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The association of Ambient Noise Pollution in Belgrade with Adverse Pregnancy Outcomes in a University Clinic

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ABSTRACT

Introduction: There is growing evidence for an adverse effect of ambient noise pollution on general reproductive health and pregnancy outcomes.**Objective:** The study aim was to investigate the association of mean ambient noise exposure during pregnancy on the rate of preterm stillbirths during a ten-year period in Belgrade.**Materials and Methods:** Study included all pregnant women with preterm stillbirth (20 to 37 weeks of gestation) of unknown reason treated in the Clinic for Ob/Gyn University Clinical Center of Serbia during a ten-year period (2012 to 2021). We used data regarding mean measured noise per year for the city of Belgrade which are provided by the Institute of Public Health of the City of Belgrade and are freely available.**Results:** During the study period 406 stillbirths occurred in our Clinic (1.02% of all deliveries). Stillbirths were the most frequent in the year 2013 (n=56) and the least frequent in the year 2019 (n=23). Gestational week of stillbirth ranged from 18 to 33 (mean +/- SD=23.8 +/- 2.9). Mean ambient noise in the investigated period ranged from 55 db (in the years 2014 and 2015) to 65 db (in the year 2017) and it significantly decreased over the investigated period (p=0.001). Level of ambient noise was not associated with the frequency of stillbirths (p=0.611) and no trend in stillbirth rates in regards to ambient noise during pregnancy was observed (p=0.273).**Conclusions:** This preliminary study shows that the rate of preterm stillbirth in Belgrade was not associated with exposure to the ambient noise pollution in the investigated period.

Keywords (3-6): ambient noise pollution, pregnancy outcome, stillbirth

INTRODUCTION

Traffic is large urban areas in increasing in both terms of motorized vehicle numbers their and commuting frequency. Consequently, traffic poses an important source of not only air pollution but also ambient noise. Potential negative effects of noise on general health (cardiovascular, endocrinological, mental health and hearing), stress, sleep and quality of life of people are well documented (1-3). Moreover, in recent literature there is growing evidence for an adverse effect of ambient noise pollution on general reproductive health and pregnancy outcomes. Maternal exposure to increased levels of ambient noise during pregnancy may cause fetal growth restrictions, gestational hypertension and premature delivery. However, data regarding effect of ambient noise pollution on pregnancy outcomes are still limited and inconsistent in different studies (4-6). Therefore, the study aim was to investigate the association of mean ambient noise exposure during pregnancy on the rate of preterm stillbirths.

MATERIALS AND METHODS

This retrospective study was performed at the Clinic for Gynecology and Obstetrics University Clinical Center of Serbia situated in the capital and the largest metropolitan area of Serbia - Belgrade. Belgrade is inhabited by 1.374 million people and each year around six thousand women give birth in our Clinic.

The total number of registered motor vehicles in city of Belgrade for in the year 2021 according to the data of the Republic Institute of Statistics was 710,071. The majority of vehicles are passenger cars with average angine volume ≤1400m^3 and powered by unleaded gasoline fuel. The number of motor vehicles in Belgrade has almost doubled during the last decade.

All pregnant women with preterm stillbirths (20 to 37 weeks of gestation) of unknown reason treated and delivered in our Clinic during a ten-year period (2012 to 2021) were included in the study. To prevent having confounding effects of different other pathologies on study findings all cases of known reason for stillbirth were excluded (fetal malformations, infections, etc.). Patient data were taken from medical records (histories of illness and delivery protocols).

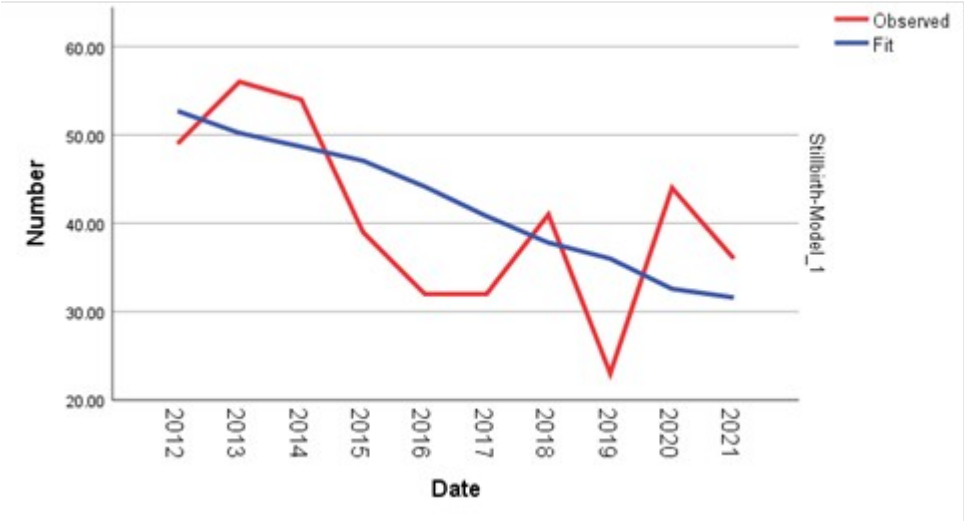
For the study purpose we used data regarding mean measured noise per year for the city of Belgrade which are provided by the Institute of Public Health of the City of Belgrade and are freely available. Throughout the city 31 ambient noise is measuring stations are distributed in all locations of interest (residential area, industrial area, city center and outskirts, area for recreation in nature, next to the schools, hospitals and large traffic roads). Measurements are performed every 15 minutes using phonometer with microphone (Bruel & Kjaer 2250) and the mean values are reported in A frequency decibels (dBA).

