

# An Outbreak of 400 Cases of Lipoatrophia Semicircularis in Barcelona: Effectiveness of Control Measures

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**Objective:** From February 2007 to October 2008, 1137 cases of lipoatrophia semicircularis were registered in distinct workplaces (WPs) in Barcelona. A protocol to establish control measures was designed. This study pretends to evaluate the effectiveness of these measures. **Methods:** In this case study, the outbreak course in relation to the implemented measures (relative humidity >50%, ground-mass electrical discharge, and avoidance of sharp-ended table edges) was analyzed. The study population consisted of 417 workers from four different WPs diagnosed between February 2007 and October 2008. **Results:** Cumulative incidences were 61.6% (WP1), 24.1% (WP2), 8.8% (WP4), and 5.5% (WP3). Based on discharges confirmed by medical services, healing rate was highest in WP1 (93%), followed by WP2 (82%), WP4 (62%), and WP3 (22%). **Conclusions:** When the three basic measures were promptly and jointly applied, 90% of the cases were resolved within 6 months.

Lipoatrophia semicircularis (LS) is a medical condition characterized by semicircular depressions generally on the anterolateral aspects of the thighs or sometimes the arms or abdomen. These lesions usually appear as bilateral, symmetrical bands, beyond which there is always atrophy of the subcutaneous fat. LS is not painful and no other symptoms or lesions are present; therefore, clinical examination is needed for diagnosis.<sup>1</sup> The lesions may revert after removal of the risk factors involved in their development.<sup>2,3</sup> Although the first case was described in 1974 by Gschwandtner and Munzberger,<sup>4</sup> studies determining the cause of this entity are still lacking. The most important hypotheses related to the working environment are based on microtrauma produced by repeated pressure on the affected area,<sup>2,5</sup> electromagnetic fields, and electrostatic discharges.<sup>6</sup>

Cases of LS have been diagnosed in several countries, including France, Italy, the Netherlands, Belgium, and Great Britain.<sup>7-9</sup> The most extensively studied outbreak to date occurred in Brussels, involving ~1300 office workers in a bank over a 12-year period. The lesions mainly occurred in women and represented 84% of cases reported in Brussels. The lesions disappeared when exposure to the workplace (WP) environment ceased.<sup>10</sup> Nowadays, because of the information reported by the experience in Belgium, the best supported hypothesis links LS with the electric discharge between the body and the table edge, especially when the internal relative humidity is low (<40%). The human body can accumulate electrostatic charge due to friction between the body and the chair or between the body and the ground. In this context, when direct contact or close proximity between the charged body and the table

edge takes place, an electric discharge is produced. In addition, the electrical field created by working technology (computers, telephones, printers, etc.) can produce an electrical charge on the surface of the desk, which can generate a discharge between the human body and the table edge. The smaller the contact surface, the higher the density of the discharge. Electron movement from one body to another would change the electric properties of adipocytes and possibly damage fat cells.<sup>3,6,10</sup>

From February 2007 to October 2008, 1011 cases of LS were registered in Barcelona in distinct WPs, especially among women (87% of all reported cases). Because the cases showed a territorial concentration and the epidemic outbreak was considered to be of occupational origin (when cases appear due to work), the Labor and Health Departments (from the Catalonia Government), in collaboration with the Public Health Agency of Barcelona, produced the first action protocol for LS<sup>11</sup> to detect new cases and to establish the necessary control measures. The recommended control measures were as follows: 1. table edges should be wide and round (so that the contact surface would be wide and not angular); 2. staff must be informed and procedures involving pressure with any part of the body against the furniture should be avoided; the design of the WP should be reviewed to avoid such pressure; 3. the use of materials that accumulate static electricity should be avoided; 4. the relative humidity rate should be around 50%; and 5. the influence of electric installations on the metallic structure of tables should be avoided by installing an earth cable and affected individuals should visit the doctor every 6 weeks for follow-up. At the same time, a case-control study was performed in an affected company in Barcelona that suggested that 90% of cases could be prevented by modifying table edges so that they were wide and round and that 30% of cases could be prevented by decreasing the frequency of leaning on table edges.<sup>12</sup> Some other regions of Spain (Basque Country, Valencia, and Andalusia) in which new cases have occurred have implemented variations of this protocol.<sup>13</sup> In October 2008, 18 months after the start of the outbreak, we wanted to evaluate the coverage and effectiveness of the protocol's control measures.

