

Benefícios: Este tipo de estudo é de suma importância no sentido de proporcionar tratamento adequado e seguro, podendo o mesmo reforçar os cuidados preventivos com relação às exacerbações e progressão da doença. Compreender os efeitos das comorbidades coexistentes na DPOC auxiliará na compreensão dos mecanismos de lesão pulmonar e suas possíveis inter-relações. Este projeto, por suas características, possui impacto como gerador de conhecimento, como fortalecedor das instituições onde o projeto será desenvolvido e também na difusão do conhecimento bem como reforçando o vínculo existente entre a Universidade de Santa Cruz do Sul (UNISC), a Universidade de Illinois de Chicago (UIC) e a Universidade Federal de São Carlos (UFSCAR). A divulgação dos resultados pretende contribuir para o debate técnico-científico e para o avanço do conhecimento no campo da avaliação dos programas de reabilitação pulmonar para DPOC. A importância de estudos sobre esta temática está explicitada principalmente na produção e difusão de conhecimento nesta área, assim como poderá contribuir para uma futura discussão a respeito da aplicação destas metodologias de avaliação e acompanhamento destes pacientes. Espera-se produção científica na área através da publicação de dissertações de mestrado, além de monografias de conclusão de cursos, 02 publicações científicas em revistas com qualis acima do nível B2 e apresentação de trabalhos em eventos científicos com publicação de resumos. O desenvolvimento da proposta prevê o fortalecimento das parcerias com pesquisadores de outras instituições promovendo maior integração de forma a potencializar os estudos desenvolvidos. Em termos de graduação, a pesquisa vem contribuir para o desenvolvimento de recursos humanos voltados para o conhecimento, a compreensão e a intervenção aos fenômenos relacionados ao processo saúde/doença e à problemática da DPOC e coexistência de DPOC/ICC. Esperamos que a pesquisa congregue esforços no sentido de repensar novos meios e estratégias para alcançar uma

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Continuação do Parecer: 2.565.942

consciência científica em prol dos problemas estudados.

Comentários e Considerações sobre a Pesquisa:

**Importante ressaltar que este projeto é um braço temático de um projeto de pesquisa proposto pela Universidade federal de São Carlos- UFSCAR, com financiamento da FAPESP (número processo 2015/26501-1; aprovado em 01/12/2017), envolvendo 3 subprojetos de pesquisa interdependentes e 17 pesquisadores, sendo 6 pesquisadores associados, 5 pesquisadores internacionais e 3 pesquisadores nacionais de outras instituições. Proposto como ensaio original, multicêntrico, aliando esforços junto a outros grupos de pesquisa no Brasil e no exterior em uma grande colaboração de pesquisa, a elaboração do Consortium FRIENDS. Esta proposta compreenderá um grande banco de dados mundial que será composto por dados obtidos de testes de exercício cardiopulmonar de pacientes com ICC, DPOC e na coexistência da DPOC-ICC, avaliando desfechos importantes do teste cardiopulmonar e seus indicadores prognósticos. O banco de dados mundial é coordenado pelo Prof Ross Arena (colaborador internacional desta proposta), sendo que a prof. Audrey Borghi e Silva (UFSCAR) será a coordenadora líder deste banco de dados do Brasil, junto aos demais parceiros nacionais.

Considerações sobre os Termos de apresentação obrigatória:

Cronograma: início da coleta em abril. OK.

Carta de aceite Promoção de Reabilitação Pulmonar do HSC: OK.

Carta de aceite do HSC: OK.

Orçamento: OK.

Folha de Rosto: OK.

TCLE: OK.

Recomendações:

Não houve menção à pesquisa junto a crianças e adolescentes, bem como não foi anexado modelo de Termo de Assentimento.

Assim sendo, em hipótese alguma poderão ser pesquisadas crianças e adolescentes.

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Conclusões ou Pendências e Lista de Inadequações:

Aprovado.

Considerações Finais a critério do CEP:

Projeto aprovado e em condições e ser executado.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

| Tipo Documento | Arquivo | Postagem | Autor | Situação |
|---|---|------------------------|---------------------------------|----------|
| Informações Básicas do Projeto | PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1067509.pdf | 20/03/2018 16:17:13 | | Aceito |
| Declaração de Instituição e Infraestrutura | Conhecimento_Instituicao_parceria_RP.pdf | 20/03/2018 16:13:02 | Andréa Lúcia Gonçalves da Silva | Aceito |
| Declaração de Instituição e Infraestrutura | Conhecimento_Instituicao_parceria_HSC.pdf | 20/03/2018 16:12:23 | Andréa Lúcia Gonçalves da Silva | Aceito |
| TCLE / Termos de Assentimento / Justificativa de Ausência | TCLE.pdf | 20/03/2018 16:11:28 | Andréa Lúcia Gonçalves da Silva | Aceito |
| Orçamento | Orcamento.pdf | 20/03/2018 16:10:53 | Andréa Lúcia Gonçalves da Silva | Aceito |
| Projeto Detalhado / Brochura Investigador | Projeto_Pesquisa_2018.pdf | 20/03/2018 16:10:26 | Andréa Lúcia Gonçalves da Silva | Aceito |
| Outros | CARTA_APRESENTCAO_DE_PROJETO.pdf | 20/03/2018 16:05:25 | Andréa Lúcia Gonçalves da Silva | Aceito |
| Folha de Rosto | Folha_de_Rosto.pdf | 20/03/2018 15:54:49 | Andréa Lúcia Gonçalves da Silva | Aceito |

