

Evaluation of the noise exposure inside and outside late night premises

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1 INTRODUCTION

The high sound levels of the musical entertainment premises have various connotations. First they are pursued as music and they represent leisure and amusement. Therefore they are searched from the visitors of those premises as an important aspect of the leisure. Nevertheless they can have dangerous effects on auditory systems of the visitors themselves.

The elevated sound levels that produce pleasure are also a characterizing element of the work environment for the premises staff: for the barmen, disc-jockey, entertainers...

At last, music coming from pub and discotheques can represent a disturbance for people living in the surroundings. Music is especially perceived as annoyance in night time when the sonorous climate is quiet and people need silence to rest.

Noise inside and outside late night premises were the subjects of two studies: one resulting from a campaign of measurements in the premises, during several events, and the second from the analysis of the noise complaints received by people living close to the premises. Noise complaints evaluation is a conventional activity of the Aosta Valley Environmental Protection Agency (ARPA) whereas the measurements campaign inside premises was performed following a specific request of the Aosta Valley Local Health Service.

2 AREA OF STUDY AND PERFORMED ANALYSIS

The studies involve the territory of the Aosta Valley Region, the smallest Italian region in the middle of the western Alps. The Aosta Valley has a tourist vocation and the dancing premises are located in Aosta, chief town of the region, and in the tourist resorts of the region. The majority of the noise complaints come from people living near this type of activity, located in these areas.

The nocturnal life in Aosta Valley region moves along the late night: starting in the evening time (about 20:30 PM) in which young people visit the premises to meet friends, the night goes on in other kind of premises where the music has not only listening purposes but also dancing purposes, till the first hours of the morning (about 5:00 AM).

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The two distinct analysis introduced in this paper follow two different approaches:

- the measurements campaign inside the entertainment clubs that produce significant sound levels.
- the noise complaints data study regarding all the night meeting points such as restaurants, bars, pubs, discothèques.

3 MEASUREMENTS CAMPAIGN INSIDE MUSIC ENTERTAINMENT PREMISES

The measurements campaign was made in agreement with the Aosta Valley region Local Health Service, with the aim to improve the knowledge of the noise levels inside the musical entertainment premises, in order to estimate the noise exposure of the visitors. Nowadays musical and dancing entertainment is very common between the youngest people: they are the most exposed to this kind of noise. It is very important to collect information on this aspect in order to promote a wider information on the risks¹⁻².

The objective of the campaign was not to verify the respect of the Italian norm regarding the sound sources acoustic parameters and the noise exposure in work environments³. On the contrary the aim of the study was to investigate the noisiness inside premises in order to describe it in a accurate way.

A. Premises categories

The night entertainment activities are represented by different kinds of premises: pubs, disco-pubs, discothèques, live concerts... In the study the various premises of musical entertainment in Aosta Valley region have been classified as follows:

1) Pub: little premise with small tables, music generally spread from electro-acoustic system. In this kind of premise music has listening purposes. The music can be rock, folk or disco-music.

2) Discothèque and Discopub: large club with dance floor and few tables. In this kind of premise the music is played by a disk-jockey and people can dance.

3) Removeable discothèque: type of entertainment that carries out in removeable structures with wood pavement and oilcloth cover. The structure of this kind of premise cannot be considered closed: it is opened on more sides in order to facilitate a better aeration.

4) Removeable dancing: it is carried out in the same removeable discothèque structure. The difference from the removeable discothèque is the music: in the dancing the music is waltz dance, Latin American dance and '60 - '70 music and it is always played by an orchestra. This kind of activity is very diffuse in Aosta Valley region in festivals and festivities events.

5) Live concerts: type of entertainment performed in the open air or in great squares purposely equipped.

In Figure 1 the distribution of number of premises involved in the measurements campaign, partitioned by kind, is represented.

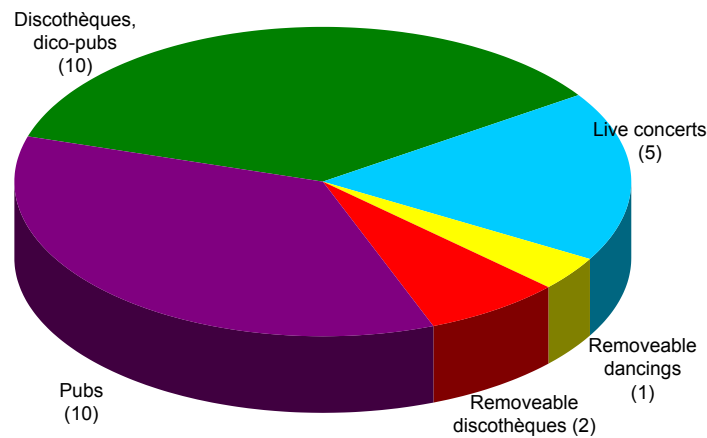


Figure 1: Number of premises partitioned by type.