## METHODS

After the first report of LS cases in February 2007, a working group was established, which was composed of representatives of the Occupational Safety Department (Labor Department and Work Inspection Service), the Health Department of Catalonia, and the Public Health Agency of Barcelona. This group studied the outbreak of cases and recommended the adoption of preventive and control measures in the affected centers. The measures were compiled in the first action protocol for LS, published 3 months after the first case was reported. From the beginning, the implementation of the measures in the affected companies, as well as the evolution of cases, was followed up.

## Study Design

Given the social alarm caused by the outbreak, the initial steps focused on the design and performance of the case-control study and aimed to develop the protocol to provide a quick set of recommendations that could be operational in April 2007, only 3

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months after the first cases were reported. As a consequence, the evaluation was planned after the recommended measures had been disseminated, and some of the WPs had already started adopting them. Evaluation was based on a case study design in which a descriptive analysis of the course of the outbreak was performed in relation to the control measures adopted.

### Study Population

The study population consisted of workers with LS from three WPs in Barcelona (WP1, WP2, and WP3) and one WP (WP4) in Hospitalet de Llobregat (a city next to Barcelona). Each WP consisted of several companies and only the main companies were included in this study (a total of 10). The main activity of these companies was administrative work, and the cleaning service (5.5%) was also included.

Affected persons were considered to be those corresponding to a case notified by the company doctors according to the data set given by them. "Healing" was considered as complete disappearance of the lesion reported by the company doctors. The diagnosis of "affected person" and "healing" was based on clinical examination with observation and palpation of the lesion.

Only affected persons who were still exposed to the WP environment at the end of the study were included. Persons initially diagnosed with LS who left the company because of long sick leave, retirement, or contract ending were excluded from the analysis. "Tracked persons" were those whose clinical information was updated after March 2008. Affected persons without information from March 2008 were considered tracking losses.

The characteristics of the WPs at the beginning of the outbreak are shown in Table 1. Three of these businesses were located in brand-new buildings opened during the last 2 years (2005 and 2006). WP3 was a 20-year-old building, first occupied by the current business in 1998 but which had been reshaped. Two of the

buildings were closed (no operating windows) and the other two were open; all of the buildings, however, operated as closed buildings to keep the air-conditioning or central heating constant. All buildings had central ventilation systems with integrated air-conditioning, and there were no specific humidifier systems. Tables were made of phenolic resins over a metallic structure, all had a computer, lamp, and telephone set, and all but one was heavily wired. The table edges of three buildings were thin and angular and all were ~72 cm high. Chairs were covered by synthetic materials, and the floor was covered by a carpet (in two buildings) or by a fitted carpet (in one building).

### Study Period

The study included cases of LS occurring in the four above-mentioned buildings from February 2007 (when the first cases occurred) to October 2008. This period was considered sufficient to observe the effects of the control measures applied since the publication of the protocol, taking into account a mean latency time from exposure to risk factors until symptom onset of 3.5 months.<sup>10,12,14</sup>

### Data Collection

Data collection was started with the information obtained from each company and the tracking visits were made to each WP after the cases were reported. Databases provided by companies were unified, as each contained information gathered in different ways.

### Information Sources

The company medical services were asked to provide a list of the persons with LS and the characteristics of the lesions and their course until the end of the study. In addition, the personnel department of each company was asked to provide all the informa-

