Resident evaluation of soccer and music concert noise near a soccer stadium

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ABSTRACT

Questionnaire surveys of soccer and concert noise were administered to residents near a stadium. Results show the following. 1) The degrees of noise annoyance and living disturbance are not significantly different for soccer and concert noise, although the noise level is reportedly higher for concerts. 2) Concert noise creates greater discomfort than soccer noise. 3) Noise annoyance is higher for residences with high resistance to noise. 4) The visibility of the stadium is not strongly related to noise annoyance. 5) Consideration of the park and the stadium when they selected the living area is not strongly related to the noise annoyance. 6) The relation between living disturbance and noise annoyance is similar for soccer and concert noise. 7) Soccer noise annoyance is lower for residents who like playing soccer. Concert noise annoyance is lower for residents who pass the park and who take a walk in the park.

INTRODUCTION

Large-scale popular music concerts attracting several tens of thousands of spectators have been held in Japan often during the last decade. They earn vast revenues and use large entertainment venues[1)]. Nagai Athletic Stadium in Osaka, an official FIFA soccer stadium that can accommodate 50 thousand spectators, has hosted more than 20 professional games annually since 1994 as the home stadium of a Japanese soccer league team: Serezo Osaka. It has also hosted a few popular music concerts since summer 2007.

Nagai Stadium located in Nagai park which area is about 70 hectares including the second stadium, a botanical garden, tennis courts, a Sumo court, a sports training center and a pool. Nagai Park was established in 1928 and area near the park was developed since 1950's as a good residential area. This study administered a questionnaire survey to residents near the stadium. The residents' evaluations of soccer and concert noise were compared. This study, comparing soccer noise and concert noise, was conducted to grasp 1) the actual conditions prevailing there, the degree of living disturbance attributable to the noise, and the relation between noise annoyance and living disturbances; 2) residential noise resistance and the appearance of the stadium from respective residences; and 3) consideration of Nagai Park when the residents selected their homes, their tastes and preferences for soccer and music, and their use of park in daily life.

METHOD

Surveyed residents

The surveyed area is the hatched area shown in Fig. 1. Effects of road traffic noise and railway noise are slight here. We visited 260 houses out of 300 detached houses in the area and asked residents to participate in the survey between December 2011 and January 2012. Among them, 72 families agreed to cooperate. Then 132 sheets were distributed; 102 of them were returned with appropriate responses. Two soccer games were held at the stadium during the period: semi-final and quarterfinal games of the All Japan Soccer Championship.

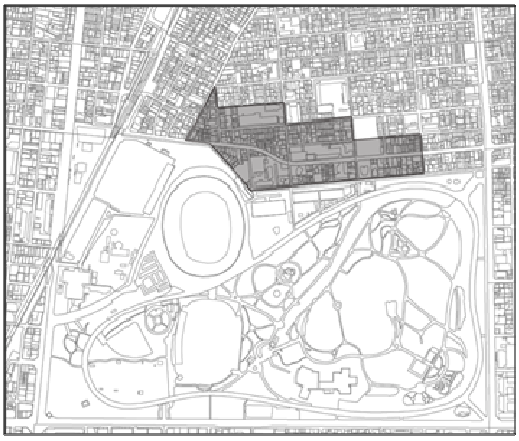


Figure 1: Surveyed Area

Which figure do you think the most appropriate to express the annoyance, disturbance and noisiness of the noise of soccer games you felt at home? (Circle the figure.)