B. Measurements method

In Italy the specific legislation that indicates limits, measurements method and instructions for the dancing premises is the Decree n° 215/1999⁴. The decree indicates a measurement procedure particularly complex requiring interferences on the normal premises activities.

For the measurements campaign discussed in this paper an unusual but original operating methodology has been planned. One of the purposes was to allow the execution of the measurements by an operator indistinguishable from the other premises visitors. It has been necessary to make the presence of the instruments imperceptible. The instruments used in the measurements campaign were individual dose meters: their small dimensions allowed to wear them and to hide them to the visitors and, overall, to the premises staff. The technicians wearing dosimeters behaved exactly as all premises visitors during a period from 1 hour to 3 hours.

C. Data analysis

The dosimeters used during the campaign registered the time history for each measurement: this allows to make several analysis on all the memorized data.

The first analysis was performed on the basis of the usual LAeq parameter, that is the level directly supplied by the dosimeters. Further investigations involve other parameters introduced by the European directive 2003/10/CE concerning workers noise exposure.

In this directive the concept that the noise level doesn't define by itself the entity of the risk is introduced: the combination between sound intensity and duration of the sound emission represents the exposure.

The directive fixes 80 and 85 dB(A) levels as attention thresholds and 87(A) dB level as a danger threshold: those levels are to be considered as daily exposure levels, referred to 8 hours.

Those levels are fixed recognizing that:

- a 80 dBA or inferior exposure level does not increase the risk;
- an exposure to noise levels between 80 and 85 dBA can increase the risk;
- an exposure to levels higher than 85 dBA increases the risk.

The Daily Exposure Level (LEX,8h) is an equivalent level (average level) reported to a 8 hours working day, or to a 40 hours working week. For a musical entertainment premise visitor it is not possible to assume a similar exposure duration. For each premises, a 3 hours permanence was assumed; the other 5 hours were supposed characterized by negligible noisiness exposure.

An alternative and much expressive way to indicate the noise exposure is the Dose. The Dose represents the time during which a person is exposed to a potentially dangerous noise: 0% dose represents no exposure and a 100% dose represents complete exposure.

In the calculation the 87 dB(A) level, supplied by the Directive 2003/10/EC, has been considered as the reference level: a 87 dB(A) exposure, reported to 8 hours (or to a week), will involve a 100% reference value dose. The exposure to a double sound power intensity (90 dBA) will involve a 200% dose, and so on.

The daily personal exposure level (LEX,8h) has been calculated with the following formula:

$$LEX_{,8h} = L_{AEQ,Te} + .0 \text{ Log}_{10} \left(\frac{Te}{T_0} \right) \quad \text{dBA} \quad (1)$$

Where:

LEX,8h is the daily personal noise exposure level of a premise visitor, expressed in dB(A)

$L_{AEQ,Te}$ is the average equivalent level

Te (measurement period) is the daily personal exposure period, in our case 3h

T_0 is the normalization period corresponding to the 8 working hours

The Dose, percentage of time during which a person is exposed to a potentially dangerous noise level, has been calculated with the following formula:

$$DOSE = 100 \frac{Te}{T_0} \cdot 10^{\left[\frac{L_{AEQ,Te} - L_c}{q} \right]} \quad \text{dBA} \quad (2)$$

Where:

T_0 is the normalization period corresponding to the 8 daily working hours or to the 40 weekly working hours

Te is the variable period of a visitor personal exposure

$L_{AEQ,Te}$ is the average equivalent level

L_c is the criterion level or the sound level producing a 100% dose; the current Italian legislation criterion level is 87 dB(A)

q is the exchange rate constant (=10)

D. Results

The levels measured inside the various visited premises are undoubtedly high. The equivalent levels (LAeq) distribution, split in 5 dB classes and involving all the measurements data, is illustrated in Figure 2.

