COMMUNITY-BASED SURVEY AS A BASIS FOR EVIDENCE-BASED PUBLIC HEALTH: CHILDREN LIVING IN UPPER SILESIAN INDUSTRIAL ZONE

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SUMMARY

Objective: The aim of the study was to estimate changes in the prevalence of respiratory diseases and disorders between 2003/2004 and 2011/2012 in 13–16 years old children living in Bytom, one of the biggest cities in the Silesia agglomeration and provide the evidence for local policy makers.

Methods: Data from two cross-sectional surveys, based on the Polish version of the International Study of Allergy and Asthma in Childhood (ISAAC) questionnaire, conducted in 2003/2004 and 2011/2012 was used. Response rate in the first and the second survey was 68% and 35%, respectively. The number of analyzed observations was 4,041 and 707 from the first and the second survey. The selection bias was controlled with the propensity score matching and potential determinants of analyzed respiratory diseases and disorders were controlled in the multivariable logistic regression model.

Results: We found statistically significant increase in asthma ever diagnosed by medical doctor (4.5% vs. 9.6%; $p < 0.01$), seizures of dyspnea (8.2% vs. 27.7%; $p < 0.01$), and chest wheeze (9.6% vs. 19.2%; $p < 0.01$).

Conclusion: Our study revealed significant increase in the prevalence of respiratory diseases and disorders after 8 years in adolescents living in the Upper Silesian Industrial Zone. This is a relevant finding which provides the evidence for decision makers in the scope of local public health policies.

Key words: chronic respiratory diseases, asthma, community-based evidence, evidence-based public health

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INTRODUCTION

According to the WHO data respiratory diseases have become the fourth leading cause of death in Europe (1). One of the priorities of Polish national policy, described in the 6th Strategic Target of the National Health Programme for 2007–2015, was the reduction of morbidity and mortality caused by chronic respiratory diseases (2). Results of scientific research showed that the prevalence of chronic respiratory diseases like asthma increased in children especially in low- or mid-income countries (3–5), whereas in developed countries the prevalence of asthma reached plateau (6, 7) or even was likely to decrease (8). Asthma was recognized as a public health problem at the summit held in 2006 in the European Parliament through the Brussels Declaration (9).

When applying evidence-based public health approach the following components are included: engaging the community in assessment and decision making, using data and information systems systematically, making decisions on the basis of the best available peer reviewed evidence, quantitative and qualitative, implementing programme planning frameworks, and finally conducting evaluation and dissemination (10). The translation of research into practice assumes that clinically relevant evidence is available (11), which is not always the case. The national epidemiological study (ECAP) conducted in 2006–2008 showed high incidence of asthma in urban areas of Poland, in children aged 13–14 years over the past decades, the symptoms of asthma were reported by 6.5% of respondents and diagnosed asthma occurred in 10.6% of the young study population (12). However, the data from this study may not fully apply to each city in the Silesian region, especially not to Bytom city, as the sample from the region included in ECAP study was drawn from Katowice – a different city in the region.

Bytom is a city which has been undergoing very deep restructuring process of the mine industry (5 of 6 mines were closed) over the past two decades. Overall negative social changes resulting from those processes, such as poverty, social exclusion, and unemployment have not been improved through the policies implemented by the local authority (13). Bytom is one of the biggest cities in Silesian agglomeration (4.57 million of inhabitants), just after Katowice, Gliwice and Zabrze, with the population of 170,761 in 2015 (14). The socioeconomic status

of the city residents is generally low. The average monthly gross wages and salaries in Bytom were 85% of the average for Silesia voivodship (14). It is also characterized by higher unemployment rate compared to the average in the region (18.5% vs. 8.2%). Also, infant mortality rate is higher than the average of the region (7.7 vs. 4.7 per 10,000 inhabitants (Report on the State of the Town, 2013). Only 13% of council flats and 25% of housing cooperative apartments in Bytom have the gas heating (14), and air pollution was high as in the whole region with exceedances in PM_{10} and other pollutants concentrations, however, it has decreased in the recent years (15). Living conditions in Bytom are also low with the average usable space in residential housing per person about 22 sq. m (14).