← not feel 0 1 2 3 4 5 6 7 8 9 10 feel →

Figure 2: Scale of annoyance

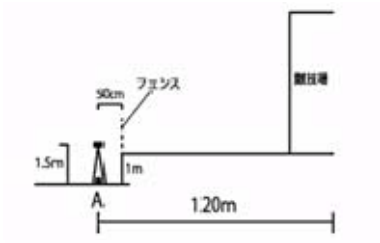


Figure 3: Measurement arrangement

Table 1: Surveyed items

item		Item(categories)
House		Stories Layout of house Housing area Garden area Possession Age Noise resistance(5) Window opening frequency(5) Visibility of stadium from house(4) Consideration of Nagai Park when selecting house(4)
RESPONDENT	Basic attributes	Sex Age(8) Living period Occupying hours (July-September)
	Taste of music	Annoying noise in house(10 items) Sensitivity to noise(4) Frequency of listening music(4) playing music(4) Frequency of singing with Karaoke(4) watching music program(4) Past concert in Nagai Stadium (announcement, attendant, place of hearing, preference of the artists)
	Taste of soccer	Preference of soccer {playing(4) watching(4)} Preference of Serezo Osaka team(4) Frequency of watching soccer on TV(4) Frequency of watching soccer game in Nagai Stadium and date in these three years
Evaluation of noise and vibration (Soccer and Concert)		Magnitude Estimation of noise/vibration Noise Impression(12 SD scales) Disturbance of conversation (4), telephone (4), TV (4), rest (4), sleep (4) Discomfort of closing windows caused by noise (4) Annoying noise (6 items for soccer, 5 items for concert) Discomfort of noise (4) Preference of noise (4) Measures against noise from Stadium (5 items)
Evaluation of Nagai Park		Frequency of visiting Nagai Park (5) Purpose of the visit (9items) Frequency of being annoyed by noises from Nagai Park(5) Time of the noise(6) Kind of the noise (5items)

Surveyed items

Table 1 shows the surveyed items. Magnitude estimations of noise and vibration on an 11 point scale are shown in Fig. 2. Responses reporting discomfort and preferences related to the noise, sound impressions and the degree of disturbance of living by noise were solicited for both soccer and concert noise. Responses

described disturbance of living activities such as conversation, telephone, TV listening, rest, and sleep using four-point scales of 'none', 'slightly disturbing', 'disturbing', and 'very disturbing'. Discomfort caused by closing of windows was also evaluated using the four-point scale. Sound preference and discomfort were evaluated using five-point scales. Sound impressions were evaluated using 12 pairs of seven-point Semantic Differential scales[2)].

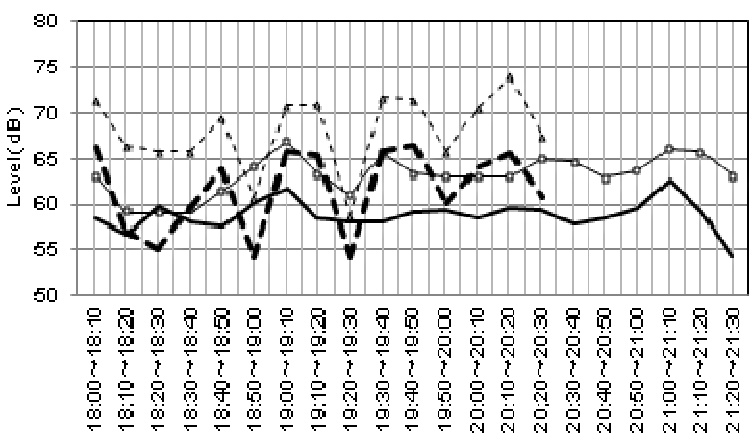
Aside from the noise evaluation, location, age, noise reduction performance of the house were reported on a five-point scale. Appearance of the stadium from the respective residences was reported on a four-point scale. The degree of consideration of Nagai Park in selecting the house was also surveyed. Respondents also reported their years of residence, sensitivity to noise, annoying noises in daily life, measures they take against noise, tastes and preferences related to soccer and music, and the frequency of stadium use. Annoying noises in daily life such as chirping, animal calls, and sounds of musical instruments were reported.

