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Impact of Average Daily Ambient Noise Pollution in Belgrade on Prevalence of Gestational Diabetes Mellitus

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ABSTRACT

Introduction: Exposure to environmental noise has been associated with an increased risk of diabetes mellitus, but evidence for gestational diabetes is still limited and conflicting. **Objective:** The study aim was to investigate the impact of average daily ambient noise exposure during pregnancy on prevalence of gestational diabetes mellitus in Belgrade. **Methods:** The data on all pregnant women with diabetes from the registry of the deliveries in Belgrade for the period between 2012 and 2020 as well as the data regarding mean daily measured noise per year for the city of Belgrade were used in this study. These data are freely provided by the Belgrade City Institute of Public Health and previously published. **Results:** During the study period 173490 women delivered in Belgrade out of which 4034 had gestational diabetes mellitus (2.33%). Average daily ambient noise in Belgrade during the study period was 61.6 +/- 1.4 dB. The level of noise did not correlate with the prevalence of gestational diabetes mellitus (p=0.168). **Conclusions:** Exposure to ambient noise of pregnant women in Belgrade did not have significant impact on occurrence of gestational diabetes mellitus. Further research is needed to confirm findings and identify potential risk factors that could influence this association.

Key words: ambient noise pollution, gestational diabetes mellitus, prevalence, association

INTRODUCTION

Different negative effects of noise on overall health (cardiovascular, endocrinological, mental health and hearing), stress, sleep and quality of life of people are well documented (1-3). Noise from a variety of sources, such as occupational and traffic noise, during pregnancy could act as a general stressor on the mother. Noise can activate the sympathetic nervous system and increases stress hormones levels and trigger inflammatory pathways. This could lead to changes that promote adverse health and obstetric outcomes. Exposure to noise was linked to several pregnancy complications such as congenital malformations, preterm birth, fetal growth restrictions and low birth weight, gestational diabetes and hypertension or even preeclampsia and eclampsia. However, data regarding effect of ambient noise pollution on pregnancy complications and gestational illnesses are still limited and inconsistent in different studies (4-6). Therefore, the study aim was to investigate the impact of average daily ambient noise exposure during pregnancy on prevalence of gestational diabetes mellitus in Belgrade.

MATERIALS AND METHODS

This retrospective study included the period of nine years (2012 to 2020). It was performed in the capital and the largest metropolitan area of Serbia (Belgrade) which is inhabited by 1.374 million people. Each year there are up to 20 thousand newborn children in Belgrade.

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 engine volume ≤1400m^3 and powered by unleaded gasoline fuel. The number of motor vehicles in Belgrade has almost doubled during the last decade.

For the purpose of this study, we used the data on all pregnant women with gestational diabetes mellitus (GDM) from the registry of the deliveries in Belgrade for the study period as well as the data regarding mean daily measured noise per examined year for the city of Belgrade. These data are freely provided by the Belgrade City Institute of Public Health and previously published.

Throughout Belgrade 31 ambient noise 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 GDM patients and noise 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 GDM time series analysis was applied. All analyses were performed using the SPSS 20 software.

RESULTS

During the study period 173490 women delivered in Belgrade out of which 4034 had gestational diabetes mellitus (2.33%). The prevalence of GDM was the highest (5.2%) in the year 2013 and the lowest in 2020 (0.6%). Although prevalence of GDM significantly

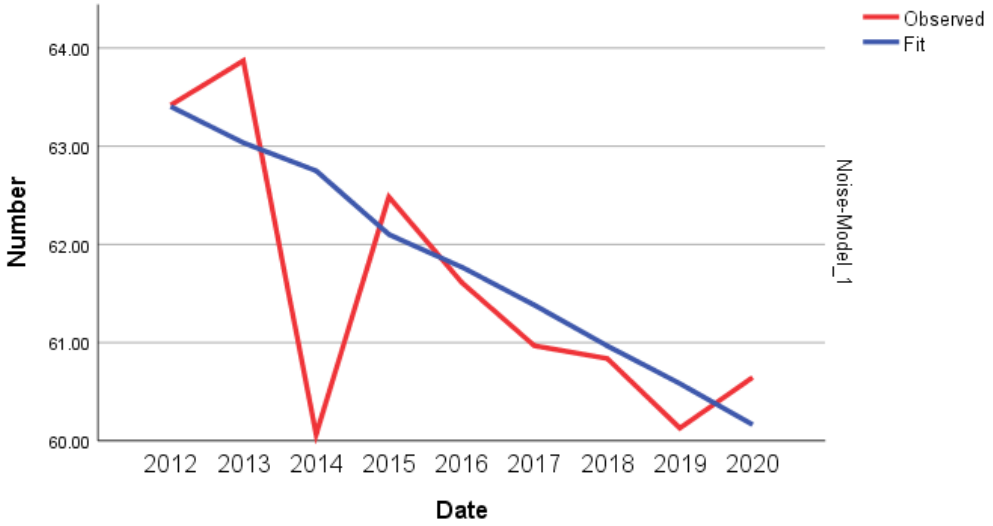
decreased during the investigated period (p=0.001), a linear trend in DGM occurrence was not confirmed. Figure 1 presents DGM rates during the examined period.

