

# Noise exposure in entertainment venues: the case of pubs and bars in Hong Kong SAR, China

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**Abstract:** Many city dwellers like to enjoy the happy moments in entertainment venues such as pubs and bars. However, they are exposed to an environment that may cause health hazards. It is because people are exposed to mood lighting, second-hand smoke, and high noise levels when they stay in pubs and bars. This paper reviews the extant literature on noise in pubs and bars. Noise measurements were performed in six pubs and bars in Hong Kong SAR, China. The analyzed results show that  $L_{eq,10-min}$  noise levels ranged from 66.5 to 79.9 dB(A) during happy hours, i.e., between 17:00 and 21:00 and  $L_{eq,10-min}$  noise levels changed to 69.5 – 97.0 dB(A) during peak hours, i.e., between 22:00 and 23:30. The maximum noise levels  $L_{max}$  ranged from 78.5 to 96.5 dB(A) during happy hours and they changed to 80.9~107.8 dB(A) during peak hours. It was found that loudness in a pub/bar can be characterized by  $L_{eq,10-min}$  value while noisiness, i.e., background noise can be characterized by  $L_{10}$  value.

**Key words:** noise exposure; pubs and bars; Hong Kong

## 0 INTRODUCTION

People have a busy and hectic life in cities. Many of them have to rush back to their offices in the morning, try to finish their work during the day, and stay in their offices until they finish most of their work until 7:00, 8:00 or 9:00 pm. After that, some office workers will visit pubs, bars, nightclubs, and discotheques for a drink and/or food as well as having chance to meet with friends. Thus, entertainment venues such as pubs, bars, nightclubs, discotheques, etc., have important social functions in cities<sup>[1-2]</sup>. However, while pub/bar (or other hangout) patrons enjoy drinking, eating, and talking with friends in high spirits, sounds emanating from people talking, cheering, laughing, the impact of glassware, loudspeakers, or live bands affect the patrons themselves, service employees, as well as the nearby residents.

Lee<sup>[3]</sup> investigated noise exposure of 40 employees working in different positions such as waiters, bartenders, disc jockeys, cashiers, and security officers in five Singapore's discotheques. Lee<sup>[3]</sup> reported that all employees regardless of their positions were exposed to noise levels at least 89 dB(A)  $L_{eq}$  for their whole work shift. Twardella et al.<sup>[4]</sup> investigated noise levels in 20 discotheques in Bavaria, Germany. Twardella et al.<sup>[4]</sup> performed noise measurements between 11:00 pm and 2:00 am and found that mean noise level in terms of  $L_{eq,30-min}$  was 101.7 dB(A), exceeding the recommended limit of 100 dB(A) as sug-

gested by the Associations of German Discotheques and Disc Jockeys. Kelly et al.<sup>[5]</sup> studied occupational noise exposure of employees working in Ireland's nightclub bars. Kelly et al.<sup>[5]</sup> reported that nightclub bar employees normally worked 4.5 to 6 hours per night and were exposed to noise levels  $L_{eq}$  from 89.5 to 98.8 dB(A)  $L_{eq}$  (mean = 93.9 dB(A); SD = 2.6 dB(A)). Barlow and Castilla-Sanchez<sup>[6]</sup> studied occupational noise exposure of employees working in four UK's music venues. Barlow and Castilla-Sanchez<sup>[6]</sup> categorized employees to three groups-bar and catering staff, technical staff including sound engineers, and promotional/security staff. Barlow and Castilla-Sanchez<sup>[6]</sup> reported that most employees worked 3 to 7 hours per shift and were exposed to noise levels  $L_{eq}$ : 74.9 to 99 dB(A) (mean = 89.6 dB(A); SD = 6.7 dB(A)) for bar and catering staff, 86.3 to 100.6 dB(A) (mean = 94.6 dB(A); SD = 4.4 dB(A)) for technical staff, and 74.4 to 96.4 dB(A) (mean = 88.9 dB(A); SD = 9.2 dB(A)) for promotional/security staff. Specifically, Twardella et al.<sup>[4]</sup> and Kelly et al.<sup>[5]</sup> reported that the measured noise level  $L_{eq}$  in a discotheque was observed to rise with time.