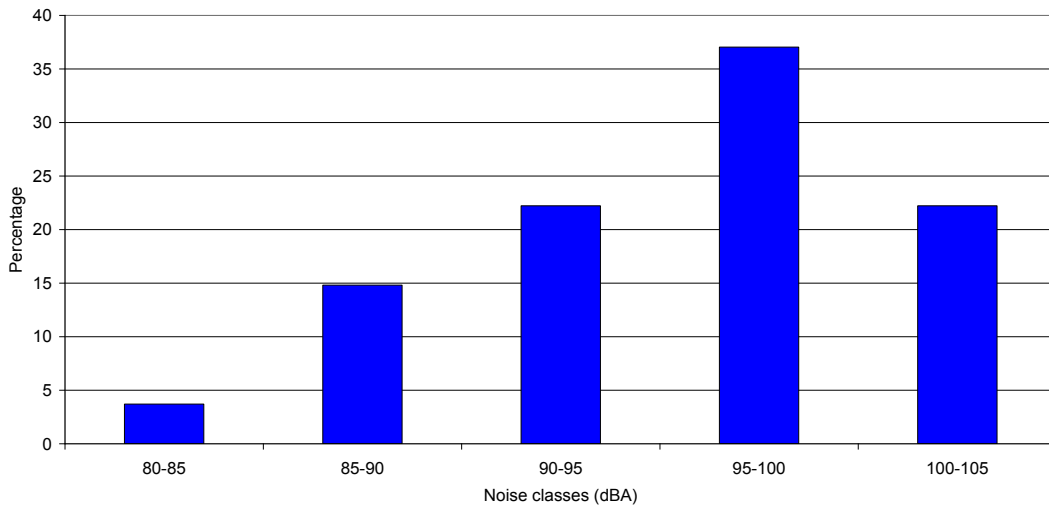


Figure 2: Percentage of noise levels, measured inside the premises, split in 5 dB classes.

It is important to observe that the type of diffused music, especially in the discothèques, can contain many low frequencies components that are not adequately quantified by A weighted measurements. In these cases the use of the C weighting curve could be more appropriate. Previous studies² showed that for this kind of music the C weighed level is about 8 dB higher than the A weighed level.

Further analysis could be performed comparing noise levels distributions in the different premises types. An example is illustrated in Figure 3.

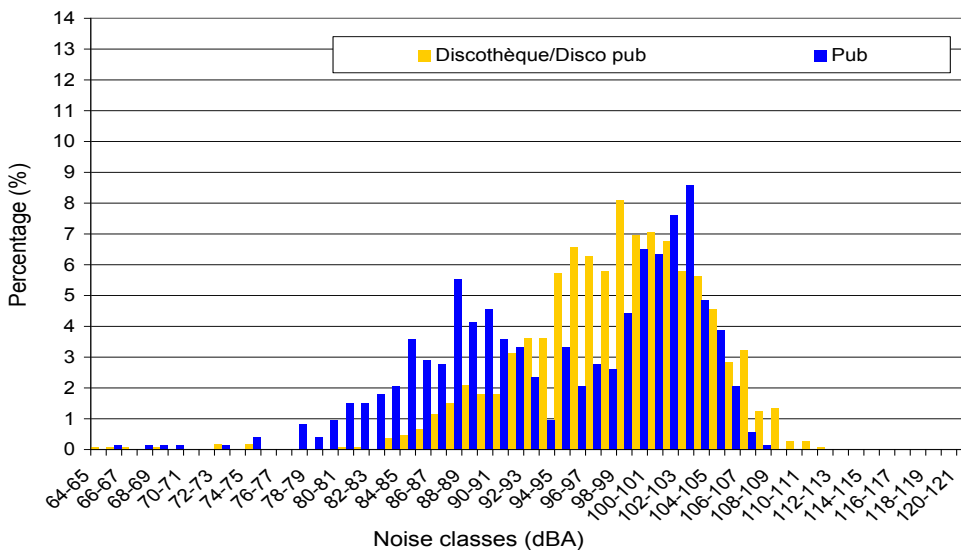


Figure 3: Noise level distribution measured inside the premises: comparison between the discothèque-discopub case and the pub one.

The figure points out the difference between two kind of the most representative music entertainment premises, discothèques/disco-pubs and pubs. The curious pubs levels distribution is due to the more various music types played in those kind of premises: folk music in the earliest hours and disco/rock music later in the night.

In Table 1 the average sound levels measured during the campaign, the matching daily personal exposure levels and the daily Dose are resumed.