Since the evidence to be used for the purpose of evidence-based public health planning should be as close to the community in which it is supposed to be used as possible, establishing asthma and other respiratory symptoms prevalence in Bytom community over the past decade can be used to assess the health needs, to evaluate needed resources, and to plan more effective public health interventions.

The aim of this study was to examine the prevalence of respiratory diseases and symptoms in two groups of children aged 13–16 years living in Bytom, one of the biggest cities in the Silesia agglomeration, and examine changes in the prevalence between the first cross sectional study performed in 2003/2004 (Survey 1) and the second one preformed in 2011/2012 (Survey 2). It is worth mentioning that annual mean concentrations of PM_{10} were 54.3 $\mu g/m^3$ and 42.4 $\mu g/m^3$, $PM_{2.5}$ were 44.5 $\mu g/m^3$ and 37 $\mu g/m^3$ in the years 2003 and 2004, respectively. It should be also noted that these concentrations in the study region remained at a similar level in 2011 and 2012: 54.6 $\mu g/m^3$ and 52.8 $\mu g/m^3$ for PM_{10}, and 43.2 $\mu g/m^3$ and 40.8 $\mu g/m^3$ for $PM_{2.5}$, respectively. Moreover, the concentration of benzo(a)pyrene was 9.2 ng/m^3 and 8.4 ng/m^3 in the years 2012 and 2012, respectively (16).

Additionally, we examined potential determinants of these respiratory health problems adjusted for socioeconomic factors. As the determinants of health are rather on population and structural level, authorities can carefully plan effective public health interventions.

MATERIALS AND METHODS

This paper is based on the data from two cross-sectional surveys conducted in the Bytom city 8 years apart in the years 2003/2004 (Survey 1) and 2011/2012 (Survey 2). The study aimed to gather data from the whole population, so children attending all schools in Bytom were targeted. Both surveys were based on the Polish version of the International Study of Allergy and Asthma in Childhood (ISAAC). In Survey 1 written questionnaires were administered to parents or legal guardians of children aged 6–18 years who attended schools in Bytom, whereas in Survey 2 written questionnaires were administered directly to 13–16 years old pupils of gymnasium (junior high school) after obtaining consent from their parents for the participation in the study.

Questionnaires used in both surveys were similar, they contained 51 questions, including demographic data, data regarding pregnancy, birth and perinatal period, congenital abnormalities, current treatment or specialist care, current neurological, gastrointestinal, allergic and respiratory symptoms, diseases ever diagnosed by the physician, school problems, vaccinations, sport activities, and living and social conditions.

Respiratory diseases/symptoms analyzed in the present study included asthma (in the questionnaire defined as ever physician-diagnosed asthma), episodes of shortness of breath (in the questionnaire defined as ever episodes of dyspnea), chest wheeze (in the questionnaire defined as ever chest wheezing or whistling).

Moreover, potential determinants of respiratory diseases/symptoms defined in the part of questionnaire devoted to living and social conditions were taken into account in the analysis. In the analysis we included gender (male vs. female), age, body mass index (BMI), siblings, number of rooms in flat (<3 vs. ≥ 3), type of heating system (coal or gas vs. central heating), exposure to environmental tobacco smoke at home (ETS), maternal education and employment. The data on paternal education and employment were also collected and available, but we decided to remove these variables from analysis because of non-significance and additional reduction in number of observations caused by the missing data ($n=246$ and $n=125$ in the Survey 1 and 2, respectively).

Qualitative data were expressed as counts and percentages. The statistical significance of between-group differences was assessed with the χ^2 test. Quantitative variables were described by median and interquartile range (IQR) due to non-normal distribution, the Shapiro-Wilk test was used to verify the normality assumption. Differences between studied groups were calculated by Mann-Whitney test.

