



## Adherence to long-term home oxygen therapy in patients with chronic respiratory disease in two cities in the state of Minas Gerais, Brazil

Felipe Meirelles de Azevedo<sup>1</sup>, Cristino Carneiro Oliveira<sup>1</sup>,  
Deborah Gollner Evangelista<sup>1</sup>, Leandro Ferracini Cabral<sup>1</sup>, Carla Malaguti<sup>1</sup>

### TO THE EDITOR:

Hypoxemia is a common clinical feature in patients with chronic respiratory disease. Long-term oxygen therapy (LTOT) is the recommended treatment for hypoxemia and can effectively improve survival in chronic hypoxemic patients. The criteria for prescribing LTOT are well established by national and international guidelines,<sup>(1,2)</sup> included a duration of at least 15 h/day in the presence of hypoxemia at rest (i.e.,  $\text{PaO}_2 \leq 55$  mmHg;  $\text{SaO}_2 \leq 88\%$ ; or  $\text{PaO}_2 = 56\text{--}59$  mmHg and  $\text{SaO}_2 \leq 89\%$  at rest in the presence of pulmonary hypertension, *cor pulmonale*, or polycythemia [hematocrit  $> 55\%$ ]).<sup>(1)</sup> Most LTOT prescriptions are provided at hospital discharge after remission of lung disease/an exacerbation. Medical societies recommend that patients eligible for LTOT be assessed 90 days after hospital discharge after remission of lung disease/an exacerbation, because more than one third of such patients will no longer need LTOT then.<sup>(1-6)</sup> Although the benefits of LTOT in the prevention and treatment of pulmonary hypertension and in the reduction of mortality are well documented, studies have reported that adherence to LTOT is poor, ranging from 45% to 70%.<sup>(5,7)</sup>

Public health care facilities based in municipalities that offer LTOT and have structured protocols (such as the city of São Paulo, Brazil) have demonstrated efficiency in LTOT dispensation.<sup>(2)</sup> Brazilian municipalities without such protocols might use different procedures 90 days after the initial LTOT dispensation.

Adherence to LTOT in the Brazilian public health care system in the state of Minas Gerais, Brazil, has yet to be studied. Therefore, we sought to investigate adherence to prescribed LTOT in patients treated in the public health care system in the cities of Juiz de Fora and Governador Valadares, both located in the state of Minas Gerais.

This was a prospective cross-sectional study conducted between March of 2019 and March of 2020 and including individuals  $\geq 18$  years of age receiving LTOT for at least three months. The study was approved by the Research Ethics Committee of the Federal University of Juiz de Fora (Protocol no. 3.084.871), and all participants gave written informed consent. Individuals hospitalized at the time of the study assessment, those whom we were unable to contact for the interview, those with a history of hospitalization/symptom exacerbation in the previous 90

days, those presenting with a disease requiring oxygen supplementation other than the primary respiratory disease, and those presenting with cognitive impairment that prevented them to complete the questionnaires were excluded.

Home visits were conducted for anamnesis and physical examination. Clinical variables related to smoking history, hospitalization, arterial blood gases, and dyspnea were obtained from medical records. Information about arterial blood gases was obtained from the public health care facilities, and samples were collected two days prior to the home visit. Variables related to LTOT use were assessed using medical records and a structured interview. Data were collected regarding daily duration of LTOT (h/day) and oxygen flow rates (L/min) at rest, during exercise, and during sleep. For those using an oxygen concentrator, the duration of LTOT in hours of oxygen consumption was collected at the health care facility by recording the hour-meter readings. Adherence to LTOT was considered adequate if the oxygen equipment was used for a daily period greater than or equal to that prescribed by the physician.<sup>(5,6)</sup>

Data analysis was performed using the IBM SPSS Statistics software package, version 25.0 (IBM Corporation, Armonk, NY, USA). Descriptive statistics are presented as absolute and relative frequencies, mean and standard deviation, or median and minimum-maximum values. Comparisons of prescribed LTOT and oxygen flow rates with actual LTOT use duration of and oxygen flow rates were made with the paired t-test or the Wilcoxon test. The chi-square test was used to identify the differences between the proportions of patients who were adherent to the prescribed LTOT ( $< 15$  h/day or  $15\text{--}24$  h/day). The level of significance was set at  $p < 0.05$ .

