THE OKINAWA STUDY: EFFECT OF CHRONIC AIRCRAFT NOISE EXPOSURE ON BIRTH WEIGHT, PREMATURITY AND INTRAUTERINE GROWTH RETARDATION

T. Matsui[1], T. Matsuno[2], K. Ashimine[3], K. Hiramatsu[4], Y. Osada[5] and T. Yamamoto[6]
[1]Asahikawa Medical College, Japan, [2]Okinawa Miyako Health Center, Japan,
[3]Okinawa Chubu Hospital, Japan, [4]Mukogawa Women's University, Japan,
[5]Institute of Public Health, Japan, [6]Kyoto University, Japan,

Introduction Many papers have been published to report the results of animal experiments and epidemiological researches suggesting the effect of noise on pregnancy [1, 2, 3]; that is the noise exposure is a factor reducing birth weight. Birth weight is governed by two processes: duration of gestation and intrauterine growth rate. Thus low birth weight (LBW, <2,500g) is caused by either short gestational age or intrauterine growth retardation (IUGR). This paper analyses the relationship between aircraft noise exposure and LBW, prematurity and IUGR around the U.S. military airfields (the Kadena and the Futenma airfields) in Okinawa, Japan.

Methods Japanese government accumulates the birth records including the information of birth weight and gestational age. The number of births in 15 municipalities around the airfields recorded for 20 years from 1974 to 1993 was 164,028, among which the records of multiple pregnancy and the records of the mothers having experience of stillbirth were excluded from the analyses.
The residential areas around the airfields are classified by noise measure of WECPNL, which was defined by the Defense Facilities Administration Agency (DFAA) in 1978. In this study, WECPNL was converted into L_{dn} based on the noise measurements carried out by the DFAA.
The birthplace is given in the name of the municipality and no further information is available to identify the noise exposure during pregnancy. In order to analyse the association with the noise exposure, average L_{dn} in each municipality was calculated based on the community population available as of June 1, 1995.
Since the gestational age was recorded in month, not week, before 1979, prematurity was defined as a gestational age less than 36 weeks (<10th month) for 1973-78 and less than 37 weeks for 1979-93. IUGR was defined as birth weight less than 2,500g and gestational age greater than or equal to 36/37 weeks.
Multiple logistic regression analyses were applied to the birth rate of LBW, prematurity and IUGR with adjustment for sex, maternal age, live birth order, occupation of householder, legitimacy of the infant, year of birth and the interaction of maternal age and live birth order.
Trend analyses were also carried out to examine the dose-response relationship between the average L_{dn} and the birth rates.

Results The 15 municipalities were classified into 4 groups according to the average L_{dn}. In Table 1 are presented the birth rates of LBW and adjusted odds ratios in the 4 groups. The birth rate of LBW in Kadena Town is 8.3%, which is higher than the control by 1.9%. Highly significant odds ratio was found even in low noise-exposed group (Okinawa City. etc.).
The adjusted odds ratios of prematurity and IUGR with 95% confidence intervals are shown in Figures 1 and 2 as a function of average L_{dn}. The asterisks indicate significance of odds

Table 1 Rate of low-birth-weight infants and adjusted odds ratio

Municipalities	Average L_{dn}	N	<2,500g	Odds ratio* (95%CI)	p-value
Kadena Town	70-75	4,425	366 (8.3%)	1.324 (1.183-1.482)	<0.0001
Chatan Town	65-70	6,066	423 (7.0%)	1.086 (0.978-1.206)	0.1232
Okinawa City, etc.	60-65	92,332	6,439 (7.0%)	1.087 (1.042-1.134)	0.0001
Control	<60	57,637	3,667 (6.4%)	1.000	

* Adjusted for sex, maternal age, live birth order, occupation of householder, legitimacy of the infant, year of birth and the interaction of maternal age and live birth order.

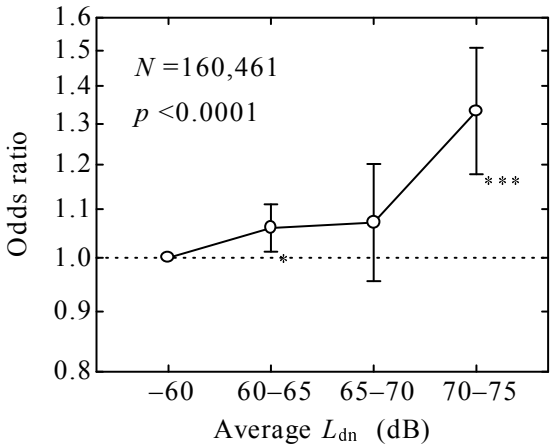

Figure 1 Odds ratio of prematurity by L_{dn}.

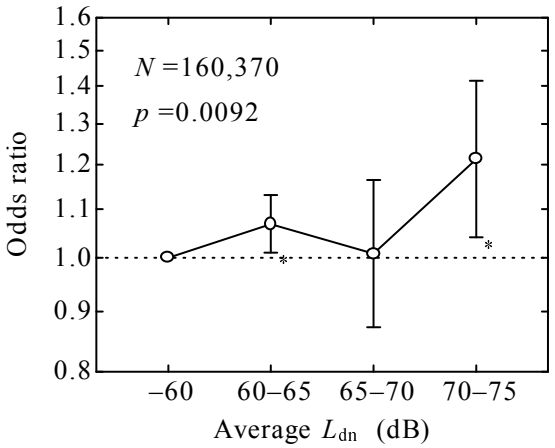

Figure 2 Odds ratio of IUGR by L_{dn}.

ratio referred to the control (*: p<0.05, ***: p<0.001). The p-values in the figures are the significance probabilities by trend test. Significant dose-response relationships were found both on prematurity and IUGR.

Discussion It has been reported that smoking habit raises the birth rate of LBW by 50 to 100%[4, 5, 6]. Since the obtained odds ratios are not adjusted for smoking habit, they might be confounded by higher smoking rate. Assuming that the higher rate of LBW in Kadena Town is attributed entirely to the smoking habit with odds ratio of 2.0, the maternal smoking rate in the town must be 40% higher than the control. In the present authors' questionnaire survey[7], however, no significant differences in female smoking and drinking habit were found among the municipalities. Moreover, no particular socio-economic differences were found in the published information available.

It would be possible to extract conclusions that the aircraft noise exposure may cause low birth weight, prematurity and IUGR observed in Kadena Town and the municipalities around the Kadena and Futenma airfields.

Keywords: Aircraft noise, Low birth weight, Prematurity, IUGR

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