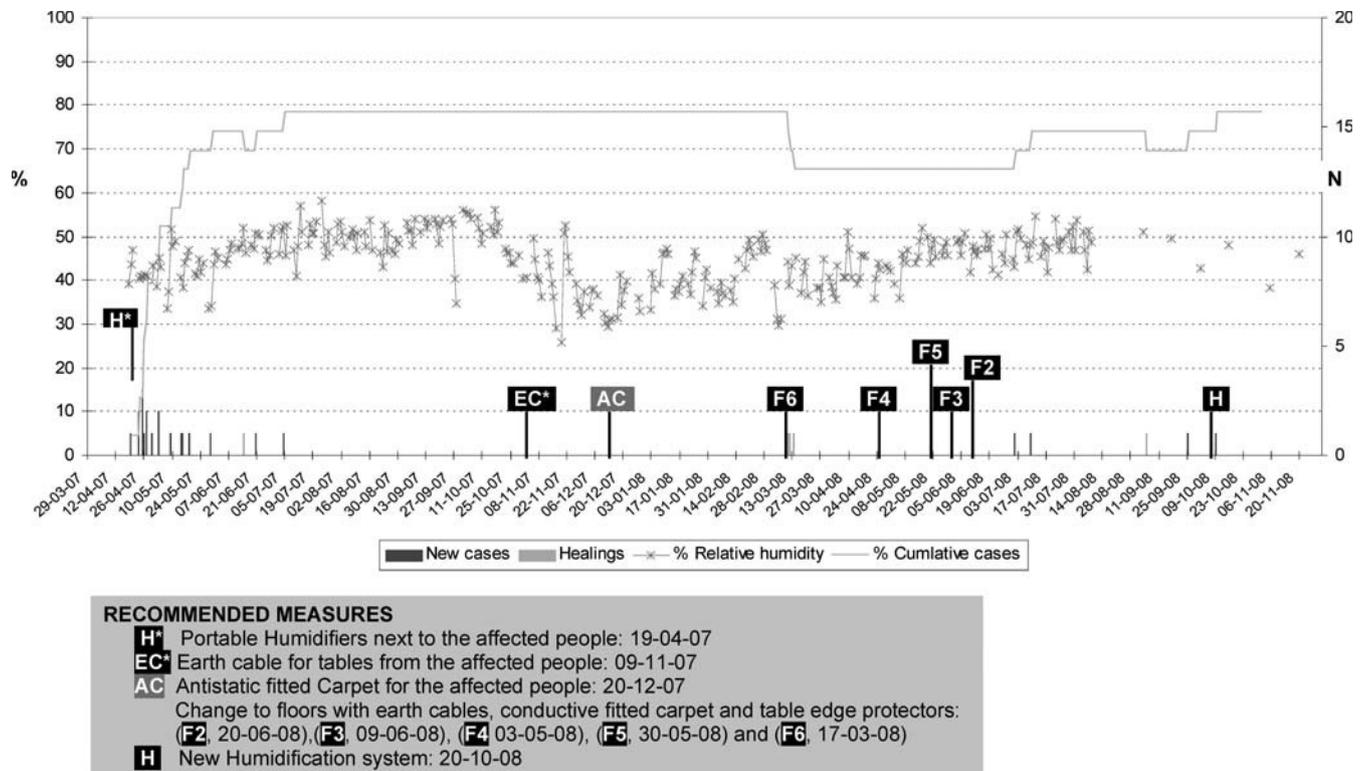
**TABLE 1.** Baseline Environmental Characteristics of the Four WPs in Barcelona at the Onset of the Outbreak in Relation to Risk Factors for LS

	WP1	WP2	WP3	WP4
Type of building				
Closed/open	Closed	Open	Closed	Open
Incorporation date	2006	2005	2006	1998
Ventilation system				
General/partial	General	General	General	General
% external air	15	20	28	
Climatization	Integrated in the ventilation system	Integrated in the ventilation system	Integrated in the ventilation system	Integrated in the ventilation system
Humidification	No	No	No	No
Table				
Structure	Metallic	Metallic	Metallic	Metallic
Electrified	Yes	Yes	Yes	No
Top	Phenolic resin	Phenolic resin	Phenolic resin	Phenolic resin
Top high	72 cm	70.5–71.7 cm	71–73 cm	71.5–73 cm
Edge	0.5 cm	0.4 cm	2 cm	0.3 cm
Chair				
Material	Synthetic textile	Synthetic textile plastic material	Synthetic textile	Synthetic textile
Working instruments				
Computer, telephone, printer	Yes	Yes	Yes	Yes
Ground				
Materials sorted by lays	1. Antistatic-fitted carpet, 2. technical ground, and 3. concrete	1. Mats, 2. technical ground, and 3. concrete	1. Synthetic ground, 2. technical ground, and 3. concrete	1. Fitted carpet and 2. concrete

**TABLE 2.** Cumulative Incidence and Recovery Rates of LS in Four WPs in Barcelona During the 18-Month Follow-Up

	Cases (N)	Staff (N)	Cumulative Incidence (%)	F	Recoveries			Recoveries + Improvements		
					N	T (%)	F (%)	N	T (%)	F (%)
WP1	258	928	27.8	256	240	93.0	93.8			
WP2	99	682	14.5	97	81	81.8	84	97	98.0	100
WP3	23	199	11.6	22	5	21.7	22.7	9	39.1	40.9
WP4	37	695	5.3	34	23	62.2	68	34	91.9	100

T, total; F, followed up.



**FIGURE 1.** New cases, healings, relative humidity, and application of measures in WP3 (the three main recommended measures evaluated are indicated by the black label).

tion related to the affected staff. Finally, information was requested on all the measures applied, their characteristics, and when they were implanted.