In order to be able to compare both groups we limited the first survey to children in the range of age 13–16 years, moreover, to control for the selection bias and differences between the groups of children participating in Survey 1 and 2 the Propensity Score Matching (PSM) technique was used. The procedure "match-it", with nearest neighbour matching option, available in R was utilized. Potential determinants were controlled in the multivariable logistic regression model. The stepwise selection method of model building was applied. The significance level to allow a determinant to enter into the model and be kept in the model was set at 0.2 and 0.3, respectively. The logistic odds ratio (OR) with 95% confidence intervals (95% CI) were calculated. Statistical analyses were performed in SAS, version 9.4 (SAS Institute Inc., Gary, NC) and R, version 3.2.3 (R Foundation for Statistical Computing, Vienna, Austria.), with significance level set at $\alpha = 0.05$.

RESULTS

Survey 1 collected data from 5,506 children aged 13–16 years with response rate of 68%, while Survey 2 collected data from 1,027 subjects with response rate of 35%. Final number of observations used in the analysis was lower due to missing data for some of the analyzed variables and amounted 4,041 and 707 from Survey 1 and 2, respectively.

Table 1 presents descriptive characteristics of studied groups, such as demographics information, family socioeconomic status, and indoor environment. Populations in two surveys differed in demographic characteristics (more girls and higher median BMI level in Survey 2 vs. Survey 1), socioeconomic status (better educated mothers and more occupationally active in Survey 2 vs. Survey 1) and indoor environment (in Survey 2 and Survey 1

environmental tobacco smoke was less frequent, more common were small apartments, more children were the only child and more families were using coal or gas for home heating). Due to significant differences in characteristics between analyzed groups the propensity score matching (PSM) procedure was deployed. Obtained controlled group from Survey 1 was equivalent to the studied group in Survey 2 for demographic characteristics, socioeconomic status, and home environment variables (Table 1). Since the aim of the study is to compare the prevalence of respiratory diseases or symptoms, the results are presented for the group participating in Survey 2 and matched control group derived from Survey 1.

Table 2 shows the prevalence of declared respiratory health problems. All of the analyzed outcomes were more frequent in Survey 2 (2011/2012) compared to the PSM control group from Survey 1.

We examined the determinants associated with the occurrence of analyzed respiratory health problems with multivariable logistic regression and the results for asthma are presented in Fig. 1, for dyspnea episode in Fig. 2, and for chest wheeze in Fig. 3. Each analysis was performed separately for data obtained in Survey 2 and for PSM control group derived from Survey 1.

In case of asthma consistent effect was observed for maternal education in both groups (Survey 2 and PSM control group) – children of better educated mothers were more likely to have asthma. The effects of other determinants were observed for one of the survey group only such as increase in the risk of asthma for male gender and higher BMI in Survey 2, and coal or gas heating system in PSM control group (Fig. 1).

In case of dyspnea episodes none of the determinants showed consistent effect in both analyzed groups: male gender was associated with higher risk of episodes of dyspnea in PSM control group, while in Survey 2 this was a protective factor; higher level of BMI was associated with increased risk in Survey 2, as was having siblings (borderline significance), while the latter one was a protective factor in the PSM control group (Fig. 2).

In case of chest wheeze none of the determinants showed consistent effect in both analyzed groups: higher maternal education was associated with higher chest wheeze risk in Survey 2, but not in PSM control group, male gender was a protective factor in Survey 2, but not in PSM control group. Environmental tobacco smoke was identified as the risk factor for chest wheeze only in Survey 2, as was higher BMI (borderline significance), while in the PSM control group having siblings was found to be protective and living in a smaller apartment was a risk factor (borderline significance) (Fig. 3).