Noise measurements

Noise and vibration were measured at the stadium boundary during events of the 'Mr. Children Tour in 2011' held on September 18, 2011 and a Japan Cup soccer game 'Serezo Osaka vs. Kashima Antlers' held on August 8, 2012. Mr. Children is an extremely popular rock music groups for people in their twenties, thirties, and forties in Japan: four hundred thousand fans had attended eight stadium concerts in 2011. The band also held a concert at Nagai Stadium in 2007. Figure 3 shows the measurement arrangement. The measurement point was about 120 m distant from the concert stage and on a blind alley with little traffic. Noise was measured (NL-6; Rion Co. Ltd.) along with vibration (UM-53A; Rion Co. Ltd.) at intervals of 1 s during 18:00–21:00 for soccer and during 17:00–21:00 for concerts.

NOISE MEASUREMENT RESULTS

The soccer stadium opened at 17:00, the game started at 19:00 and ended at 21:00. Points were scored at 27 min in the first period and at 63 min (PK) and 70 min in the second period by the Antlers, the visiting team. The game had 9,555 spectators. Concerts were held on September 18 and 19. Stadium opened at 15:30, the concert began at 17:30 and ended at 20:30 after 26 music pieces had been performed. The event attracted about 20,000 spectators. The weather was fine for the soccer and concert events.



----- Soccer - - - Concert

Figure 4: Measured noise level

Figure 4 presents the measurement results. LA_{eq} of soccer noise varied smoothly between 56 and 60 dB and increased to 62 dB at the game start and to 63 dB at the game end. L_{max} began to increase at about 30 min before the game start and reached the maximum of 72 dB at the ending. LA_{eq} of concert noise varied greatly between 55 and 65 dB

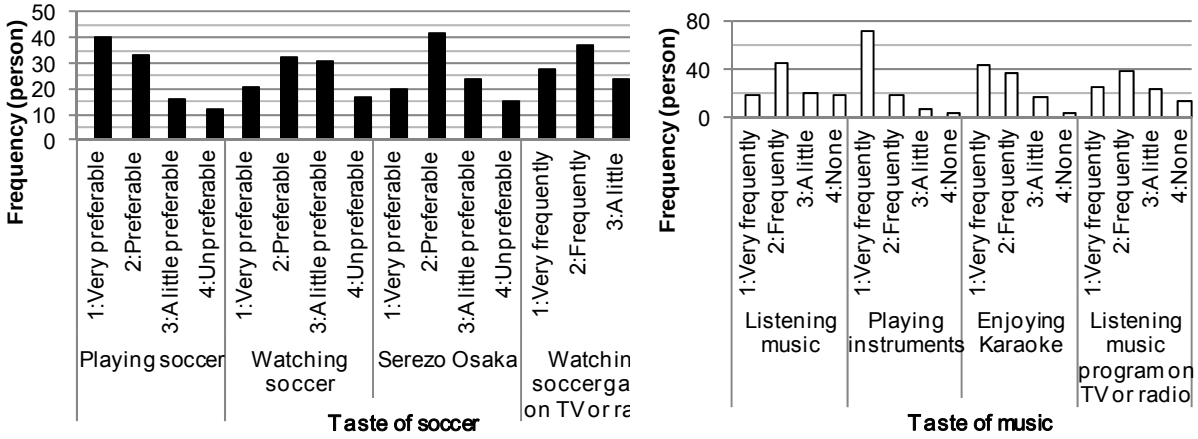


Figure 5: Taste of soccer and music

according to music tunes. L_{max} increased to 75 dB at the ending of the concert. Vibrations were 31.2 dB at the maximum and out of the regulation.

RESPONDENTS

Respondent attributes

Of the respondents, 40.2% were men; 59.8% were women. Most were in their forties (22.5%), their fifties (19.6%), and their sixties (19.6%). In addition, 27.5% had lived in the house for fewer than ten years; 28.4% had resided more than thirty years. They spend 16.2 hr in the house during weekdays, on average and 17.9 hr on weekends during summer.