Table 1: Personal daily exposure levels (Leq, LEX,8h and percentage dose) with 3 hours time exposure

Premise type	Average LAeq dB(A)	Daily LEX,8h dB(A)	Daily Dose Rif. 87 dB(A)
Pubs	98.9	94.7	588%
Discothèques / Disco-pubs	98.5	94.2	530%
Removeable discothèques	101.3	97.0	1002%
Removeable dancings	94.4	90.1	206%
Live concerts	96.9	92.6	366%

The data show that a 3 hours period in a pub produces a dose greater than the workers reference value.

The data of Table 1 refer to a single day and they do not take into account the habits of the premises visitors. To make the noise exposure evaluation more realistic, various scenarios have been imagined. For each of them, the dose and exposure esteem have been carried out. In this case the reference period is 40 hours, reproducing the weekly work duration.

The results are shown in Table 2.

Table 2: Personal weekly exposure levels (LEX,8h and percentage dose)

Weekly scenario	Weekly LEX,8h (40h) dB(A)	Weekly Dose with reference to 87 dB(A)
3 hours in pub 3 hours in discothèque	90.5	224%
4 hours in pub 2 hours of live concerts 3 hours in discothèque	91.9	312%
6 hours in pub 3 hours in removeable discothèque 4 hours in removeable dancing	93.9	490.8%

The conceived scenarios produce dose data significantly over the reference levels.

4 NOISE COMPLAINTS

A different type of analysis can be performed on the basis of the number of complaints received by people living in the surroundings of the music entertainment premises.

The objective of this kind of investigation is to quantify the number of complaints due to the musical entertainment activities and their distribution on the territory.

A. Premises involved in the analysis

The complaints data analysis involves all the premises representing meeting points and not only night and music entertainment premises: restaurants and bars are so included in the study.

The complaints coming from those activities are due not exclusively by the high music sound levels but also by the noise produced by visitors themselves.

Moreover it is correct to point out that live concerts and other temporary activities are not involved in the analysis, because their brief duration doesn't allow formal complaints.

B. Analysis method

The number of the complaints forwarded to the Aosta Valley Environmental Protection Agency during the last 17 years, from 1992 to June 2009, were elaborated⁶⁻⁷ following this method:

- the noise complaints data were organized by source type. This arrangement indicates a significant annoyance due to the musical entertainment activities;
- the number of complaints, taking into account only those related to the musical entertainment activities, was split in two periods, according to the tourist feature of the Aosta Valley region: high season (winter and summer) and low season (spring and autumn). The analysis also took into account the noise complaints territorial distribution;
- the Italian law limits overcomings, involving exclusively the musical entertainment activities, were also analysed.

C. Noise complaints data

In Figure 5 the number of noise complaints, involving all noise sources forwarded to the Aosta Valley ARPA since 1992 to June 2009, is reported.

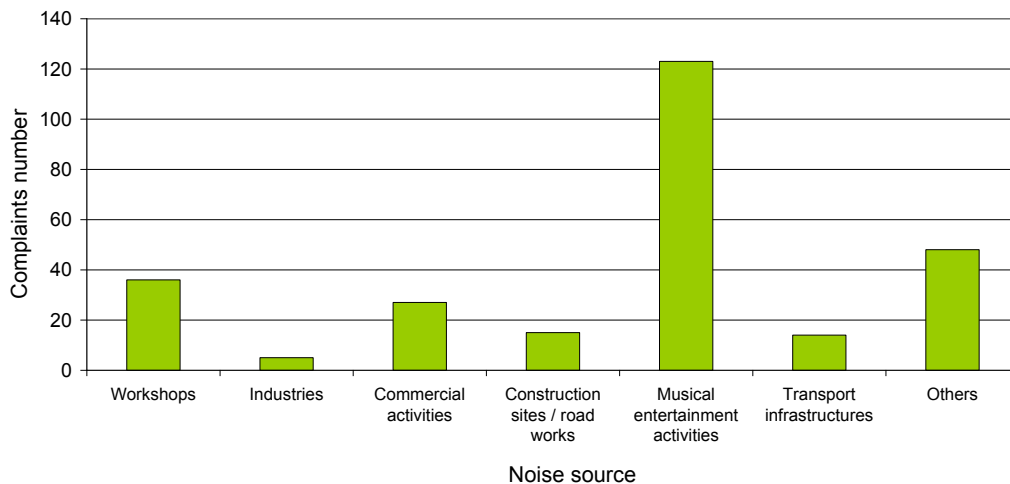


Figure 4: Number of noise complaints delivered since 1992 until June 2009

Figure 4 shows how much the music entertainment premises affects the number of the noise complaints received by the Aosta Valley Environmental Protection Agency. They represent about the half of the total amount of the complaints (46 %).