Sadhra et al.<sup>[7]</sup> studied occupational noise exposure among student employees working in UK's university entertainment venues. Sadhra et al.<sup>[7]</sup> reported that student employees were exposed to noise levels  $L_{eq,6-hr+}$  from 82.6 to 95.2 dB(A) in a bar with background music, from 92.9 to 103.7 dB(A) in a discotheque with a bar, and from 86.6 to 101.7 dB(A) in a discotheque without a bar. Smeatham<sup>[8]</sup> conducted a literature review on noise levels and noise exposure of workers in pubs, bars, night clubs, and discos in 2002.

Based on the literature on entertainment noise published between 1985 and 1999, Smeathan<sup>[8]</sup> summarized that the measured noise levels in these entertainment venues ranged from 73 to 113 dB(A) while average employees' daily personal noise exposure levels  $L_{EP,d}$  was 92.3 dB(A) (SD = 4.2 dB(A); the number of sample,  $n = 204$ ) for bar employees, 92.9 dB(A) (SD = 4.2 dB(A);  $n = 32$ ) for floor staff, 96.2 dB(A) for security personnel (SD = 3.2 dB(A);  $n = 10$ ), and 96.3 dB(A) (SD = 4.8 dB(A);  $n = 53$ ) for disc jockeys. Even taking the casual nature of this form of employment into consideration, there was a significant potential for bar/club employees to incur some level of hearing loss<sup>[8-9]</sup>. Edwards and Gustafsson<sup>[10]</sup> indicated that the measured noise levels in eating establishments generally exceed noise criteria and occupational noise guidelines. Edwards and Gustafsson<sup>[10]</sup> suggested that the average noise level in pubs was about 83.1 dB(A) (SD = 8.29 dB(A)). Lawrence and Turrentine<sup>[11]</sup> conducted noise measurements in 8 bars in the U.S. Noise samples were collected by two researchers using personal noise dosimeters from 10:00 pm to 2:00 am on Friday and Saturday nights. Lawrence and Turrentine<sup>[11]</sup> reported that noise levels  $L_{eq,4-hr}$  ranged from 85.9 to 91.9 dB(A) (mean = 88.2 dB(A); SD = 2.4 dB(A)). Beach et al.<sup>[12]</sup> studied leisure noise exposure in Australia. Noise measurements were collected by volunteers who visited entertainment venues such as pubs, bars, nightclubs, etc., and arts and cultural activities such as music concerts, theatre, drama, dance, movies, etc. Beach et al.<sup>[12]</sup> reported that mean noise level  $L_{eq}$  was found to be 83.8 dB(A) for pubs/bars – no live music (SD = 6.5 dB(A);  $n = 30$ ), 93.4 dB(A) for pubs/bars – with live music (SD = 7.1 dB(A);  $n = 5$ ), and 97.3 dB(A) for nightclubs (SD = 5.1 dB(A);  $n = 12$ ). Mean noise level  $L_{eq}$  was found to be 84.7 dB(A) for classical music concerts (SD = 3.7 dB(A);  $n = 11$ ), 95.9 dB(A) for popular music concerts (SD = 6.4 dB(A);  $n = 10$ ), and 74.9 dB(A) for movies (SD = 4.3 dB(A);  $n = 12$ ). In Hong Kong, noise measurements were conducted at three bars during peak hours. The service area of the three selected bars ranged from 600 to 1 600 m<sup>2</sup>. It was found that the measured noise level in terms of  $L_{eq}$  ranged from 72 to 79 dB(A) but the measured  $L_{max}$  value ranged from 89 to 97 dB(A)<sup>[13]</sup>.