Figure 5 presents some data for soccer and music. Of respondents, 58% had not watched any soccer game at the stadium in the prior three years, 12% had watched one once, and 9% had watched a game twice. Figure 6 shows the degree of consideration of Nagai Park when they first moved into the homes.

Resident attributes

Of residents, 91.4% owned their own homes. The average period of residence was 24.0 years: 30.4% had lived there fewer than 10 years; 31.8% had resided there for more than thirty years. Old and new houses were mixed. Furthermore, 51.5% were two-story homes; 44.6% were three-story homes. Also, 17.5% were 50–100 m^2, 44.4% were 100–150 m^2, and 30.2% were 150–200 m^2. The average living area was 132.6 m^2. Regarding the garden area, 56.0% were smaller than 10 m^2, 19.0% were 10–20 m^2, and 11.9% were larger than 40 m^2. The average was 14.3 m^2.

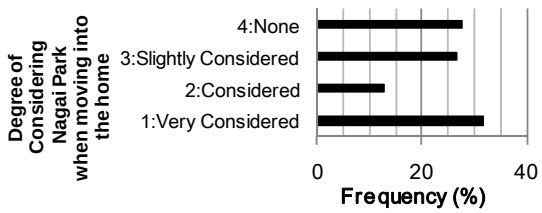


Figure 6: Degree of consideration of Nagai Park

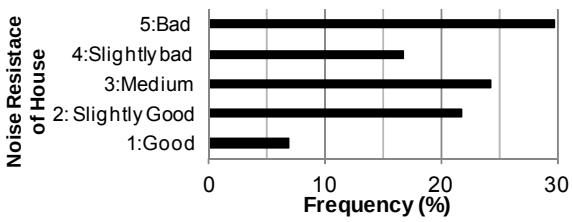


Figure 7: Noise resistance of house

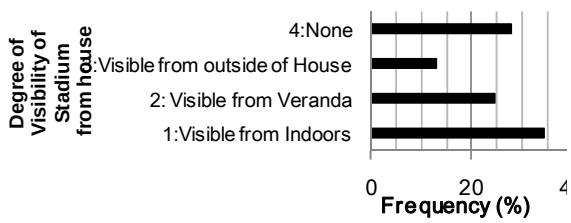


Figure 8: Visibility of Stadium from house

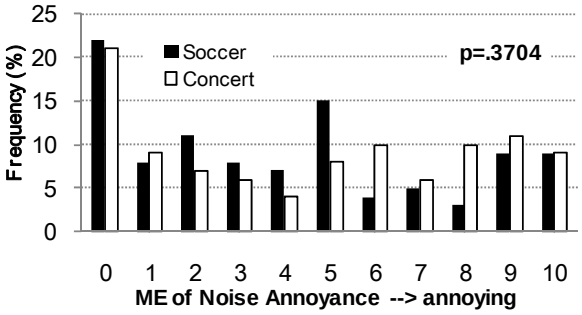


Figure 9: Distribution of noise annoyance

Figure 7 shows a subjective evaluation of noise resistance of the houses. Of respondents, 29.4% answered 'good', although the sum of 'slightly bad' and 'bad' was 28.8%. Figure 8 shows the visibility of the stadium from the house. 'Visible from indoors' was reported by 30.4% of respondents. 'Visible from the veranda' was reported by 24.5% of respondents, and 'Not visible' by 28.7%.

Regarding the frequency of park use, 19.8% use it every day and 20.9% use it two or three days a week. In fact, 29 people use it as a path to work; 46 use it for walking. Of the respondents, 45.6% reported that they sensed no noise from the park, but 22 people felt that it was noisy because of raucous merry-making, 18 people cited dancing and musical instruments as disturbances, and 17 people complained of skateboards.