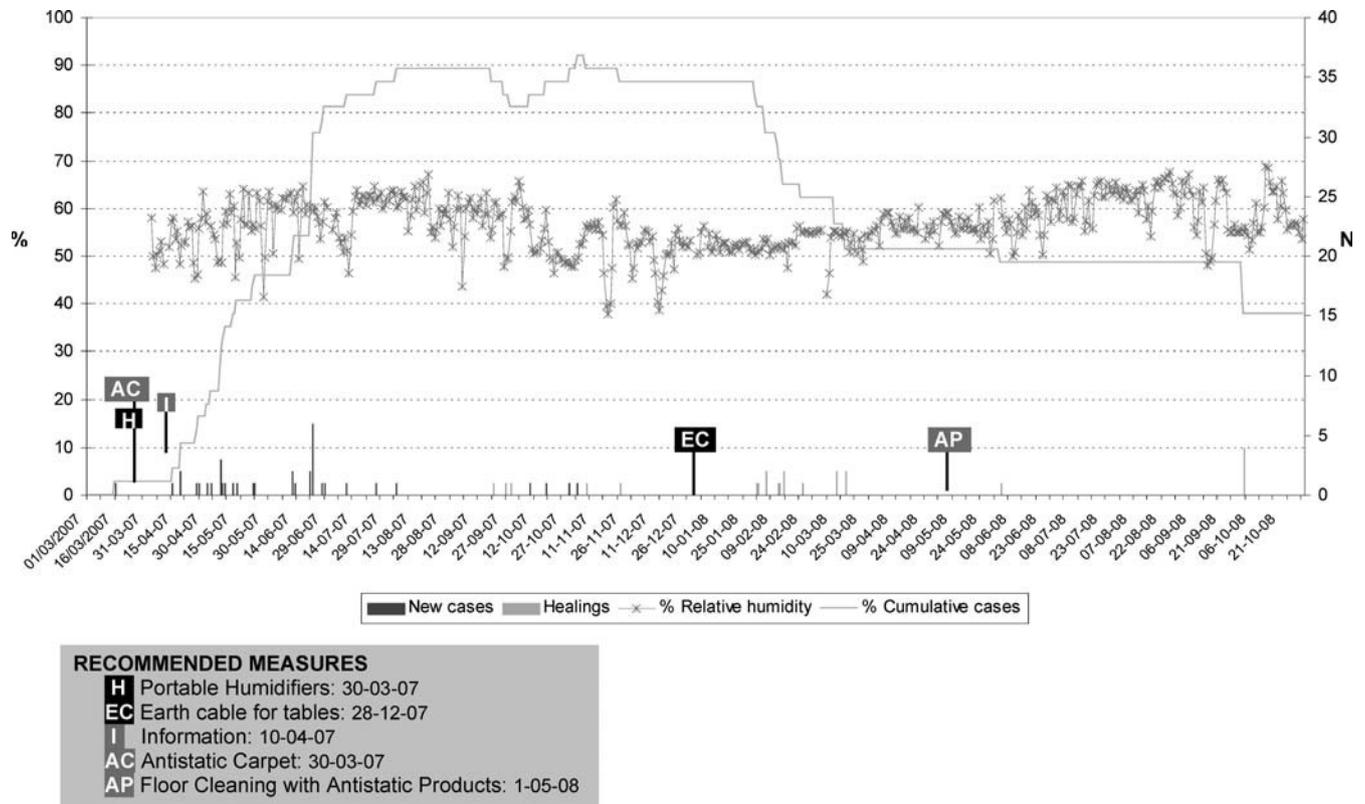
**Study Variables**

Sociodemographic data (sex and age), work-related data (working center, date of incorporation, building, floor/working area, and specific tasks), and clinical data (type and date of diagnosis, date of healing, and clinical status at the end of the study) were collected on affected individuals from routine sources. Environmental data on risk factors were collected from business representatives. Information was gathered on the date of implantation of humidifiers and the relative percentage of humidity during the study period. The date of incorporation of earth cable was also recorded. The date when table edges were changed or edge protection was installed were gathered. Other collected variables were the information provided to workers about positions to be avoided, physiotherapy sessions (professional massage offered to cases from WP1), and changes of material that accumulate static electricity (footrest,

chair material, and floor cleaning with antistatic products). Some of those measures like physiotherapy sessions were not directly recommended by the protocol but the WP1 management decided to offer that option to their affected workers.