With respect to noise from entertainment venues affecting neighbors, the Health Council of the Netherlands<sup>[14]</sup> reported that 342 out of the 1 265 noise complaints filed to a problem desk at night in the Rijnmond area in 2003 were related to noises from bars,

clubs, and events. Huttenmoser<sup>[15]</sup> conducted a questionnaire survey on the annoyance of leisure noise in a Swiss city. 59 percent of the 352 respondents in that Swiss city indicated that leisure noise prevented them from falling asleep, and 46 percent of the respondents mentioned that leisure noise awoke them at midnight<sup>[15-16]</sup>. In the UK, about 10 percent of its population, i.e., 6 million are bothered by noise from pubs, clubs, or entertainment venues<sup>[17]</sup>. Noise levels at nearby residents depends on sound power of the source, i.e., an opening/open area of the pub or bar, distance from the concerned pub or bar, reflections from other hard surfaces, and absorption of surfaces and other objects. Hence, the measured noise levels due to sound emanating from pubs and bars will be site specific. Gosling<sup>[18]</sup> investigated the noise emanating from Eden Nightclub, Bournemouth, in the UK. Gosling<sup>[18]</sup> performed noise level measurements at nearby residential premises at about 35~65 m from the nightclub at night. The measured noise levels  $L_{eq}$  at the exterior of a bedroom ranged from 57 to 65 dB(A) between 11:00 pm and 3:00 am, occasionally increasing up to over 70 dB(A) during the monitoring measurement period<sup>[18]</sup>. In Asia, many bars and pubs have been opened in the past four decades when Asian countries/cities have transformed from a manufacturing and production-based economy to a finance-, commerce- and/or tourism-based economy<sup>[19-20]</sup>. Many bars and pubs open from 6:00 pm to 2:00 am, i.e., 8 hours a day and overnight. Inevitably, noise becomes one of the main concerns of local communities. For example, there were 8 500 noise complaints file to different government departments in Macao in 2016. Among these 8 500 complaints, 4 971 of them were related to people conversation, shouting, music and karaoke, excluding from those emanating from other residential premises or neighbors<sup>[21]</sup>. Many noise complaints were filed at night due to activities in local bars and pubs. In Hong Kong, most bars and pubs are located at Central and Western District, Wan Chai District, and Yau Tsim Mong District. The government statistics showed that there were about 250 and 76 complaints on noise from bars and pubs filed to the Hong Kong Police and Hong Kong Environmental Protection Department in 2010<sup>[22]</sup>. The number of noise complaints caused by activities in bars and pubs at Central and Western District alone (and filed to the Hong Kong Police) increased sharply to 338, 598, and 499 in 2013, 2014, and 2015 respectively<sup>[23]</sup>. The China Ministry of Environmental Protection of China indicated that over 51 000 complaints relating to en-

ertainment noises such as noise from bars, pubs, karaoke, etc., were filed to provincial environmental protection bureaus in 2016<sup>[24]</sup>.

So, how noisy are pubs and bars in Hong Kong? Will the exposure to noise in pubs and bars impose health hazards to patrons and employees? Will the noise emanating from bars and pubs adversely affect neighborhood residents? Hence, the objective of this paper is to answer these important questions by performing noise measurements in a number of typical pubs and bars in Hong Kong.

## 1 METHOD

### 1.1 Selection of measurement sites

There are several hundred complaints on noise emanating from pubs and bars in Hong Kong. In order to have a clear picture about the severity of this noise issue, noise measurements were performed in six pubs and bars. Two pubs/bars were located in Central and Western District. Two pubs/bars were located in Wan Chai District, and two pubs/bars were located in Yau Tsim Mong District. One of these six pubs and bars was a very small bar with a floor area of 20 m<sup>2</sup>. The rest of them had a floor area ranging from 72 to 264 m<sup>2</sup>. Five pubs and bars had background music and the remaining one turned on the television during our noise measurements. Table 1 presents the characteristics of the six selected pubs and bars.

### 1.2 Noise measurements




Noise levels were measured in the six selected pubs and bars during normal weekdays in November 2017–January 2018. Noise measurements were conducted between 5:00 pm and 9:00 pm to characterize noise levels in pubs and bars during happy hours and between 10:00 pm and 11:30 pm during peak hours. Our researchers visited the selected pubs and bars as customers and they were fitted with personal noise dosimeters (soundB(A)dge, the UK). All noise dosimeters were compiled with IEC 61252:1993 Class 2 Personal Sound Exposure Meter. They had a frequency range of 20 Hz to 20 kHz and sound level operating range from 55–140 dB(A) SPL/120–143 dB Cpk. Each of noise dosimeters was calibrated by an acoustic calibrator at 94 dB(A) before and after each noise measurement. The difference between the calibrated levels was always below 0.5 dB(A). The collected noise records were analyzed using soundView software.