NOISE EVALUATION

Magnitude estimation of noise annoyance

Figure 9 shows magnitude estimation of noise annoyance. The mean value was 4.0 for soccer and 4.6 for concerts: 21.6% were 0, 14.7% were 5, 10.8% were 2 for soccer; and 20.6% were 0, 10.8% were 9 for concerts. Responses higher than 6 were 30.3% for soccer and 45.1% for concerts. However, no significant difference

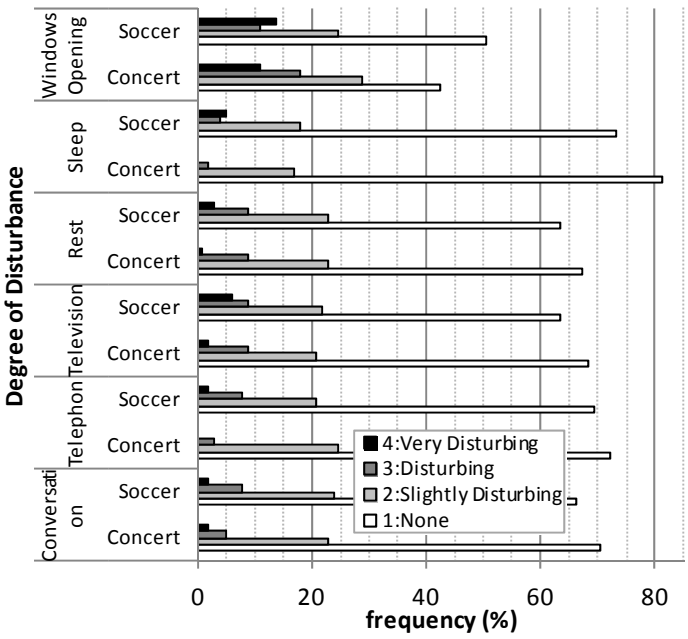


Figure 10: Degree of living disturbance

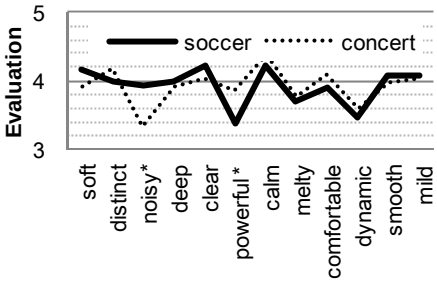


Figure11: Sound impression

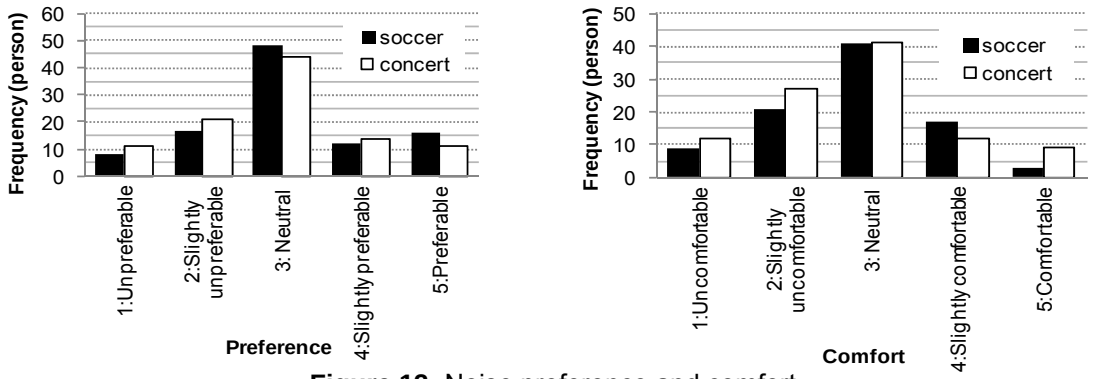


Figure 12: Noise preference and comfort

was found between soccer and concert responses.

