Factors related to variability in long-term oxygen therapy prevalence

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SUMMARY

OBJECTIVE: To analyse the variability of long term oxygen therapy (LTOT) prevalence according to several organisational and population factors.

METHODS: Prospective multicentre survey in 29 public hospitals (population 6 796 964) recording data on the organisational structure of the participating centres and factors related to LTOT prevalence. Official figures were also obtained from local health authorities on the prevalence and cost of LTOT.

RESULTS: The overall prevalence of LTOT was 184 per 100 000 population (range 71–473). There was a specific unit or staff member for LTOT supervision in 17 (58.6%) centres, giving a lower prevalence (169 vs. 237/100 000; \( P = 0.03 \)). The altitude of the participating centres (median 92 m, mean 275 m; range 4–848 m) was found to influence LTOT prevalence (\( r = 0.73; P = 0.005 \)). In the linear regression analysis, the coefficient of determination for altitude was 0.504. Other factors, such as percentage of population aged over 65 years, the attitude of prescribers towards patients with low adherence, current smokers or those with a \( \text{PaO}_2 \geq 61 \text{mmHg} \), were not related to LTOT prevalence.

CONCLUSIONS: Altitude and the existence of a specific unit or staff member for LTOT supervision significantly influence LTOT prevalence.

KEY WORDS: chronic obstructive pulmonary disease; long term oxygen therapy; prevalence; altitude

RANDOMISED CONTROLLED trials on long term oxygen therapy (LTOT) in the early 1980s1,2 demonstrated its efficacy in terms of survival for patients with chronic obstructive pulmonary disease (COPD) and severe hypoxaemia, leading to increased use of LTOT. The relative innocuousness of LTOT at usual dosages has encouraged its use in patients in whom there is no evidence of benefit, significantly increasing health care costs in several countries.3

Many studies have reported high rates of LTOT among patients who do not meet the criteria for treatment.4-7 Most of these studies present prevalences with wide geographic variability, considered by some authors to be due to prescribers lacking experience in LTOT.5,9

In 1997, the Andalusian Local Health Authorities (Servicio Andaluz de Salud [SAS]), introduced a regulation that transferred supervision of LTOT to hospitals in the public health service. As chest physicians were responsible for LTOT supervision in all public hospitals, the expected variability in prevalence due to inexperienced prescribers was considered to be low, and it should thus be possible to identify other factors related to variability in LTOT prevalence. The aim of the present study was to analyse variability in LTOT prevalence according to several organisational and population factors and different aspects of prescription such as smoking or low adherence.

METHODS

The SAS is in charge of health care coverage for most of the Andalusian population. It is comprised of 29 public hospitals, each of which covers a clearly marked area. The population ascribed to each hospital ranges from 74 557 to 690 986, of a total population of 6 796 964. Each hospital is responsible for LTOT supervision in its area, and there is always at least one chest physician in each hospital.

As in the rest of Spain, in Andalusia LTOT is prescribed according to the guidelines of the Spanish Society of Respiratory Physicians (SEPAR).10 In addition to adopting this guideline, the SAS also established time limitations: the first prescription could not last for more than 3 months, and the time limit for renewal was 12 months, after which the patient needed

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to be reassessed. Each hospital was responsible for organising LTOT supervision and follow-up using its own resources. Technical maintenance of equipment at patients’ houses was performed by auxiliary companies. Before 1997, any physician could prescribe and supervise LTOT and there was no time limit to the prescription, which meant that patients could obtain oxygen therapy for years without follow-up.

During the first quarter of 2002, a survey was sent to each of the physicians in charge of LTOT supervision in each public hospital in Andalusia. The survey was designed by a group of experts and recorded different aspects of LTOT, the organisational structure of the centre and factors related to prevalence variability (Appendix). Answers to the questionnaire were organised in a similar manner to those used in previous consensus statements.11 The survey included some questions that required a direct answer and others in which the participant was asked to indicate the appropriateness of an option using a 9-point scale.

Official figures were obtained from local health authorities on the prevalence of LTOT during the first months of 2002. Population data were obtained from the Statistical Department of Andalusia. Altitude figures were obtained from the Cartographic Institute of Andalusia.

The statistical analysis was performed using the Statistical Package for Social Sciences version 11.0 (SPSS Inc, Chicago, IL, USA). The study was performed over aggregate data. Descriptive analysis was performed for qualitative and quantitative variables. The U Mann-Whitney test was used to compare quantitative variables. The relationship between quantitative variables was assessed using Pearson’s correlation coefficient and a simple linear regression analysis was made. \( P \) value was set at 0.05.

RESULTS

The overall prevalence of LTOT in Andalusia was 184 per 100,000 population (range 71–473). The prevalences of the different devices were as follows: 44/100,000 (range 3.5–172) for concentrators, 129/100,000 (range 16–395) for cylinders, and 11/100,000 (range 0–37) for liquid oxygen (Figure 1).