DISCUSSION

This paper provides evidence concerning increasing prevalence of asthma and other respiratory symptoms from two community

Table 1. *Characteristic of studied groups in Survey 1 (2003/2004) and Survey 2 (2011/2012) and matched control group derived from Survey 1 (PSM)*

Characteristic	Survey 2 (2011/2012)	Survey 1 (2003/2004)		Survey 1 PSM control group	
	N = 707	N = 4,041	p-value	N = 707	p-value
Demographics					
Gender (female)	58.4%	53.0%	0.01	59.4%	0.71
Age 15+	46.1%	46.6%	0.79	45.3%	0.75
BMI [median (Q1–Q3)]	20.0 (18.4–21.9)	19.4 (17.8–21.6)	< 0.01	20.1 (18.3–22.2)	0.53
Socioeconomic status					
Maternal education (high school and above)	62.4%	47.9%	< 0.01	60.0%	0.35
Maternal employment	73.1%	49.0%	< 0.01	73.6%	0.86
Indoor environment					
Environmental tobacco smoke	43.6%	56.3%	< 0.01	48.2%	0.08
Heating system (coal or gas)	35.9%	27.9%	< 0.01	36.9%	0.70
Siblings	79.9%	85.8%	< 0.01	82.2%	0.28
Rooms (< 3)	42.6%	17.7%	< 0.01	42.7%	0.96

PSM – propensity score matching, IQR – interquartile range, BMI – body mass index, p-value compared to 2011/2012 study period

Table 2. *Prevalence of respiratory health problems in Survey 2 (2011/2012) and in PSM control group derived from Survey 1 (2003/2004)*

Outcome	2011/2012 N = 707	2003/2004 (PSM control group) N = 707	p-value
Any of the three analyzed respiratory health problems	38.9%	12.45%	< 0.01
Asthma ever	9.6%	4.5%	< 0.01
Episodes of dyspnea	27.7%	8.2%	< 0.01
Chest wheeze	19.2%	9.6%	< 0.01

PSM – propensity score matching

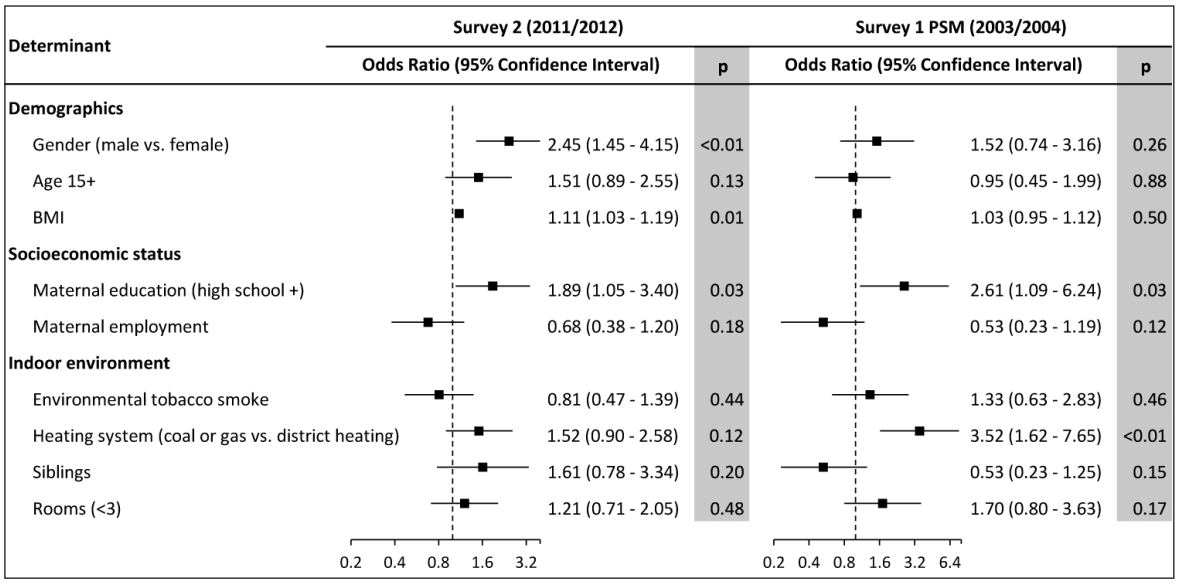

Fig. 1. *Determinants of asthma ever diagnosed by medical doctor in Survey 2 and PSM control group derived from Survey 1, OR with 95% CI.*