On the basis of the complaints data, further analysis were performed to investigate spatial/territorial and seasonal distribution. The aim of this further analysis was to understand if the noise complaints number varies according to the more or less tourist features of the Aosta Valley region.

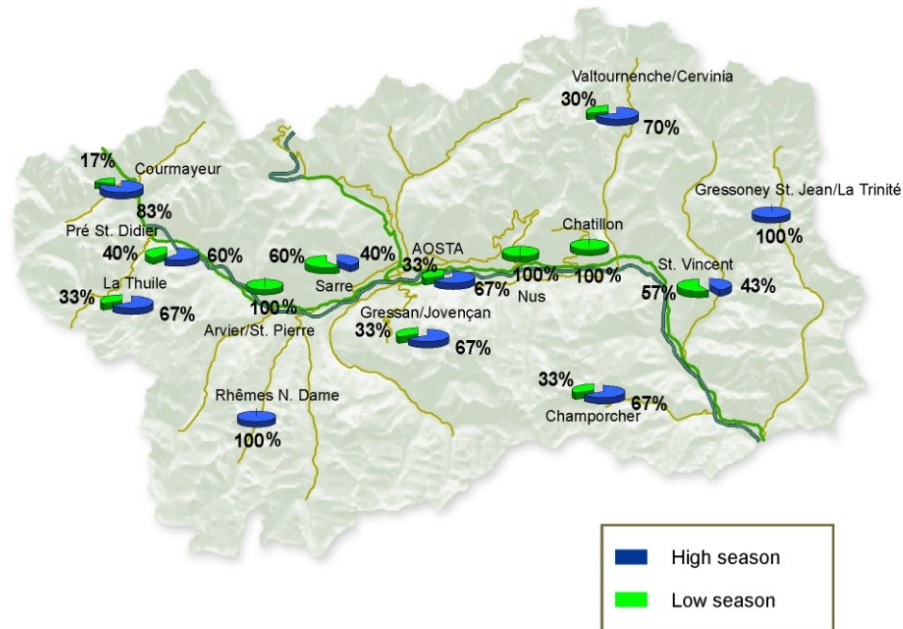


Figure 5: Territorial and seasonal noise complaints distribution with reference to the music entertainment premises

Aosta Valley has the peculiar characteristics of an alpine region, where spaces are constrained by important morphologic barriers. Besides the tourist feature of the area produces nearness between entertainment noisy premises and residential buildings. Therefore the noise complaints converge in tourist seasons and in resorts that attract a great number of tourist visitors.

Following the noise complaints, investigations and measurements were performed to verify Italian law limits overcomings⁸.

The results of the evaluations involving exclusively the musical entertainment activities are resumed in Figure 6: the complaints are often a sign of a law limits overcoming.

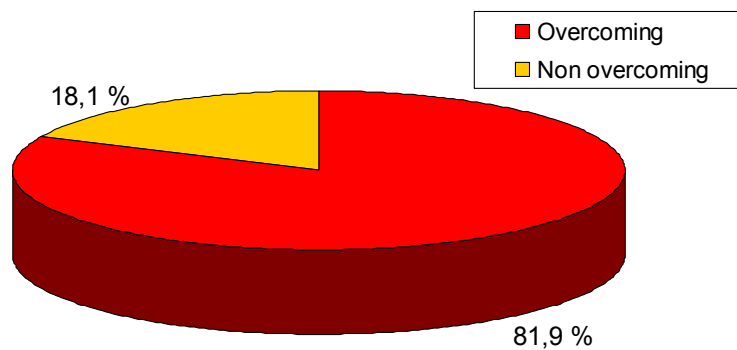


Figure 6: Overcomings following musical entertainment premises inspections since 1992 until June 2009

5 CONCLUSIONS

Also considering that the music is not simply uncontrolled mechanical energy dissipation and that it is searched by the visitors of night premises, it is necessary to become conscious on the risks that the high noise levels exposure could produce.

The dancing entertainment premises legislation is already going to this direction. It would be suitable to expand this attention to all the music entertainment domains, not only for the aspects that concern workers protection but also taking into account visitors risks.

Moreover, an uncontrolled music diffusion could cause annoyance outside the premises themselves, as the data discussed in the second part of the paper confirm.

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