In 14 (48.3%) areas the first prescription for LTOT could be given by any physician, including primary care physicians, in 14 areas only hospital departments could prescribe oxygen, and in the remaining centre oxygen could only be prescribed by hospital departments and primary care emergency rooms. The differences in prevalence were not significant (215 vs. 186/100,000; \( P = 0.827 \); Figure 2). In 28 (93%) centres, the prescription was confirmed within 3 months, regardless of which physician was responsible for the first prescription.

When asked whether they had a specific unit or staff member in charge of LTOT supervision, 17 (58.6%) centres declared that they did. Prevalence of LTOT use was significantly lower in these centres (169 vs. 237/100,000; \( P = 0.03 \)).

Andalusia is a region with very high altitude areas and others located at sea level. The altitude of the participating centres where blood gas samples were obtained ranged from 4 to 848 m (median 92 m, mean 275 m) above sea level. Figures 3 and 4 show the relationship between LTOT prevalence and the altitude of the centre. This was found to be significantly related to LTOT prevalence. In the regression analysis, the coefficient of determination was 0.504, which indicated that 50.4% of this variability was explained by altitude.

The percentage of the population aged over 65 years in Andalusia was 13.7% (range 9.1–22%). Age was not related to oxygen prevalence (\( r = 0.206; P = \text{NS} \)). The attitude of prescriptors towards active smokers, low adherence or patients presenting with a \( \text{PaO}_2 \) of 61 mmHg varied widely between respondents (Figure 5), and was not related to variability in
LTOT prevalence. Centres that were university hospitals showed no variation in LTOT prevalence (203 vs. 191/100,000; \( P = \text{NS} \)).

**DISCUSSION**

The implementation of the new SAS regulations required compulsory renewal of the first prescription after 3 months and renewal of LTOT at least once a year. It also gave responsibility of LTOT supervision to chest physicians. These changes produced a reduction in LTOT prevalence of nearly 100/100,000 (1997: 270/100,000; 2000: 172/100,000). Current prevalence in Andalusia is similar to that of other regions in Spain: Madrid has a similar prevalence (178/100,000),\(^{12}\) whereas in other areas such as Majorca the prevalence is much lower (56/100,000).\(^{13}\)

Several studies have revealed an improvement in the prescription of oxygen therapy when chest specialists rather than primary care physicians were responsible for prescriptions.\(^{8}\) In our study, although prescriptions were always controlled by chest lung physicians, there was wide variability between different areas in the region. Another factor previously related to oxygen prevalence was higher prevalence in university hospitals than in other hospitals.\(^{14}\) This difference was not noted in our study.

The attitude of physicians towards indications for treatment could also influence prevalence, as it has been argued that prescriptions made by chest physicians are not always adequate.\(^{15,16}\) We aimed to evaluate different aspects considered to be controversial, such as attitude towards active smokers, low adherence or PaO\(_2\) = 61 mmHg. There was wide variability in these aspects between the different participating centres, although it did not influence prevalence.

Our results suggest that in Andalusia the existence of a specific unit or staff member for LTOT supervision significantly reduces oxygen prevalence. Several other studies have concluded that such units are cost-effective.\(^{13}\) With a target population of nearly 7 million, we observed lower prevalence in those areas where LTOT supervision was carried out by a specific unit or staff.

Although the physician responsible for the prescription may influence oxygen prevalence, other factors that may also influence prevalence have been little studied. As COPD prevalence increases with the age of the patients, so should LTOT. In our study, we found no relationship between prevalence and age. This may be due to the wide variability in COPD prevalence in Spain among different geographic areas (5–18%),\(^{17}\) which might act as a confounding factor.

Another factor associated with LTOT prevalence is altitude. The effects of altitude on oxygen-inspired air partial pressure among both healthy populations and COPD patients are well known.\(^{18}\) Several studies have observed decreases or increases in arterial oxygen pressure depending on a higher or lower altitude, respectively.\(^{19,20}\) In our area, the difference between the highest hospital and those at sea level is 844 m. This reflects a change in barometric pressure of 70 mmHg, which, following the alveolar gas equation, would establish differences in inspired air oxygen pressure of 13.7 mmHg. Thus, it should be expected that more COPD patients require LTOT in higher altitude areas.
We have found no studies that have directly analysed the relationship between altitude and oxygen prevalence, as most published data are based on different aspects related to adherence to indication criteria,\textsuperscript{15,16} type of hospital\textsuperscript{14} or physicians involved in prescription.\textsuperscript{8}

The cost of COPD is elevated in industrialised countries,\textsuperscript{21} and will probably increase in the next few years with the increase in disease prevalence. LTOT represents a significant fraction of this expense, which in France represents up to 25\% of direct costs.\textsuperscript{21} The cost of LTOT in the US has been estimated at $3800 million per year, $330 million in France and $75 million in Spain.\textsuperscript{22}

In an attempt to optimise costs, local health authority managers often compare prevalence figures among different areas and attribute any increase in prevalence to indiscriminate prescribing habits. Our study provides data indicating variability in some areas due to altitude; this should be considered when comparing prevalence figures among areas of different altitudes.