PSM – propensity score matching, BMI – body mass index

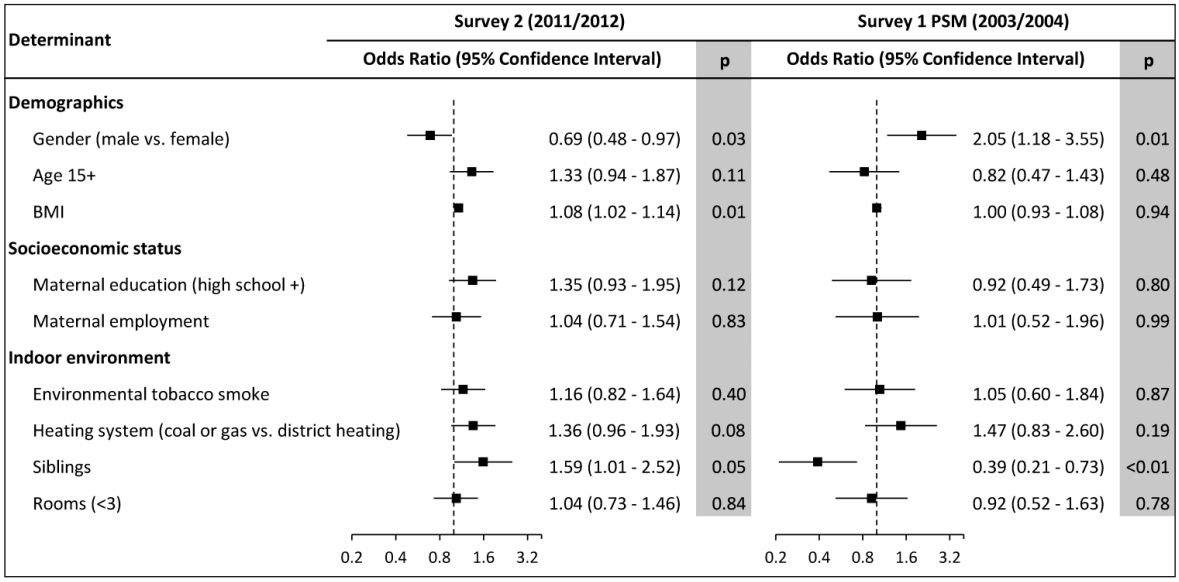

Fig. 2. *Determinants of episodes of dyspnea in Survey 2 and PSM control group derived from Survey 1, OR with 95% CI.*

PSM – propensity score matching, BMI – body mass index

based studies conducted in the city of Bytom. Effective public health policy needs translating scientific research into policy and practice. The results of this study could be used and should have implications for the planning of public health policies. A preliminary step in the evidence-based public health approach should concern identifying the health needs of the local population, and therefore the public health interventions could be prepared and implemented in a way which would enhance health benefits. Study results revealed considerable increase in the prevalence of all analyzed respiratory health problems, such as declared asthma ever diagnosed by medical doctor, episodes of dyspnea and chest wheeze, when the results of two surveys conducted 8 years apart (2003/2004 and 2011/2012) in the community of Bytom were compared. This finding suggests the rise in the prevalence of asthma from 4.5% to 9.6% ($p<0.01$) over the period of eight years. The observed phenomenon could be partly explained by improvements in diagnosis of respiratory disorders (17), also asthma and other respiratory tract diseases received more public attention in recent years (17, 18). Asthma was also recognized as a public health problem at the summit held in 2006 in the European Parliament through the Brussels Declaration (9).