## 2 RESULTS

### 2.1 Noise levels during happy hours

The equivalent continuous sound level for 10-minute,  $L_{eq,10-min}$ , was recorded to determine the noise exposure of a patron for a drink who experienced roughly three different songs in a pub or bar. As

**Table 1 Noise monitoring sites in Hong Kong**

| District                        | Pub/Bar<br>(code number) | Characteristics:<br>Floor area x height | Location  | Photo (example)   |
|---------------------------------|--------------------------|---|---|---|
| Central and<br>Western District | CW01-TK                  | 20 m <sup>2</sup> ×5 m                  | On-street shop; 11 pubs<br>and bars in the vicinity.                        |  |
|                                 | CW02-HRC                 | 360 m <sup>2</sup> ×3 m                 | Bar on the ground floor of<br>a hotel; 11 pubs and bars in<br>the vicinity. | (CW02-HRC)  |
| Wan Chai<br>District            | WC01-ST                  | 264 m <sup>2</sup> ×5 m                 | On-street shop; 7 pubs and<br>bars in the vicinity.                         |  |
|                                 | WC02-ABL                 | 72 m <sup>2</sup> ×6 m                  | Bar on the mezzanine floor<br>of a hotel. No pubs and<br>bars nearby.       | (WC02-ABL)  |
| Yau Tsim Mong<br>District       | YTM01-RO                 | 120 m <sup>2</sup> ×3 m                 | Bar on the ground floor of<br>a hotel. No pubs and bars<br>in the vicinity. |  |
|                                 | YTM02-BTP                | 100 m <sup>2</sup> ×5 m                 | On-street shop; 8 pubs and<br>bars in the vicinity.                         | (YTM02-BTP)   |

noise in pubs and bars is non-stationary in nature, we also determined statistical noise levels such as the maximum noise level ( $L_{max}$ ), the minimum noise level ( $L_{min}$ ), and the 90<sup>th</sup> percentile-exceeding level ( $L_{90}$ ). It should be noted that  $L_{90}$  is frequently taken as the background noise level in noise assessment and monitoring [25]. Table 2 shows the measured noise levels in the six selected pubs and bars during happy hours. It illustrates that the measured noise levels in terms of  $L_{eq,10-min}$  ranged from 66.5 to 79.9 dB(A) while the measured  $L_{max}$  values ranged from 78.5 to 96.5 dB(A) during the measurement periods. Background noise levels of these pubs and bars,  $L_{90}$ , ranged from 61.5 to 75.0 dB(A). Figure 1 shows the short-term noise levels measured at 1-s intervals in the six selected pubs and bars during happy hours. It demonstrates that noise levels varied rapidly due to speeches, music, and other background sounds.

Figure 2 shows the probability distributions of short-term noise levels measured at 1-s intervals in two of the six selected pubs and bars, WC02-ABL in which patrons' speeches were very noticeable during happy hours and YTM01-RO in which classical music