References


APPENDIX QUESTIONNAIRE

1 The first prescription for oxygen therapy in your area is made by:
   • Only the Department of Respiratory Medicine
   • The Department of Respiratory Medicine and other hospital departments
   • Any physician in your Health Area (including primary care physicians)
   • Other (please specify): _____________________.

2 If the first prescription is made by departments other than the Department of Respiratory Medicine, is it confirmed within the next 3 months by a pulmonary physician?
   • Yes
   • No
   • Other (please specify): _____________________.

3 Is there a specific unit, out-patient clinic or specific staff member in charge of the supervision of oxygen therapy in the Department of Respiratory Medicine?
   • Yes
   • No
   • Yes, but not within the Department of Respiratory Medicine (please specify department): _____________________.
4 If oxygen therapy is prescribed during an exacerbation, is the indication confirmed within 3 months? (choose the most appropriate)
   Never 1 2 3 4 5 6 7 8 9 Always
5 Do you plan periodic visits for patients on oxygen therapy?
   Never 1 2 3 4 5 6 7 8 9 Always
6 Which department organises these visits?
   • Department of Respiratory Medicine
   • A specific oxygen therapy unit
   • Other (please specify): ______________________
7 How many chest physicians are there in your area? ______________
8 If you find that a patient currently using oxygen therapy has PaO₂ = 61 mmHg (8.1 kPa), do you suspend therapy?
   Never 1 2 3 4 5 6 7 8 9 Always
9 If therapy is not suspended, please specify why: __________________________________________
10 If the patient using oxygen therapy is a current smoker, do you suspend therapy?
   Never 1 2 3 4 5 6 7 8 9 Always
11 If a patient uses oxygen for <15 hours a day, do you suspend therapy?
   Never 1 2 3 4 5 6 7 8 9 Always

RÉSUMÉ

OBJECTIF: Analyser les variations de prévalence de l’oxygénothérapie au long cours (LTOT) en fonction de divers facteurs organisationnels ou de population.

MÉTHODES: Enquête prospective multicentrique, menée dans 29 hôpitaux publics couvrant une population de 6.796.964, qui a recueilli les données sur la structure d’organisation des centres participants et sur différents facteurs liés à la prévalence du LTOT. Les données officielles provenant des autorités locales de santé ont été obtenues également en ce qui concerne la prévalence et les dépenses de l’oxygénothérapie au long cours.

RÉSULTATS: La prévalence globale du LTOT est de 184 pour 100.000 (extrêmes 71–473). Une unité ou un personnel spécifique pour la supervision du LTOT existait dans 17 centres (58,6%) dans lesquels la prévalence est plus faible (169 vs. 237/100.000 ; P = 0,03). L’altitude des centres participants (médiane 92 m ; moyenne 275 m ; extrêmes 4–848 m) s’avère influencer la prévalence du LTOT (r = 0,72 ; P = 0,005). Le coefficient de détermination de l’analyse de régression linéaire pour l’altitude est de 0,504. D’autres facteurs, tels que le pourcentage de population dépassant l’âge de 65 ans, l’attitude des prescripteurs vis-à-vis de patients à faible adhérence, le taux de fumeurs ou des sujets dont la PaO₂ = 61 mm Hg ne s’avèrent pas corrélés avec la prévalence du LTOT.

CONCLUSION: La prévalence de LTOT est influencée significativement par l’existence d’une unité ou d’un personnel spécifique pour superviser la LTOT ainsi que par l’altitude.

RESUMEN

OBJETIVO: Analizar la variabilidad en la prevalencia de la oxigenoterapia crónica domiciliaria (OCD) según varios factores organizativos y poblacionales.

MÉTODOS: Encuesta prospectiva multicéntrica que recogía datos sobre la estructura organizativa de los centros participantes y diversos factores relacionados con la prevalencia de la OCD. El estudio se realizó en 29 hospitales públicos (población 6.796.964). Datos oficiales de la prevalencia de la OCD se obtuvieron de las autoridades sanitarias locales, así como datos sobre el gasto generado.

RESULTADOS: La prevalencia global de OCD fue 184 (rango 71–473) por 100.000. Existía una unidad o personal específico para el control de la OCD en 17 (58,6%) centros, que presentaban una prevalencia menor (169 vs. 237/100.000 ; P = 0,03). Se encontró que la altitud de los centros participantes (mediana 92 m; media 275 m ; rango 4–848 m) influye en la prevalencia de la OCD (r = 0,73 ; P = 0,005). El coeficiente de determinación del análisis de regresión lineal para la altitud fue de 0,504. Otros factores como el porcentaje de población mayor de 65 años o la actitud de los prescriptores ante pacientes poco cumplidores, fumadores activos o con PaO₂ = 61 mmHg no se encontraron estar relacionados con la prevalencia de la OCD.

CONCLUSIONES: La existencia de una unidad o personal específico para el control de la OCD y la altitud influyen significativamente la prevalencia de OCD.