Obtained data of patients and temperatures were compared and analyzed by methods of descriptive (number, percent, mean, standard deviation – SD) and analytical statistics (Hi square test, ANOVA). To analyze trends in ambient noise levels and stillbirths time series analysis was applied. All analyses were performed using the SPSS 20 software.

RESULTS

During the study period 406 stillbirths occurred in our Clinic (1.02% of all deliveries). Stillbirths were the most frequent in the year 2013 (n=56) and the least frequent in the year 2019 (n=23). Gestational week of stillbirth ranged from 18 to 33 (mean +/- SD = 23.80 +/- 2.93). At the time of delivery children in average had 546.84 +/- 210.03 grams (range 100 to 980 grams). There were no significant differences regarding the gender of stillbirth children (males=50.5%; females=49.5%; p=0.458). Figure 1 presents stillbirth rates during the examined ten years.

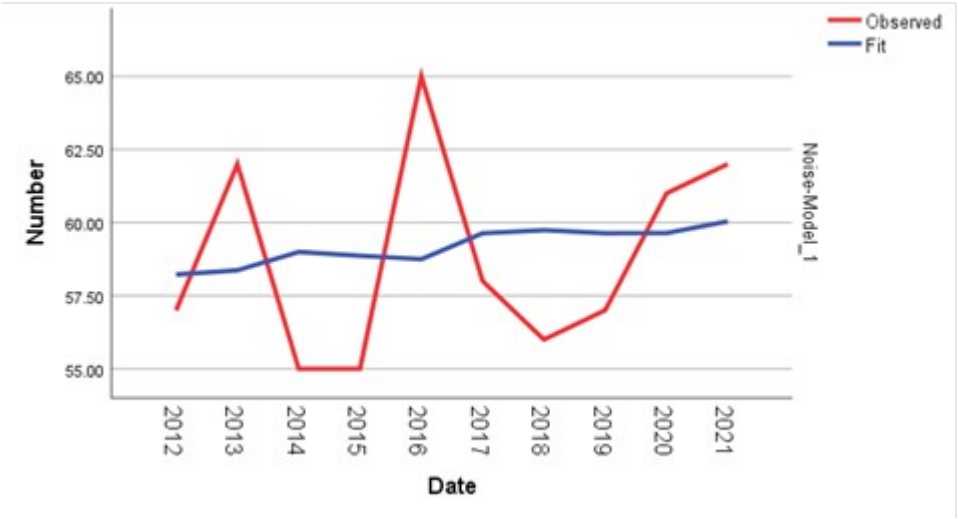
Figure 1. Stillbirth rates during the examined ten years



Women who had preterm stillbirths had 17 to 46 years of age (mean +/- SD = 31.06 +/- 6.15 years) and were mostly primiparous (54.5%; p=0.001).

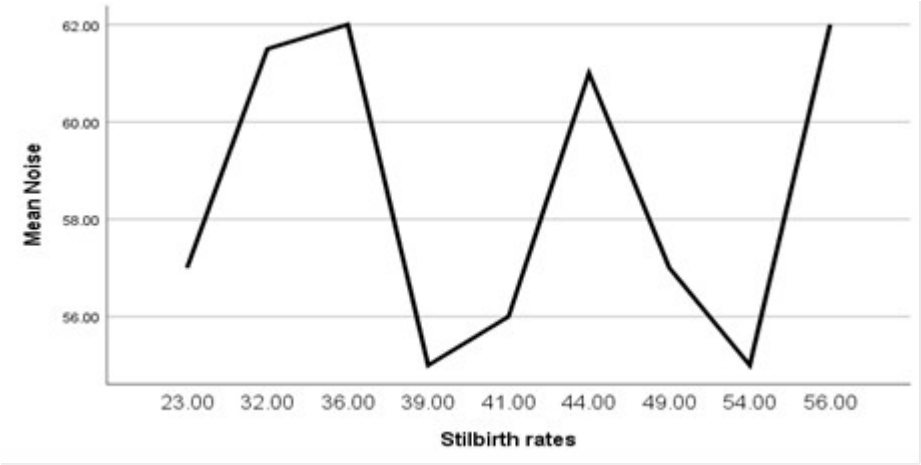
Overall mean ambient noise in the investigated period was 57.64 +/- 3.07 dBA. It ranged from 55 dB (in the years 2014 and 2015) to 65 dB (in the year 2017). However, ambient noise significantly decreased over the investigated period (p=0.001). Figure 2 presents mean ambient noise during the examined ten years.