Our findings are in good agreement with the previous research conducted in Chorzów, a community neighbouring Bytom, where an increase in the prevalence of asthma, allergic rhinitis and attacks of dyspnea was also observed (5). The national epidemiological study (ECAP, 2006–2008) confirmed a high incidence of asthma in urban areas of Poland, in children aged 13–14 years over the past decades (12) with symptoms of asthma reported by 6.5% of respondents and asthma diagnosed in 10.6% of the young study population. Undiagnosed cases of asthma are a huge problem in Poland, the ECAP findings suggested that bronchial asthma may be underdiagnosed in even 70% of people, who has

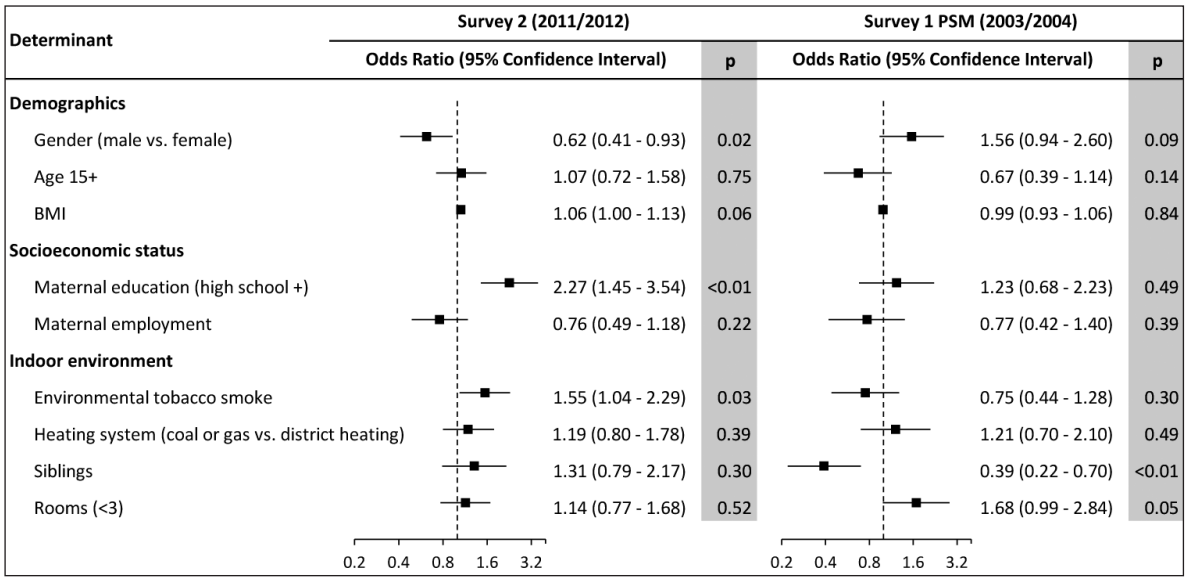

Fig. 3. *Determinants of chest wheeze in Survey 2 and PSM control group derived from Survey 1, OR with 95% CI.*

PSM – propensity score matching, BMI – body mass index

already experienced symptoms of this disease. Therefore, Polish National Programme of Early Diagnostics and Treatment of Asthma (POLASTMA) was introduced to improve asthma diagnosis and control in Poland. It is important to note that the results of asthma epidemiological study depend mostly on the applied research tools (questionnaire forms, additional examinations, methods of revision of medical diagnosis) and the population structure (age, sex, socioeconomic status) (19).