Data from 74 LTOT users diagnosed with chronic respiratory diseases were analyzed. Most individuals were female ( $n = 47$ ; 63.5%). The mean age was  $73 \pm 8$  years. COPD was the most prevalent diagnosis ( $n = 61$ ; 82.4%), followed by interstitial lung disease ( $n = 9$ ; 12.2%), and asthma ( $n = 4$ ; 5.4%). The median oxygen flow rate was 2 (1-5) L/min, and the median duration of LTOT use was  $2.56 \pm 3.00$  years. Regarding the LTOT device, 82.4% of the patients used an oxygen concentrator and 17.6% used an oxygen cylinder. Nasal cannula was the most common interface (97.3%), followed by tracheostomy (2.7%).

1. Programa de Pós-Graduação em Ciências de Reabilitação e Desempenho Físico-Funcional, Faculdade de Fisioterapia, Universidade Federal de Juiz de Fora, Juiz de Fora (MG) Brasil.

**Table 1.** Comparison between prescribed and actual use of long-term home oxygen therapy (N = 74).<sup>a</sup>

Variable	Prescribed use	Actual use	p
LTOT duration, h	15 (8-24)	8 (6-8)	0.008
LTOT flow rate, L/min			
At rest	1 (1-2)	2 (2-4)	0.325
During exercise	2.33 ± 0.57	1.83 ± 0.28	0.317
During sleep	2.0 ± 1.0	1.5 ± 0.5	0.180

LTOT: long-term home oxygen therapy. <sup>a</sup>Values expressed as median (minimum-maximum) or mean ± SD.

No significant differences were found between prescribed and actual oxygen flow rates at rest, during exercise, or during sleep (Table 1). Adherence to LTOT prescription was higher (91.6%) among patients on LTOT = 15-24 h/day than among those on LTOT < 15 h/day (42.1%;  $p < 0.001$ ). When we classified the patients with COPD regarding severity of the disease and compared the subgroups according to LTOT prescription adherence rate, we found that 58.3% of those classified as GOLD stages 1 and 2 were adherent to LTOT, as were 68.4% of those classified as GOLD stages 3 and 4, that is, the greater the disease severity, the higher the LTOT adherence.

The fact that adherence to LTOT was low in patients with a 15-h/day prescription can be explained by the fact that they had less severe disease, fewer symptoms, and fewer functional limitations. These results corroborate the findings of one study that showed that patients with more severe COPD are more adherent to LTOT than are those with less severe COPD.<sup>(6)</sup> Our findings have relevant clinical implications, because low adherence to LTOT can compromise the dose-response effect and the clinical benefits of LTOT might not be achieved.

Adherence to LTOT is complex and multifactorial.<sup>(7)</sup> Studies have shown that although the perception of oxygen therapy might be positive,<sup>(8)</sup> patients often report it as negative because of social stigma, as well as psychological and behavioral effects,<sup>(8-10)</sup> such as embarrassment while using the oxygen equipment in public, misunderstanding of oxygen flow prescription, lack of perception of the benefits from treatment, poor functional status, smoking, and fear of oxygen addiction.<sup>(8-10)</sup> These concerns, along with the clinical cardiorespiratory benefits and increased quality of life that are achieved when LTOT is used appropriately, should be addressed and discussed with patients, families, and caregivers. The lack of standardized oxygen hour meters to record the daily duration of LTOT is a limitation of the present study. Future studies should

investigate adherence to LTOT using standardized meters to measure oxygen consumption. Public health care systems should also take that into consideration for LTOT dispensation. The strength of our study lies in the fact that it is based on self-reported data on oxygen consumption in a local population from the state of Minas Gerais.

Some strong points are the fact that this was a prospective study and the fact that patients with a history of symptom exacerbation/hospitalization in the previous 90 days were excluded from the sample because hypoxemia in such cases is still labile. In addition, the present study has high internal validity because of the cultural and socioeconomic context in which it was conducted (i.e., patients with chronic respiratory disease in the state of Minas Gerais, Brazil), which can be different from that of studies conducted elsewhere, particularly in other countries.