Figure 2. Mean ambient noise during the examined ten years



Level of ambient noise was not associated with the frequency of stillbirths (p=0.611) and no trend in stillbirth rates in regards to ambient noise during pregnancy was noticed (p=0.273). Figure 3 presents relationship of stillbirth rates and mean noise levels.

Figure 3. Relationship of stillbirth rates and mean noise levels



DISCUSSION

Sound phenomena can be characterized as noise when, according to subjective assessments, they disturb a person both during work and during rest and are therefore felt as unwanted. In the modern world, the trend of noise pollution is increasing. The most significant source of noise in the environment is all forms of traffic, especially in urban areas. Population growth, urbanization, constant technological development, construction of roads, international airports and railways contribute to the complexity of this problem (1-3).

In addition to the subjective impression of distraction and discomfort, noise also causes measurable psychophysical reactions of the organism similar to those caused by other stressors in the working and living environment. Noise as a stressor affects the hypothalamic-pituitary-adrenal axis which increases the concentration of circulating stress hormones that can cause harmful effects on overall health, but primarily on the cardiovascular and central nervous system (1-3).

The primary cardiovascular effects of exposure to noise are arterial hypertension and ischemic heart disease. Numerous studies have indicated frequent psychological disturbances in residents of high level of ambient noise such as frequent headaches, a feeling of anxiety, tension and mood swings. Noise prolongs the time necessary to fall asleep, makes sleep superficial and leads to frequent awakenings, causing constant fatigue and reduced work capacity. Moreover, staying in a very noisy environment can lead to decreased sensitivity of hearing, which can be reversible or, if conditions are prolonged, even permanent. Long-term professional exposure to noise levels ≥85 dBA poses a risk of permanent hearing damage (1-3).

All these effects of ambient noise pollution can have even more intensified effects on pregnant women and fetuses. Potential biological pathways are based on maternal stress

responses for noise leading to disturbed placental function, and thus adverse birth outcomes. Literature data indicate that exposure to noise during pregnancy can lead to spontaneous abortions, intrauterine growth restriction of fetuses, low birth-weight of term neonates, premature deliveries, teratogenic risk, toxemia of pregnancy, gestational hypertension and diabetes mellitus and a decline of human placental lactogen (4-6).

Some data indicate that exposure to increased levels of ambient noise more than six hours per day in a residential area correlate with recurrent spontaneous abortions. Noise is considered to be an element of fatigue score which correlated with preterm delivery. Mothers exposed to noise <65dBA had 18% infants with low birth-weight while mothers exposed to noise of 65 and more dBA had 23-29% infants with low birth-weight. Human placental lactogen (HPL) has growth stimulating and lactogenic activity. HPL levels in the serum of mothers subjected to traffic noise were lower than those that lived in the quiet reference area. The lower HPL levels were associated with lower birthweight for infants from mothers exposed to noise (7-9).

On the other hand, numerous investigations could not confirm these associations. According to our study results ambient noise did not correlate with occurrence of preterm stillbirth deliveries and no trend in stillbirth rates in regards to ambient noise levels during pregnancy was noticed (10,11).

Perhaps one of the explanations for such findings is the fact that most of the studies that reported a correlation of noise and adverse pregnancy outcomes explored effects of occupational noise on pregnancy and or extreme ambient noise (proximity of airports, etc.), as levels of noise ≥80-85 dBA that are related to negative impact on human health are generally found only in work environment (mostly manufactories and industry) (12,13). This was true for our study as well where the average level of ambient noise was not higher than 65 dBA. Furthermore, exposure to road traffic noise should also be adjusted for air pollution and toxicity of exhaust gasses on mothers and fetuses (4,11). Therefore, more large sampled studies regarding this issue should be undertaken in order to investigate the effects of ambient noise on pregnancy outcome and all potential confounding factors.

CONCLUSION

Rate of preterm stillbirth in the city Belgrade was not associated with exposure to the ambient noise pollution.

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