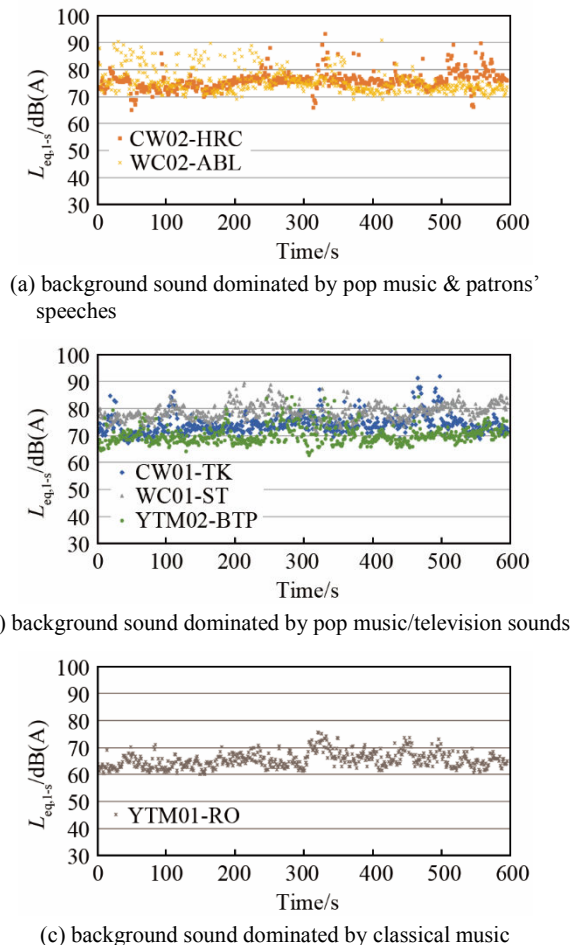


Fig.1 Short-term noise levels ( $L_{eq,1-s}$ ) in the six selected pubs and bars during happy hours

dominated the soundscape of this pub/bar. Figure 2(a) shows that there was a peak at around 78 dB(A) and it was characterized by  $L_{eq,10-min}$  as shown in Table 2 while background noise, i.e., 'noise floor' was 71 dB(A) and it was characterized by  $L_{90}$  as shown in Table 2. Figure 2(b) indicates that background noise was 61.5 dB(A) in YTM01-RO – very close to  $L_{90}$  value of this pub/bar as shown in Table 2.

2.2 Noise levels during peak hours

Table 3 shows the measured noise levels in the six selected pubs and bars during peak hours. It illustrates that the measured noise levels in terms of  $L_{eq,10-min}$  ranged from 69.5 to 97.0 dB(A) while the measured  $L_{max}$  values ranged from 80.9 to 107.8 dB(A) during the measurement periods, covering the measured noise levels reported in a previous study-commissioned by the HK Environmental Protection Department [13]. Background noise levels of these pubs and bars,  $L_{90}$ , ranged from 64.4 to 82.2 dB(A). Figure 3 shows the short-term noise levels measured at 1-s intervals in the six selected pubs and bars during happy hours and peak hours. Again, it demonstrates that noise levels varied rapidly due to speeches, music, and other background sounds.