**RESULTS**

A summary of cumulative incidence and recovery (total and partial) rates is shown in Table 2. Between February 2007 and October 2008, 417 cases (84% women) were notified in the four WPs. A total of 61.6% worked in WP1 (n = 258, 83% women, mean age: 39.5 years), 24.1% worked in WP2 (n = 99, 93% women, mean age: 38 years), 8.8% in WP4 (n = 37, 95% women, mean age: 41 years), and 5.5% in WP3 (n = 23, 96% women, mean age: 43 years). Based on discharges confirmed by the WP medical services, a notable finding was the higher healing rate in WP1 (93%), followed by WP2 (82%), WP4 (62%), and WP3 (22%). If improvements without achieving complete cure were also taken into account, these rates would be 98%, 92%, and 39% in WP2,



**FIGURE 2.** New cases, healings, relative humidity, and application of measures in WP4 (the three main recommended measures evaluated are indicated by the black label).

WP3, and WP4, respectively, and those in the WP2 and WP3 being similar to that in WP1. Information on improvement in affected individuals not achieving complete cure in WP1 was not available but would have increased the healing rate, as in the other WPs. Recovery rates were higher in all the WPs when only observed persons (from whom we had medical information at the end of the study) were considered in the denominator. In WP3, the recovery rate was substantially lower than in the other WPs in all the cases.

Figures 1 to 4 show the cumulated number of cases and healings in each work center and the time of application of the recommended measures. The relative humidity inside the offices is also shown. The course of LS and the control measures adopted by each WP varied. In WP3, new diagnoses peaked in April 2007, the first case being reported on April 19, 2007 and the last case being reported 18 months later (Fig. 1). At the beginning, the earth cable was placed on the tables of affected individuals and fitted conductive carpet on the floors. Although portable humidifiers were installed at the end of March 2007, relative humidity remained <50% in most of the WPs until the end of the study. After October 2007, relative humidity reached values of <40% in some WPs. A new general humidifying system was installed in October 2008 but humidity values showed no increase. At the end of June 2008, workers finished moving to different floors which had fitted conductive carpet, earth cables in all the tables, and protected edges, but new cases were detected during the following months until the end of the follow-up period and healing did not significantly increase. Six months after the first case was reported, the proportion of persons still affected was similar to that at the end of the study, which was ~80%.

Figure 2 shows how diagnoses were distributed over time in WP4 with a small peak in June 2007, the first case being reported

on March 14, 2007 and the last case being reported 8 months later. Six months after the first case occurred and after workers were informed of the situation, relative humidity was controlled at ~50%, and the floor had been covered with antistatic carpet; however, 89.19% of affected individuals still had lesions. Earth cables were not laid until December 2007, and from May 2008, the ground was cleaned daily with an antistatic product. After these measures, the number of healed lesions increased, reaching 40% of remaining lesions at the end of the study.

Changes in the number of affected persons in WP2 are shown in Fig. 3, with a peak of new cases at the end of April 2007 and a high peak of healing in October 2008. The first case was reported on April 12, 2007, and the last case was reported 1 year later. Six months after the first case occurred, the proportion of staff still affected was 78.79%. After the first diagnoses, the earth cable for tables and chairs was laid (April 2007), and the floor was treated with antistatic products. The air ventilation volume was increased but humidity values were not stable at ~50%. After these measures were adopted, only a few more cases occurred and some affected individuals (~7%) recovered. Preliminary plastic mobile table edge protectors were incorporated in July 2007 but fixed and round protectors were not ready until February 2008. Until the end of February 2008, after the general ventilation system was modified, humidity values were not stable at ~50%. After humidity was controlled at ~50%, earth cables and table edge protectors were placed and the floor was cleaned with antistatic products, and only a few sporadic new cases were reported, the last in April 2008, 1 year after the first diagnosis. Approximately half of healed lesions were reported after table edge protectors were placed and the other half after relative humidity was maintained at ~50%. The cumu-

