ABSTRACT

Aim: The aim of this work is to study the congenital malformations, deformations and chromosomal abnormalities in Cyprus and their relationship to air pollution. Methods: The statistical methods were used to derive the results of this work are Student t-test in order to check the statistical significance of the congenital malformations, deformations and chromosomal abnormalities in relation to gender, One-Way ANOVA test in order to check the statistical significance of these abnormalities in relation to age and the Pearson correlation coefficient for the relationship between these abnormalities of the predisposing factor of air pollution. Results: The results showed that there is no statistically significant difference in the number of congenital malformations, deformations and chromosomal abnormalities in relation to gender, while there is a statistically significant relationship between these abnormalities with age, and in particular they occur mainly at ages 1-14. Finally, there is a statistically significant relationship between the numbers of incidents of the congenital malformations, deformations and chromosomal abnormalities with air pollution. Conclusions: This study has shown that congenital malformations, deformations and chromosomal abnormalities differ in the incidence in terms of age while air pollution is a significant predisposition. Moreover, the congenital malformations that are statistically significant are those of the circulatory system and the musculoskeletal system.

Keywords: Congenital malformations, deformations, chromosomal abnormalities, air pollution

1. INTRODUCTION

According to the scientific literature, air pollution is a major public health concern as it can cause many diseases such as cardiovascular diseases, asthma, chronic obstructive pulmonary disease (COPD) and cancer [1-12]. International literature has suggested the correlation between particle material (PM) exposure and fetal anomalies, particularly cardiovascular malformations. The data showed correlations between exposure to PM with aerodynamic diameter ≤10 μm (PM10) and fetal cardiovascular malformations, ie correlations between PM10 and abdominal septal defects, pulmonary valve stenosis [13], arterial patent resource [14] and multiple congenital heart defects [15]. It has also been shown that exposure to PM10 is associated with an increased risk of vaginal deficits [16]. In contrast, a number of studies have shown no correlation between PM10 and fetal cardiovascular malformations [17]. An inverse correlation between PM10 and abdominal diaphragmatic defects has also been reported [18] between fine particles (PM2.5 with aerodynamic diameter ≤ 2.5 μm) and vaginal diaphragmatic defects [13,19] and isolated arterial patency [15]. This
work studies the congenital malformations, deformations and chromosomal abnormalities related to the gender and age of occurrence in Cyprus and their relation to atmospheric pollution.

2. METHODS

The data used in this work come from the Republic of Cyprus and cover the period 2012 – 2015. Cyprus is a small island in the Mediterranean and has been a member of the European Union since 2004, with a population of approximately 838,897 inhabitants. The statistical methods used to extract the results of this work are Student t-test to check the statistical significance of the congenital malformations, deformations and chromosomal abnormalities in relation to gender and One-Way ANOVA test to check the statistical significance of these abnormalities in relation to age and the Pearson correlation coefficient for the relationship between these abnormalities and of the predisposing factor of air pollution. The Student t-test checks whether the mean values of a variable vary significantly between two independent samples. The One-Way ANOVA test checks whether the mean values of a variable differ significantly between more than two independent samples while the Pearson correlation coefficient r controls whether there is a linear correlation between two quantitative variables. Data from the 5 General Hospitals of Cyprus (Nicosia, Larnaka, Lemesos, Ammochostos and Pafos) for the years 2012-2015 were used to implement the above two methods. The study was carried out using IBMSPSS 20 software package for Windows.

3. RESULTS

To check the zero hypothesis that the mean of the admitted to hospitals in Cyprus with congenital malformations, deformations and chromosomal abnormalities did not differ in gender, the Student t-test statistical criterion was used. As can be seen in table 1, there is no statistically significant difference in the number of these abnormalities relative to gender.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Males</th>
<th>Females</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congenital malformations, deformations and chromosomal abnormalities</td>
<td>59.6</td>
<td>33</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Spina bifida</td>
<td>0.4</td>
<td>0</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Other congenital malformations of the nervous system</td>
<td>1.2</td>
<td>2.6</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Congenital malformations of the circulatory system</td>
<td>4.6</td>
<td>4.4</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Cleft lip and cleft palate</td>
<td>0.6</td>
<td>1.2</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Absence, atresia and stenosis of small intestine</td>
<td>0</td>
<td>0.2</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Other congenital malformations of the digestive system</td>
<td>6.4</td>
<td>4.8</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Undescended testicle</td>
<td>14.8</td>
<td>0</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Other malformations of the genitouritory system</td>
<td>16.6</td>
<td>2.6</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Congenital deformities of hip</td>
<td>0.8</td>
<td>2.2</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Congenital deformities of feet</td>
<td>1</td>
<td>0.2</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Other congenital malformations and deformations of the musculoskeletal system</td>
<td>7</td>
<td>6.6</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Other congenital malformations</td>
<td>6.2</td>
<td>8.2</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

Table 1: Student t-test

In order to test the zero hypothesis that the mean of the admitted to the hospitals in Cyprus with congenital malformations, deformations and chromosomal abnormalities did not differ in age, the one-way ANOVA statistical criterion was used. As can be seen in Table 2, there is a statistically significant difference in the number of these abnormalities with age. More specifically, congenital malformations of the circulatory system occur more often in the ages under 1 year old. Congenital malformations and deformations of the musculoskeletal system and other congenital malformations occur more often in the ages 1-14.

Table 3 shows the Pearson correlation coefficient among the total number of congenital malformations, deformations and chromosomal abnormalities and the concentration of air pollutants of CO, NO, NO2, SO2 and PM2.5 for the years 2012 to 2015.

As can be seen from Table 3, the atmospheric pollutants that are statistically significant are particulate matter PM, carbon monoxide CO and Cadmium Cd (p<0.05). The Pearson correlation coefficient between the total number of congenital malformations, deformations and chromosomal abnormalities and CO concentrations is -0.98. Similar results were found with the concentrations of PM (r=-0.94) and Cd (r=-0.94) which indicates that there is a strong correlation between air pollution and these abnormalities.

### 4. DISCUSSION

Increasing attention should be given to the association between air pollution and the number of congenital malformations, deformations and chromosomal abnormalities. It is noted that despite the reduction in air pollutant concentrations over the years, the number of patients with congenital malformations, deformations and chromosomal abnormalities is rising. This indicates that current levels of atmospheric pollutant concentrations are still particularly high and affect human health. It is also noteworthy that congenital malformations occur mainly in children. Worldwide deaths caused by congenital abnormalities in children are estimated to reach 10% [20]. Only in the five-year period 2008-2012 the mortality rate from congenital abnormalities reached 9.3 per 10,000 births. Of these, 23.7% concerned chromosomal abnormalities, 22.6% congenital heart defects and 17.2% nervous system abnormalities [21]. The causes of these abnormalities are multifactorial, including environmental exposures [22].
5. CONCLUSIONS

This study has shown that congenital malformations, deformations and chromosomal abnormalities differ in the incidence in terms of age while air pollution is a significant predisposition.

REFERENCES