Living disturbance by noise

Figure 10 presents the degrees of living disturbance. Of respondents, 23% of them answered 'slightly disturbing' for conversations, telephones, TV, and resting. The sums of 'Uncomfortable‘ and 'Slightly uncomfortable' were higher for soccer noise, but 'Very uncomfortable' was higher for concerts. No significant difference was found between soccer and concert noises in terms of living disturbances.

Noise impression, discomfort and preference

Figure 11 exhibits a profile of noise impressions. Soccer noise is more ‘strong’ and concert noise is more ‘loud’. Figure 12 shows noise discomfort and preferences. The sum of ‘slightly uncomfortable’ and ‘uncomfortable’ is higher for concert noise. The sum of ‘Slightly dislike’ and ‘dislike’ is also higher for concert noise.

RESIDENT ATTRIBUTES AND NOISE EVALUATION

Noise resistance of homes and noise annoyance

Figure 13 shows a relation between noise resistance of house and noise annoyance. ‘Bad’ is higher for ME=0; ‘Good’ is higher for ME=9 and 10. Consequently, they feel less annoyed when noise resistance is bad. This tendency is higher for concerts (p<0.0001) than for soccer (p=0.0103). Figure 14 shows relations between rest disturbance and discomfort of closed windows and noise annoyance. Conversation, telephone, and TV disturbances show similar results to those of rest disturbance.