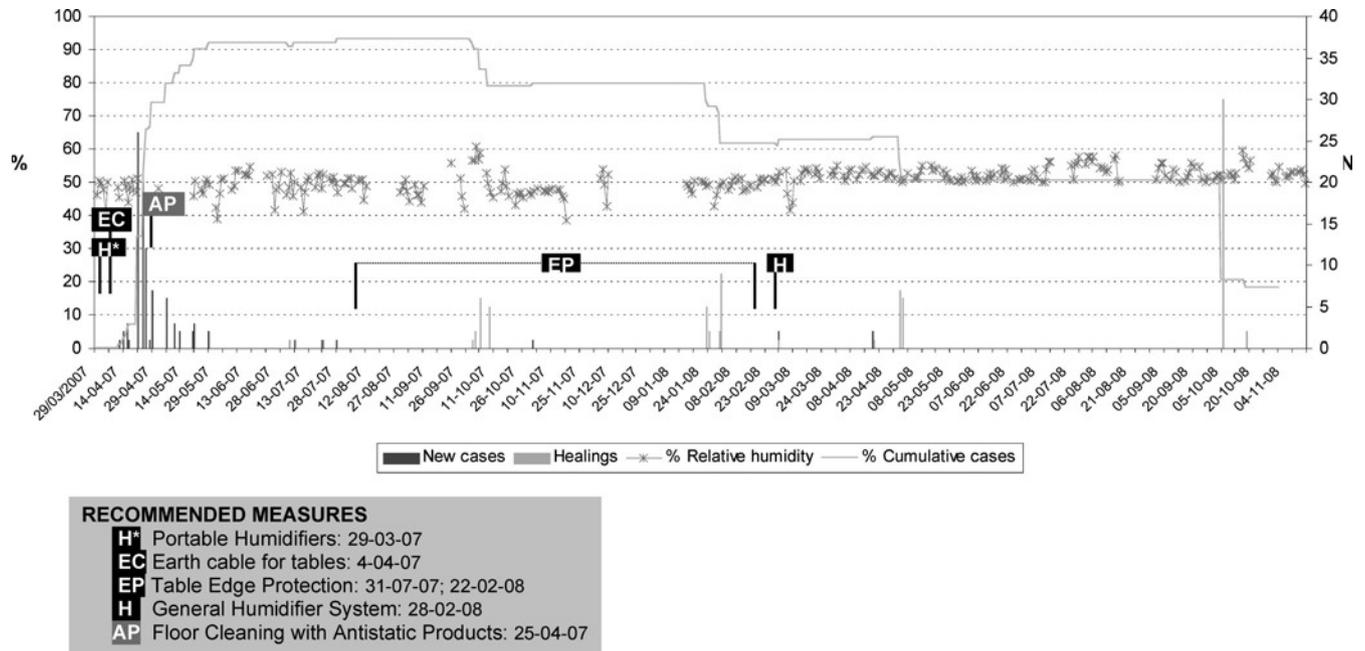


FIGURE 3. New cases, healings, relative humidity, and application of measures in WP2 (the three main recommended measures evaluated are indicated by the black label).