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

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Continuação do Parecer: 2.565.942

SANTA CRUZ DO SUL, 27 de Março de 2018

Assinado por:
Renato Nunes
(Coordenador)

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AUTHOR INFORMATION PACK

TABLE OF CONTENTS

| | |
|-----------------------------------|------------|
| • Description | p.1 |
| • Impact Factor | p.1 |
| • Abstracting and Indexing | p.1 |
| • Editorial Board | p.1 |
| • Guide for Authors | p.3 |



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The *Archives of Physical Medicine and Rehabilitation* publishes original, peer-reviewed research and clinical reports on important trends and developments in **physical medicine** and **rehabilitation** and related fields. This international journal brings researchers and clinicians authoritative information on the therapeutic utilization of **physical, behavioral** and **pharmaceutical agents** in providing comprehensive care for individuals with **chronic illness** and **disabilities**.

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GUIDE FOR AUTHORS

INTRODUCTION

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A steadily increasing rate of submissions has forced the *Archives* to adopt a policy of restricting its manuscripts to topics that proved new information that may alter clinical practice or represent influential advances in the research. *Archives* will not review studies involving animal models, healthy normal samples, or small case reports, except in unusual circumstances. We may make exceptions when the clinical implications for populations of persons with chronic illness or disability are compelling. In addition, we will not review studies that report psychometric information of well-established instruments for language-specific applications.

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Original Research: Present new and important basic and clinical information, extend existing studies, or provide a new approach to a traditional subject. Manuscripts should be limited to 3000 words of text (Introduction through Conclusions). Figures, tables, and references should be limited to the number needed to clarify, amplify, or document the text.

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BEFORE YOU BEGIN

Ethics in Publishing

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While there may be occasional exceptions, the *Archives* is committed to the need for clinical trial reports to be accompanied by adequate periods of follow-up. A lack of sufficient follow-up may be detrimental to a paper's acceptance.

As of January 1, 2017 the *Archives* will **only** consider clinical trials that have been registered before the first patient is enrolled.

For our purposes, a clinical trial is defined as "any research study that prospectively assigns human participants or groups of humans to one or more health-related interventions to evaluate the effects on health outcomes" (<http://www.who.int/ictrp/en>). Thus, cohort and retrospective studies without an intervention do not require registration, and neither do observational studies of clinical care. However, studies of human subjects with prospective assignment of an intervention by the investigators, regardless of the size of the trial or method of assignment, must be registered.

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The EQUATOR Network (<http://www.equator-network.org>) is an excellent resource for key reporting guidelines, checklists, and flow diagrams. These guidelines should be especially useful for *Archives'* authors.

Click on the checklist that applies to your manuscript, download it to your computer, fill it out electronically, "save as," and upload it with your manuscript when you submit. Links to mandatory flow diagrams also are provided. Below are the most commonly used checklists but please note that the Equator Network provides many others (e.g. TRIPOD, SRQR, etc.) and it is up to the authors to select the one most appropriate for their study. Randomized Controlled Trials — **CONSORT** — Consolidated Standards of Reporting Trials Observational Studies — **STROBE** — Strengthening the Reporting of Observational studies in Epidemiology Systematic Review of Controlled Trials — **PRISMA** — Preferred Reporting Items for Systematic Reviews and Meta-Analyses Study of Diagnostic accuracy/assessment scale — **STARD** — Standards for the Reporting of Diagnostic Accuracy Studies For psychometric studies the editors recommend either the **COSMIN** or **GRRAS** guideline, though the final choice is up to the author.

During the submission process when you are prompted to state which checklist is needed please check the appropriate box for your manuscript or check Not Applicable if your paper is a Commentary, Letter to the Editor, etc. Then the system will allow you to select the file type and upload the appropriate

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All submissions will be screened by editors to determine their suitability for further review. Manuscripts that are approved for review will be evaluated by at least one recognized expert in the particular subject matter. Biostatistical review may be obtained. Peer reviewers' assessments are referred to a member of the Editorial Board, who may also critique the manuscript. The assigned Editorial Board Member will then make a final decision and communicate with the corresponding author via e-mail. Decisions are typically communicated within 60 days after the manuscript has been approved for peer review. All reviews are conducted in a double-blind fashion.

Letters to the Editors and Editorials are generally evaluated by an editorial committee, however, external reviews may also be sought.

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Submission of a revised manuscript includes submission of separate documents in the following order: (1) cover letter; (2) title page, including acknowledgments and explanation of any conflicts of interest; (3) main text file with highlighted changes, including an appropriate (structured or standard) abstract, keywords, list of abbreviations, body of the text, suppliers' list, references, figure legends; (4) a clean copy of the main text file with no highlighted changes, including an appropriate abstract, keywords, list of abbreviations, body of the text, suppliers' list, references, figure legends; (5) figures; (6) tables; (7) appendices; (8) supplementary files; (9) checklist; and (10) ICMJE Form for Disclosure of Potential Conflicts of Interest for each author.

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PREPARATION

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