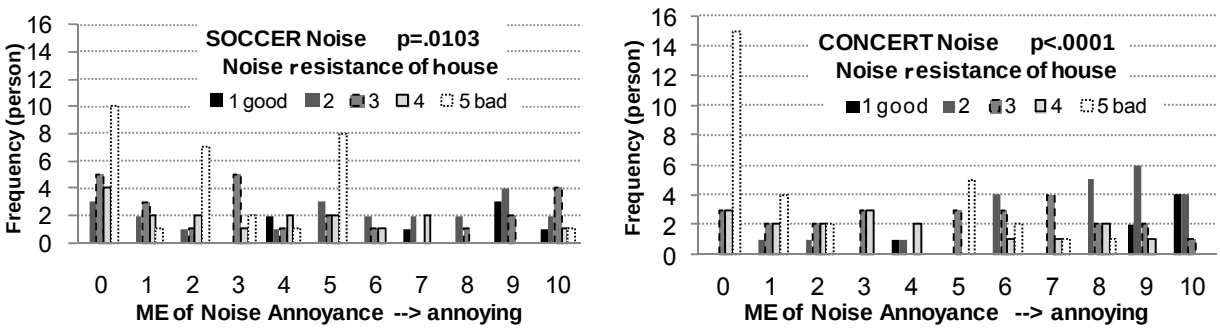


Figure 13: Noise resistance of house and noise annoyance

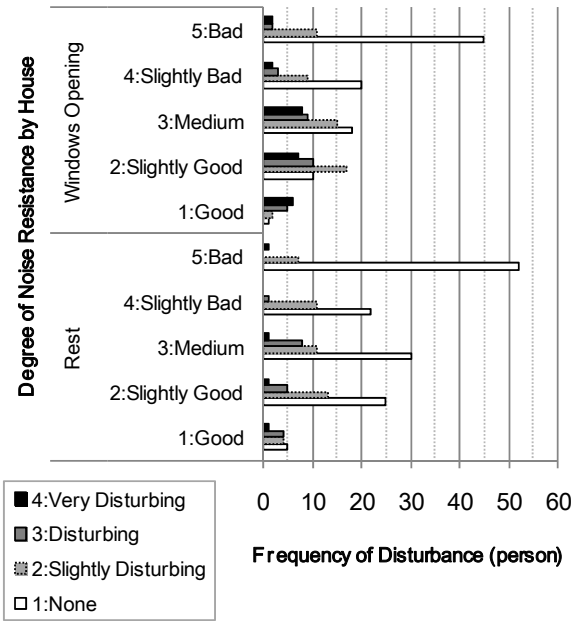


Figure 14: Living disturbance and annoyance

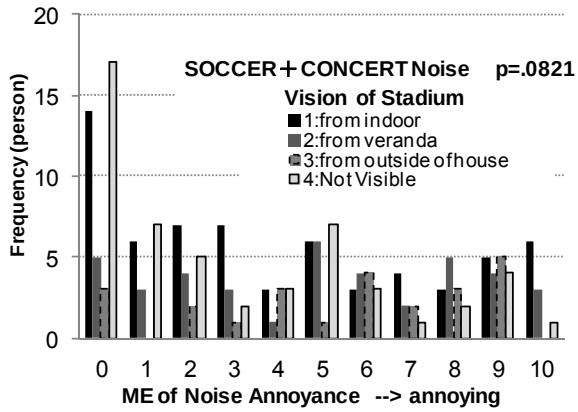


Figure 16: Vision of Stadium and annoyance

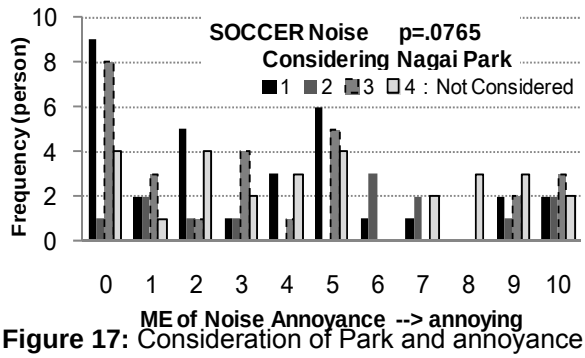


Figure 17: Consideration of Park and annoyance

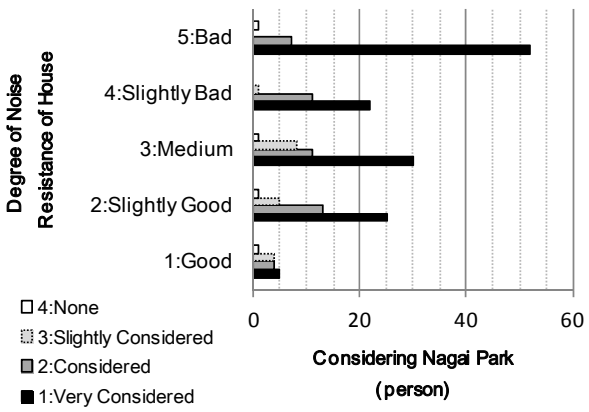


Figure 15: Consideration of Park and noise resistance

Rest disturbance (p=0.0021) and discomfort of closed windows (p<0.0001) are lower when the noise resistance of the house is lower. Figure 15 shows the relation between degree of Nagai Park and noise resistance. 'Much considered' is higher for lower resistance (p<0.0001). It is assumed that noise resistance was improved considering the park, but noise annoyance is high as predicted. Residents cannot open windows and feel uncomfortable. However, noise from the park was not so annoying. Residents who were not conscious of the park were not considered.

Visibility of stadium from house and noise annoyance

Figure 16 shows the relation of the vision of the stadium from the house and noise annoyance for total of soccer (p=0.2672) and concert (p=0.0582). 'Visible from indoors' is the highest for ME=9 and 10. However, it is also the highest for ME=2, 3, 7 and higher for ME=0. 'Not visible' is the highest for ME=0. Relation between vision of stadium and noise annoyance is not certain (p=0.0821).