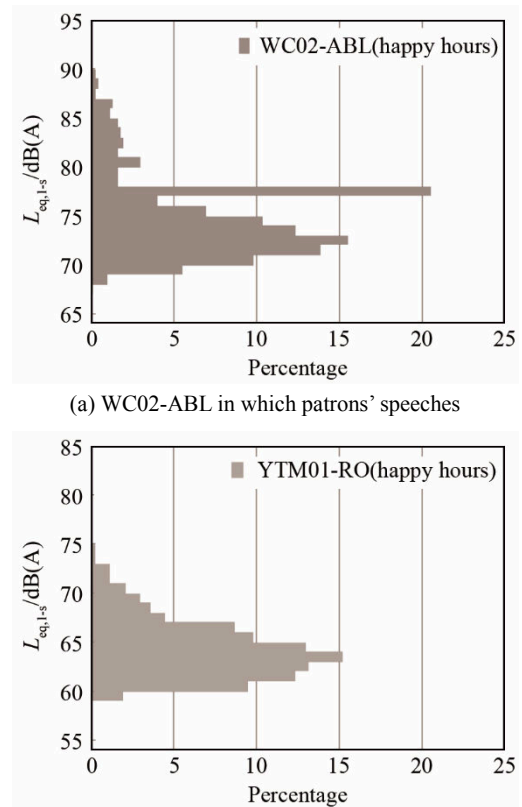


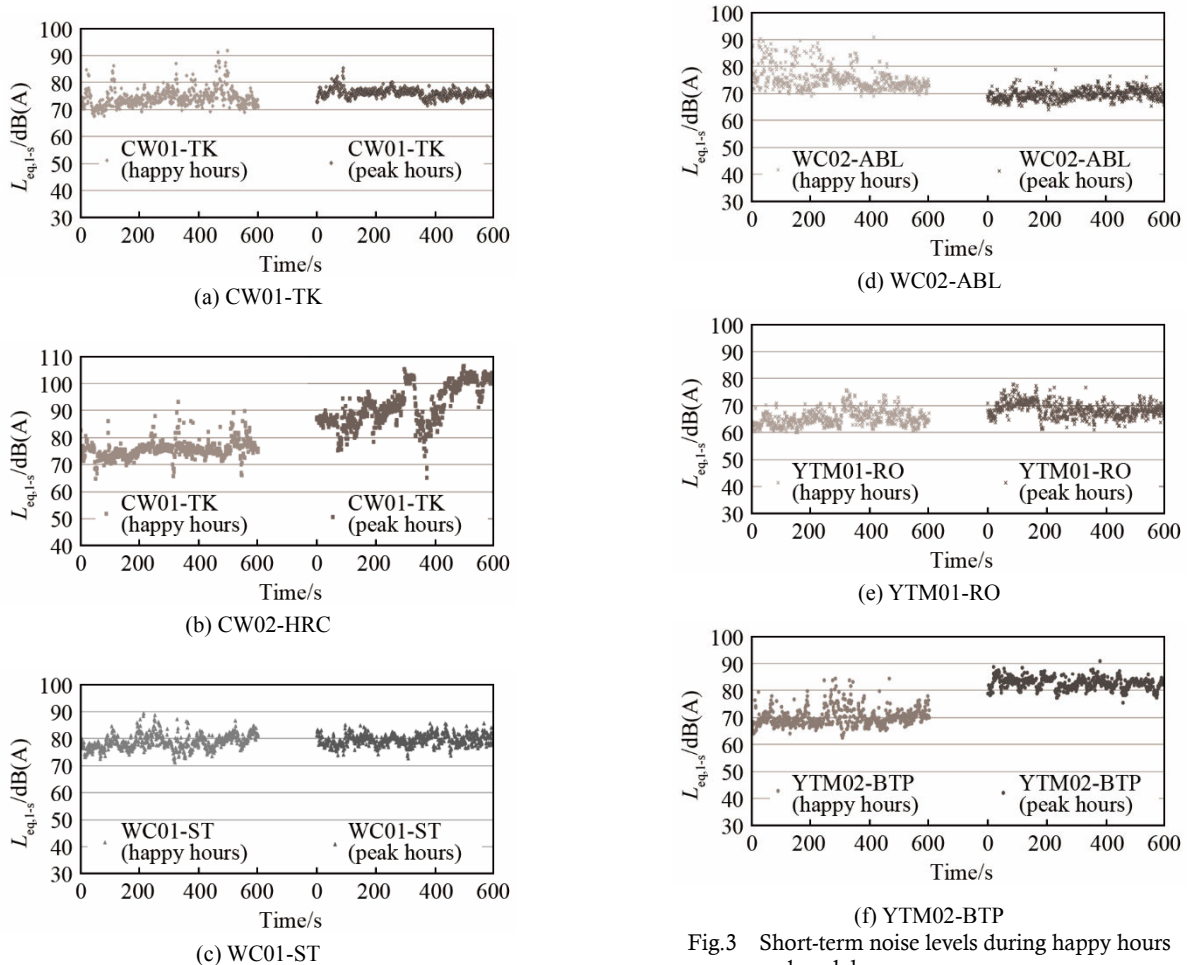
Fig.2 Probability distributions of short-term noise levels ( $L_{eq,1-s}$ )

**Table 2 Measured noise levels in the six selected pubs and bars during happy hours**

| District                     | Pub/Bar<br>(Code number) | Dominant sound source<br>during measurement | Noise Levels/dB(A) |           |          |           |
|------------------------------|--------------------------|---|--------------------|-----------|----------|-----------|
|                              |                          |   | $L_{eq,10-min}$    | $L_{max}$ | $L_{90}$ | $L_{min}$ |
| Central and Western District | CW01-TK                  | Pop music                                   | 76.7               | 94.8      | 70.2     | 66.6      |
|                              | CW02-HRC                 | Pop music, patrons' speeches                | 77.5               | 96.5      | 72.0     | 63.5      |
| Wan Chai District            | WC01-ST                  | Pop music                                   | 79.9               | 94.2      | 75.0     | 70.0      |
|                              | WC02-ABL                 | Patrons' speeches                           | 78.6               | 94.2      | 71.0     | 66.8      |
| Yau Tsim Mong District       | YTM01-RO                 | Classical music                             | 66.5               | 78.5      | 61.5     | 59.0      |
|                              | YTM02-BTP                | Television broadcasting                     | 72.1               | 87.8      | 66.2     | 60.1      |