In conclusion, adherence to LTOT in patients treated in the Brazilian public health care system is suboptimal, particularly among those who are prescribed LTOT < 15 h/day. There is a need to improve adherence to LTOT in patients with chronic hypoxemia. This can be achieved by using structured protocols and periodic monitoring by a multidisciplinary team.

## FINANCIAL SUPPORT

This study received financial support from the *Fundação de Amparo à Pesquisa do Estado de Minas Gerais* (FAPEMIG, Minas Gerais Research Foundation; CDS-APQ 03921-17) and the *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (CAPES, Office for the Advancement of Higher Education, Funding Code 001). CCO received financial support from the *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq, Brazilian National Council for Scientific and Technological Development; Grant 424542/2018-8)

## REFERENCES

- Hardinge M, Annandale J, Bourne S, Cooper B, Evans A, Freeman D, et al. British Thoracic Society guidelines for home oxygen use in adults. *Thorax*. 2015;70 Suppl 1:i1-i43. <http://dx.doi.org/10.1136/thoraxjnl-2015-206865>
- Cidade de São Paulo. Secretaria Municipal da Saúde. Núcleo de Programas Estratégicos [homepage on the Internet]. São Paulo: a Secretaria; [updated 2010; cited 2020 Oct 1]. Diretrizes do Programa Pulmão Paulistano e de Oxigenoterapia Domiciliar Prolongada. [Adobe Acrobat document, 28p.]. Available from: [https://www.prefeitura.sp.gov.br/cidade/secretarias/upload/saude/arquivos/nupes/Manual\\_Diretrizes\\_ODP-SMS-SP2010.pdf](https://www.prefeitura.sp.gov.br/cidade/secretarias/upload/saude/arquivos/nupes/Manual_Diretrizes_ODP-SMS-SP2010.pdf)
- Verduri A, Ballerin L, Simoni M, Cellini M, Vagnoni E, Roversi P, et al. Poor adherence to guidelines for long-term oxygen therapy (LTOT) in two Italian university hospitals. *Intern Emerg Med*. 2014;9(3):319-324. <https://doi.org/10.1007/s11739-012-0898-2>
- Marcondes VK, Kuwazuru TS, Silva LPCE, Cezare TJ, Franco EAT, Prudente R, et al. Evaluation of the association of adherence to

- long-term home oxygen therapy and clinical markers and five-year mortality in patients with Chronic obstructive pulmonary disease. *J Bras Pneumol.* 2020;46(6):e20190158. <http://dx.doi.org/10.36416/1806-3756/e20190158>
5. Guyatt GH, Nonoyama M, Lacchetti C, Goeree R, McKim D, Heels-Ansdell D, et al. A randomized trial of strategies for assessing eligibility for long-term domiciliary oxygen therapy. *Am J Respir Crit Care Med.* 2005;172(5):573-580. <https://doi.org/10.1164/rccm.200412-1692OC>
  6. Mesquita CB, Knaut C, Caram LMO, Ferrari R, Bazan SGZ, Godoy I, et al. Impact of adherence to long-term oxygen therapy on patients with COPD and exertional hypoxemia followed for one year. *J Bras Pneumol.* 2018;44(5):390-397. <http://dx.doi.org/10.1590/S1806-37562017000000019>
  7. Gauthier A, Bernard S, Bernard E, Simard S, Maltais F, Lacasse Y. Adherence to long-term oxygen therapy in patients with chronic obstructive pulmonary disease. *Chron Respir Dis.* 2019;16:1479972318767724. <https://doi.org/10.1177/1479972318767724>
  8. Kelly CA, Maden M. How do respiratory patients perceive oxygen therapy? A critical interpretative synthesis of the literature. *Chron Respir Dis.* 2014;11(4):209-228. <https://doi.org/10.1177%2F1479972314551561>
  9. Breaden K, Collier A, Litster C, Allcroft P, Currow DC, Phillips JL. Stigma and the in(visible) perspectives and expectations of home oxygen therapy among people with chronic breathlessness syndrome: A qualitative study. *Palliat Med.* 2019;33(1):82-90. <https://doi.org/10.1177%2F0269216318805621>
  10. Myers H, Taylor J, Finn RS, Beckert L. Doctors learn new tricks, but do they remember them? Lack of effect of an educational intervention in improving Oxygen prescribing. *Respirology.* 2015;20(8):1229-1232. <https://doi.org/10.1111/resp.12614>