Figure 1. DGM rates during the examined period

The average age of investigated women with GDM was 32.96 +/- 5.22 years, the average gestational age at delivery was 38.4 +/- 1.86 weeks, the average birth weight of children was 3453.99 +/- 611.11 grams and the average Apgar score was 8.63 +/- 1.21.

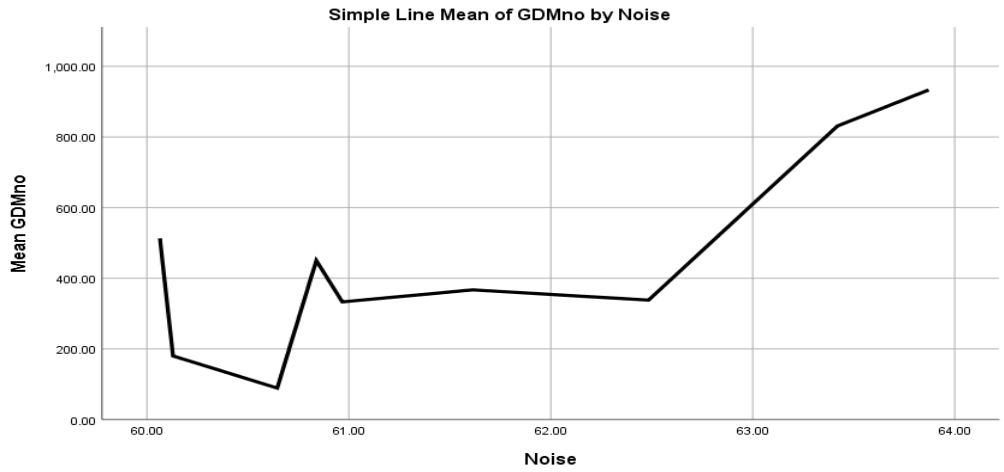
Average daily ambient noise in Belgrade during the study period was 61.6 +/- 1.4 dBA. It was the lowest in the year 2014 and the highest in the years 2012 and 2013, but it did not go over 65dBA at any of the investigated years. Figure 2 presents mean ambient noise during the examined period.

Figure 2. Mean ambient noise during the examined period



The level of ambient noise did not correlate with the prevalence of gestational diabetes mellitus (p=0.168). Figure 3 presents relationship of GDM rates and mean noise levels.

Figure 3. Relationship of GDM rates and mean noise levels.



DISCUSSION

Rates of gestational diabetes mellitus (GDM) among women of reproductive age are increasing and in recent years in Europe 2–6% of all pregnancies are complicated by GDM (7). During pregnancy different physiological changes occur including the changes of insulin metabolism. Therefore, pregnancy is considered as an insulin-resistant state and a vulnerable time for development of diabetes mellitus. Consequently, various factors affecting pregnant women, including environmental exposures, may lead to GDM (8).

Ambient noise is nowadays one of the most common environmental factors that negatively impacts health in multiple ways, but primarily disturbing central nervous and cardiovascular systems (1,2). Noise presents an environmental stressor, which can lead to hyperactivation of the hypothalamic-pituitary-adrenocortical and sympathetic-adrenal-medullary axes. This triggers different metabolic responses, including the release of cortisol and insulin resistance. Sleep disturbance caused by noise can disrupt metabolic pathways such as those of glucose metabolism, circadian rhythm, appetite regulation and energy expenditure. Numerous studies have, therefore, associated ambient noise with obesity and diabetes (3,9).

In current literature there are few available investigations regarding correlations of ambient noise exposure and GDM. According to literature occupational exposure to >85 dBA of noise increased the risk of GDM in primiparous women (10). In some cohort studies of singleton pregnancies weak association between ambient noise and GDM occurrence was established, but air pollution was found to be significant confounding (11,12). Other studies showed that GDM occurrence is associated with first trimester exposure to nighttime noise, but not noise during daytime (13).

On the other hand, numerous investigations could not confirm these associations. In our study as well the level of ambient noise did not correlate with GDM prevalence.

A potential explanation for such findings is the fact that most of the studies that reported a correlation of noise and pregnancy complications 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) (14). 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 (4,15). Moreover, authors have suggested that the source of noise can also be a confounding factor as the characteristics of noise differ between noise emitted from road traffic, railway, and aircraft. It was suggested that railway noise exposure may influence the development of GDM, while road traffic noise did not appear to be associated with increased GDM risk. Therefore, it would be important to explore each noise source independently which is quite difficult in real-life settings. Further research on larger samples is needed to investigate the effects of ambient noise on pregnancy complications and all potential confounding factors.

CONCLUSION

Exposure to ambient noise of pregnant women in Belgrade did not have significant impact on occurrence of gestational diabetes mellitus.

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