**Table 3 Measured noise levels in the six selected pubs and bars during peak hours**

| District                     | Pub/Bar<br>(Code number) | Dominant sound source<br>during measurement | Noise Levels/dB(A) |           |          |           |
|------------------------------|--------------------------|---|--------------------|-----------|----------|-----------|
|                              |                          |   | $L_{eq,10-min}$    | $L_{max}$ | $L_{90}$ | $L_{min}$ |
| Central and Western District | CW01-TK                  | Pop music                                   | 76.5               | 87.8      | 73.9     | 71.0      |
|                              | CW02-HRC                 | Pop music, patrons' speeches                | 97.0               | 107.8     | 82.2     | 64.0      |
| Wan Chai District            | WC01-ST                  | Pop music                                   | 80.1               | 88.2      | 76.4     | 71.4      |
|                              | WC02-ABL                 | Pop music                                   | 70.0               | 82.6      | 66.7     | 61.8      |
| Yau Tsim Mong District       | YTM01-RO                 | Classical music                             | 69.5               | 80.9      | 64.4     | 58.8      |
|                              | YTM02-BTP                | Television broadcasting                     | 83.2               | 92.3      | 79.5     | 72.2      |



**Fig.3 Short-term noise levels during happy hours and peak hours**

Specifically, the measured noise levels in terms of  $L_{eq,10-min}$ ,  $L_{max}$ , and  $L_{90}$  during peak hours were higher than that during happy hours in three pubs and bars: CW02-HRC, YTM01-RO, and YTM02-BTP. In another two pubs/bars, CW01-TK and WC01-ST, the difference between the measured noise levels  $L_{eq,10-min}$  during happy hours and that during peak hours was only 0.2 dB(A). However, background noise levels  $L_{90}$  in these two pubs/bars increased by 3.4 dB(A) and 1.5 dB(A), respectively during peak hours. Nevertheless, the measured noise levels during peak hours were lower than that during happy hours in WC02-ABL.

Figure 4 shows the probability distributions of short-term noise levels measured at 1-s intervals in YTM01-RO during happy hours and peak hours. Figure 4(a) shows that background noise was about 61 dB(A) during happy hours while Figure 4(b) shows that background noise level changed to 64 dB(A) during peak hours. Both values were identified by  $L_{90}$  in Tables 2 and 3, respectively.

A number of dependent  $t$ -tests for pair samples were performed to examine whether there were significant differences between the measured noise levels during happy hours and that during peak hours. It was

found that there were no significant differences between the measured noise levels in terms of  $L_{eq,10-min}$ ,  $L_{max}$ ,  $L_{90}$  and  $L_{min}$  during happy hours and that during peak hours.