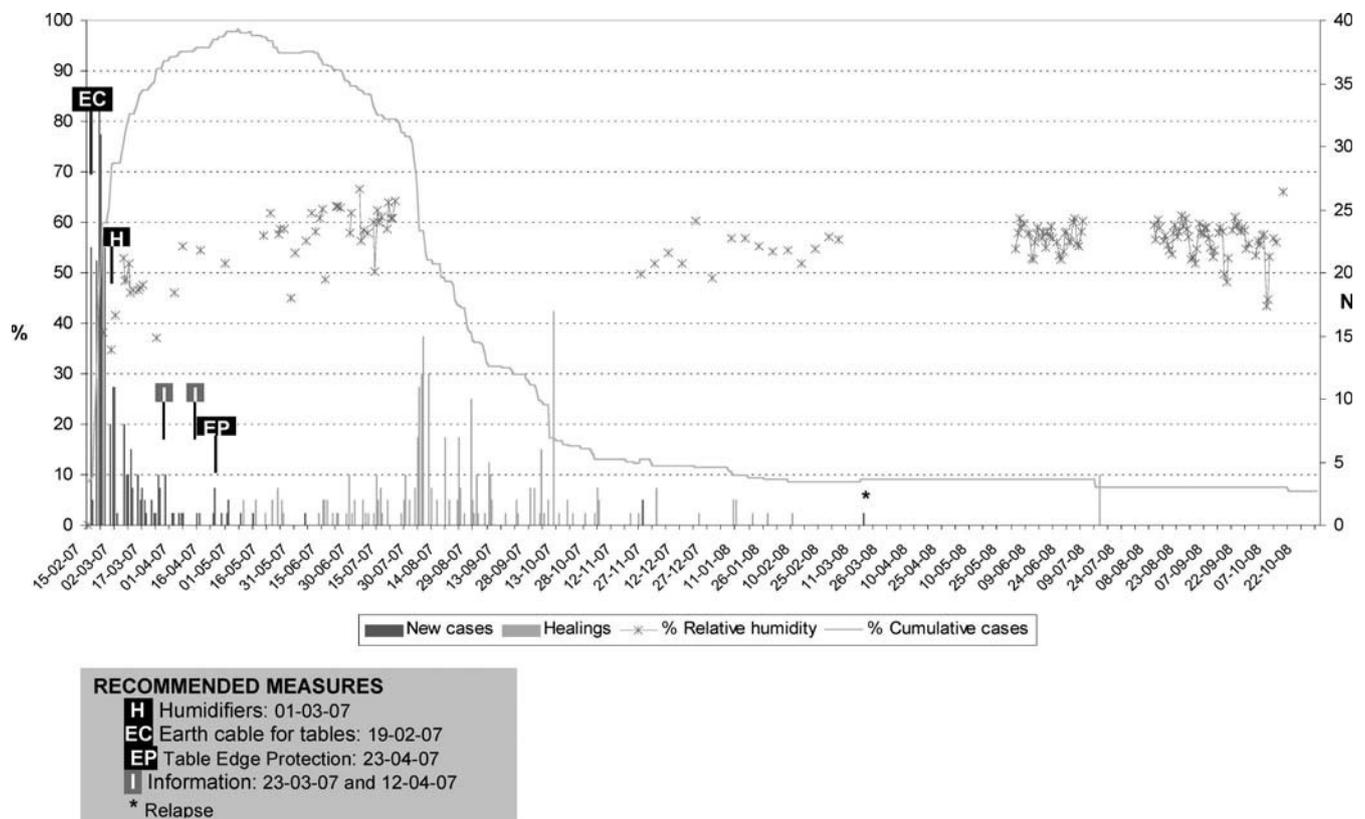


FIGURE 4. New cases, healings, relative humidity, and application of measures in WP1 (the three main recommended measures evaluated are indicated by the black label).

lative incidence decreased to 20% of the remaining affected staff at the end of the study.

Figure 4 shows that more than half of the cases in WP1 were diagnosed in February 2007; the first case being reported on

February 16, 2007 and the number of affected staff reaching a peak in May of that year. Control measures were rapidly adopted, shortly after diagnosis of the first cases, between February 2007 and April 2007. Relative humidity soon reached values ~50%, the earth

cables were laid, and workers were informed about how to prevent LS; physiotherapy sessions were offered to affected staff, and table edges were changed. After May 2007, affected persons started to be discharged, and reported recoveries reached a peak in August 2007. Approximately 50% of affected persons were discharged within 6 months after the first diagnosis, and >90% had been discharged by the end of the study.

## DISCUSSION

This study is the first to report the effectiveness of control measures taken after a massive outbreak of LS. Overall, we found that when the three basic measures (control of relative humidity >50%, ground-mass electrical discharge, and avoidance of sharp-ended table edges) were promptly and jointly applied, 90% of cases were resolved within 6 months. Although the underlying mechanisms (electrostatic, electromagnetic fields, microtrauma, or other pathways) are poorly understood, these conclusions have enormous potential in terms of public health.

### Limitations

One of the main limitations of the study is the lack of an objective diagnostic technique and diagnostic criteria, both for lesions and for healing affecting the evaluation of the measures' effectiveness. Furthermore, if improvements in lesions—considered by doctors in charge of patient tracking—together with complete cures were taken into account, the results obtained in WP2—and especially in those in WP4—would have been better. In the case of WP3, the results would also change but 50% of affected staff would continue to show no improvement. Importantly, at the end of the study period, not all patients had been followed up, and healing rates were based on information from the previous months; therefore, these rates could have been higher in all four WPs at the end of the study, mainly in WP4. In addition, diagnosis and healing dates are not representative of the exact moment when someone is diagnosed or recovers but of the time of consultation. Therefore, information on healing date will be more or less exact depending on the frequency of consultations in each company and the kind of tracking that is performed. Moreover, precise information on individual exposure to risk factors and recommended measures was unavailable because the areas were large, involving different floors or buildings. Furthermore, conclusions were extracted ecologically with little detail. Precise dates when measures were implanted were recorded but their correct functioning was not exactly determined. The differences in clinical information provided by distinct physicians as well as in the control measures taken by the different companies could also have affected comparability.

### Recovery Rates According to the Implemented Measures

The results show a substantial difference among healing rates at the end of the study: WP1 (93%), WP2 (82%), WP4 (62%), and WP3 (22%). The probability of healing in WP1 was 4.2 times higher than that in WP3, a statistically significant difference. The probability of healing was also significantly higher in other WPs (WP2 and WP4) with different combinations of preventive measures. No differences were found considering differences in working categories in any company.