According to the Evidence Based Public Health (EBPH) guidance scientific evidence identifying risk factors and health determinants connected with the health outcomes is also required. In our study we observed changes in analyzed risk factors and health determinants of respiratory diseases and symptoms over the period of 8 years. Mothers were better educated, and more mothers were employed in the recent study, which is in good agreement with official statistics for Poland and also for Silesian Voivodship (14). The maternal education was statistically significant determinant for all analyzed respiratory health problems in Survey 2, while it was significant only for asthma in the PSM control group. It is possible that higher prevalence of asthma in children of better educated mother is associated with the fact that they are more aware of such symptoms and point it out to the physician as it has been observed that mother education level is related to the severity of asthma (20). In Survey 2 more children lived in flats with less than three rooms and more flats/houses had coal or gas heating system. Earlier published data from Chorzów confirmed that the indoor exposure to tobacco smoke and coal stove emission are significant factors responsible for adverse respiratory health effects in children living in heavily polluted and densely populated urban areas (21). Less children had siblings and this observation is consistent with profile of demographic situation in Poland (14), and what is important, less children were exposed to the environmental tobacco smoke, available data suggest that the percentage of 13–15 years old children in Poland exceeded 60% in 1999 (22), while global assessment conducted in 2009 revealed that 44% of children in that age group were exposed to the second-hand smoking (23).

Several studies also indicated that socioeconomic status is an important determinant of asthma prevalence (24). Regarding risk factors the coal or gas heating system was found as statistically significant risk factor of asthma, but only in the matched control group from the first survey. Environmental tobacco smoke was identified as the risk factor for chest wheeze only in Survey 2. Environmental health risk factors exposure is strictly connected with socioeconomic situation of individuals. Some studies have investigated various impacts of air pollution on more susceptible groups of population based on area of residence, educational attainment, race, sex, and age (25). Many international researches indicate that socioeconomic and socio-environmental factors have strong association with the prevalence of childhood allergic diseases like asthma, allergic rhinitis and eczema (26).

Further steps are necessary for identifying those at highest risk, to develop asthma care and service programmes and to plan effective public health interventions. An increase in the number of outpatients visits due to asthma in the whole Silesian voivodeship and in the Bytom county was observed (18). An insufficient control of asthma in patients is another problem in Poland, which should be taken into account by the local authorities. It is also important to note that the improvement in asthma outcomes requires a broad, cross-sectoral and multi sectoral engagement (27). There are some examples which indicate that mobilizing diverse stakeholders and focusing on policy can generate significant reductions in health care use for vulnerable children with asthma (28). Interventions designed to improve health care services and coordination of care, school-based interventions, as well as the decrease of environmental risk factors exposure can greatly decrease asthma morbidity (29, 30). The Allies Against Asthma coalitions at the local level generate important community benefits, the work of Allies Against Asthma contributes significantly to the small but growing body of evidence indicating that targeting policy through collaborative community-wide work can bring about needed change (31). On the basis of our study such public health intervention could be planned and when implemented such a programme should undergo monitoring to ensure its proper realization and evaluation against defined short term and long term goals.

There are some limitations of our research. First of all, both studies were cross-sectional with well-known weaknesses. More-

over, the response rate in the first survey was on acceptable level, whereas in Survey 2 the response rate was 35% only, this could significantly increase the risk of bias. In order to reduce the bias we have proposed propensity score matching procedure to get comparable groups from both studies and therefore the sample size used for comparing the changes between Survey 1 and 2 was reduced. The analysis of results is based on declarations of parents (Survey 1) or children (Survey 2), which may also introduce bias.

CONCLUSION

Decision making about policies, programmes and health related interventions first requires credible information on the health status of a population, health inequalities and the causes of health burden. Results of our study revealed significant increase in the prevalence of respiratory diseases and disorder like doctor diagnosed asthma, seizures of dyspnea, chest wheeze in the 8-year time span in children aged 13–16 years living in the Upper Silesian Industrial Zone. The results of this study provide the evidence for decision makers and should have implications for the planning of local public health policies.

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Conflicts of Interests

None declared

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