Consideration of Nagai Park when selecting the house and noise annoyance

Figure 17 shows the relation of consideration of Nagai Park when selecting a house and noise annoyance for soccer noise (p=0.0795). 'Considered a lot' is the highest for ME=0. The ratio of 'Not considered' is high for ME=8, 9, 10. It can be said that noise annoyance can be avoided by the consideration. However, 'Considered a lot' is also high for ME=9 and 10, indicating that residents predicted the annoyance but could not avoid or accept it for some reason. No relation was found between the

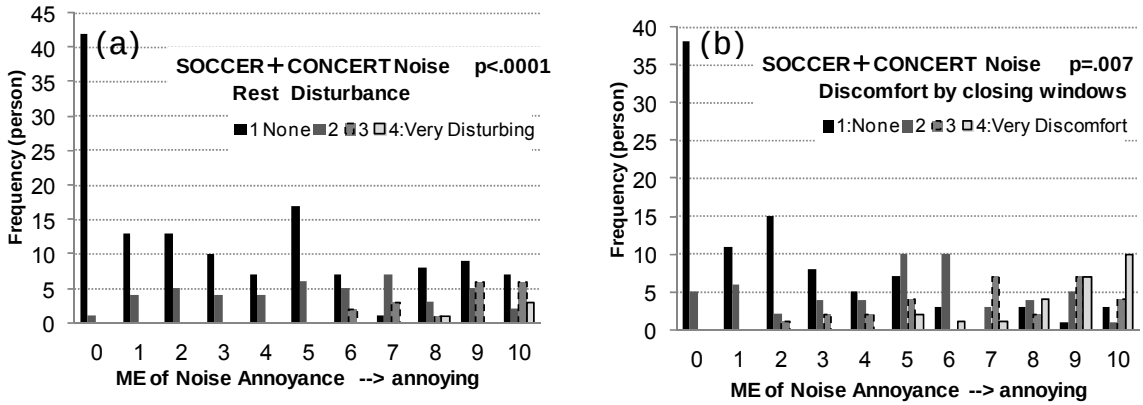


Figure 18: Living disturbance and noise annoyance

consideration and noise annoyance (p=0.6216). It is natural they were unable to predict concert noise because concerts started to be held in 2007, although it seems that consideration of the park when selecting a site for residences can not so much cover the concert noise annoyance as soccer noise annoyance.

DEGREE OF LIVING DISTURBANCE AND NOISE ANNOYANCE

Figure 18(a) presents the relation of living disturbance by noise and noise annoyance for total of soccer and concerts. The relations are similar for soccer and concert noise. The degree of living disturbance is related to noise annoyance (p<0.0001), but 'None' is distributed for ME=0 to 10. 'None' is also the highest for ME=8, 9 and 10. Tendencies are similar for conversation, telephone, and TV disturbances.

Figure 18(b) shows the relation of discomfort by closing windows and noise annoyance for the total of soccer and concerts. 'Very uncomfortable' is high for ME=8, 9 and 10. 'None' is high for ME=0, 1 and 2. Discomfort by closing windows is related to noise annoyance.

RESIDENT ATTRIBUTES AND NOISE ANNOYANCE

Soccer noise annoyance is lower when residents enjoy playing soccer, although it is not reduced by watching soccer. Soccer noise annoyance is higher when residents notice sound and voices of guards and noise outside the stadium. Concert noise annoyance is lower when residents pass the park and take a walk in the park.

CONCLUSIONS

Questionnaire surveys of soccer and concert noise were administered to 102 residents near Nagai Stadium. Results show the following. 1) The degrees of noise annoyance and living disturbance are not significantly different for soccer and concert noise, although the noise level is reportedly higher for concerts. 2) Concert noise creates greater discomfort. It is more disliked and louder than soccer noise. 3) Noise annoyance is higher for residences with high noise resistance. 4) The visibility of the stadium is not strongly related to noise annoyance. 5) Consideration of Nagai Park is not strongly related to the noise annoyance. 6) The relation between living disturbance and noise annoyance is similar for soccer and concert noise. 7) Soccer noise annoyance is lower for residents who like playing soccer. Concert noise annoyance is lower for residents who pass the park and who take a walk in the park.

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1) PIA Research Institute (2009), White paper on live entertainment, PIA Corporation.

2) Nanba S and Kuwano S (1998), Method of Psychological Measurement of Hearing Research, Acoustical Society of Japan.