It is noteworthy that in WP1, there was a rapid implantation of preventive measures and their follow-up (3 months). Besides, they adopted all together the three main recommended measures. Because of the quick and efficient intervention, there were practically no new cases, affected persons started to improve rapidly, and a high healing rate was achieved at the end of the study. A large percentage of healings appeared after the table edges were changed,

earth cables for tables were introduced, and relative humidity was maintained >50%.

Other companies failed to apply the recommended measures as quickly and efficiently as WP1, which was reflected in the course of the outbreak. The healing rate was lower in WP2 than in WP1, even though the same main measures were adopted. One difference between these two buildings was that WP1 offered physiotherapy sessions to affected staff. A further difference between WP1 and WP2 was that all the measures were simultaneously and immediately implanted in the case of WP1. WP2 took longer to introduce all the control measures, thus maintaining exposure to risk factors, which may have increased the severity and duration of lesions. Therefore, a longer study period would be required to review LS lesions and determine the point at which exposure to risk factors ceased.

In WP4, the main measure initially adopted was control of relative humidity at ~50%. Afterwards, only a few new cases developed, and some recoveries were reported but the main percentage of healing was detected after earth cables were installed. We initially believed that modifying the tables was not a priority in WP4 as they were wider (2 cm) than those in the other centers but not rounded. Because the healing rate was lower than that in WP1, the measures taken in WP4 appear to have been insufficiently effective. This lower healing rate could be explained by the table edges, although they were not excessively thin or angular, which did not exactly match the safety criteria, and therefore, healings would have increased if the edges had been more rounded. In addition, earth cables were installed later than in WP1. As in WP2, the severity and persistence of lesions could be explained by longer staff exposure to risk factors, thus slowing recovery. In WP3, relative humidity rates >50% could not be maintained during the study period. Earth cables for tables and table edge protection were not installed for all staff until May 2008, approximately. Nearly 80% of affected staff continued to have lesions at the end of the study period.

The relative weight of each of the recommended measures could not be distinguished because we were unable to establish direct relationships between a higher number of healings and specific measures. The results obtained indicate that application of an isolated measure is less effective than application of all the measures at the same time (increasing relative humidity rate to >50%, installing earth cables for tables, and making table edges wider and rounded ones). Another important factor is that the interval between the first appearance of cases until the application of all the measures was the shortest possible because this interval could affect healing time. Physiotherapy sessions were different among the buildings adopting all the measures together but its role in healing cannot be determined as there is no information on how widely this measure was applied.

The effect of control measures in preventing the development of new cases in addition to producing healing is also important. In WP3, as the main measures were not fully implemented at the end of study, new cases continued to appear. In WP4, after earth cables were installed and relative humidity was maintained at ~50%, no new cases appeared, although the target healing rate was not reached. In WP2, after earth cables were installed, almost no new cases developed, but the main percentage of healing was reached after relative humidity was controlled and table edges were changed.

Equally, we did not evaluate the effect of the measures applied for which control parameters are not available (information, antistatic treatment on chairs and floors, and physiotherapy sessions). To assign a specific weight to each measure, a specific study should be performed with uniform diagnostic criteria and measurement of variables, as well as distinct combinations of measures in different WPs to aid comparison.

## Conclusions

Despite the above-mentioned limitations, we can conclude from the results obtained that the measures recommended in the protocol for LS were effective because, when they were correctly implanted, new cases did not appear and existing cases were rapidly discharged. We recommend that companies that have not achieved a healing rate of nearly 90% report the course of outbreaks as well as the control measures implemented until this percentage is achieved.

The results of this study agree with the experience in Belgium on healing when affected staff cease to work in adverse condition.<sup>10</sup> In other regions of Spain, all the cases of LS in one company ( $n = 13$ ) and ~90% of cases in another company ( $n = 29$ ) resolved when the relative humidity increased to values of ~60%. In a third company, 64% of the lesions ( $n = 65$ ) disappeared and the residual lesions improved after furniture was modified by installing earth cables and protecting table edges and chairs but without changing humidity.<sup>15</sup>

Although the specific cause of LS remains unknown, electromagnetic fields, electrostatic discharge, relative humidity, and furniture conditions play an important role in this entity. Acting on all these factors quickly stops the development of new cases and provides an environment that allows recovery of >90% of cases in a short period of time.

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