### 3 CONCLUSION

Noise in pubs and clubs can be one of the major health hazards in cities. Although smoking has been banned in all public indoor areas including pubs, bars, and other entertainment venues since 1 January 2007 in Hong Kong, high noise levels in pubs and bars have yet to be properly monitored and effectively mitigated. This paper explores noise exposure in bars and pubs and investigates its potential impact on customers and pub/bar employees. Based on noise measurements in six pubs and bars at three popular nightlife districts in Hong Kong, it was found that noise levels in terms of  $L_{eq,10-min}$  in pubs and bars ranged from 66.5 to 79.9 dB(A) during happy hours. Noise levels ( $L_{eq,10-min}$ ) in pubs and bars changed to 69.5 to 97.0 dB(A) during peak hours. Besides, the maximum noise levels  $L_{max}$  ranged from 78.5 dB(A) to 96.5 dB(A) during happy hours and  $L_{max}$  values ranged from 80.9 to 107.8 dB(A) during peak hours. Among the six-selected pubs and bars, background noise levels  $L_{90}$  tend to increase from happy hours to peak hours in five selected pubs and bars. This finding is similar to the ones reported by Twardella et al. [4] and Kelly et al [5]. Noise measurements show that the continuous equivalent noise levels  $L_{eq,10-min}$  in the six-selected pubs and bars were all below 85 dB(A) during happy hours, and the continuous equivalent noise levels  $L_{eq,10-min}$  in five out of these six pubs and bars were all below 85 dB(A) during peak hours. Hence, noise exposure in these pubs and bars (except CW02-HRC) will unlikely cause hearing losses alone to customers. Hong Kong's bartenders normally work 8 hours a day and 5 days a week. Bartenders and other service employees are exposed to below a daily noise exposure level  $L_{EP,d}$  85 dB(A) in five pubs and bars. However,  $L_{eq,10-min}$  in CW02-HRC during peak hours was found to be 97.0 dB(A), meaning that a person should not be exposed to such high noise level for more than half an hour a day. Hence, the owner, bartenders, and service employees should find ways to reduce noise levels during its peak hours in this particular pub/bar. Otherwise, employee well-being may suffer.

Moreover, the maximum noise levels  $L_{max}$  in pubs and bars can cause environmental nuisances because at certain times their values reached 94 dB(A)

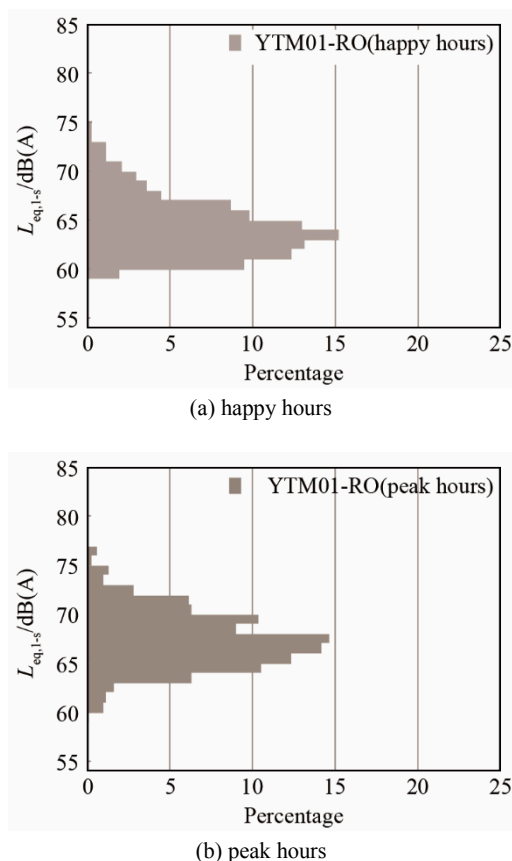


Fig.4 Probability distributions of short-term noise levels ( $L_{eq,1-s}$ ) in YTM01-RO

or more in those pubs and bars in Central and Western District, and Wan Chai District.

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## 娱乐场所的噪声——香港酒吧的情况

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**摘要:** 许多城市居民喜欢在酒吧等娱乐场所享受快乐时光。但是, 他们暴露在可能造成健康危害的娱乐场所环境中。这是因为人们逗留在酒吧时, 会受到昏暗的灯光、二手烟和高噪声的影响。回顾了有关酒吧噪声的文献, 并在香港的六家酒吧进行了噪声测量。分析结果显示, 在欢乐时间即在 5:00 pm 和 9:00 pm 之间, 酒吧声音水平( $L_{eq,10-min}$ ) 介于 66.5~79.9 dB(A)之间, 酒吧声音水平在繁忙时间即 10:00 pm 至 11:30 pm 介于 69.5~97.0 dB(A)之间。在欢乐时间, 最高噪声水平( $L_{max}$ ) 介于 78.5~96.5 dB(A)之间, 在繁忙时间介于 80.9~107.8 dB(A)之间。分析发现, 酒吧内的声音水平可以通过  $L_{eq,10-min}$  测量, 酒吧内的背景噪声则可以通过  $L_{90}$  测量。

**关键词:** 噪声; 酒吧; 中国香港

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