

Air pollution – awareness among the most susceptible groups of patients

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ABSTRACT

Purpose: Air pollution is one of the most important and often underestimated causes of death worldwide. The study evaluates awareness of its effects on health, access to information and seeking protection from pollution among the most susceptible population.

Materials and methods: A 22-item survey was constructed (Cronbach's $\alpha=0.81$), including two parts, 1 - 'Awareness' and 2 - 'Personal protection and access to information' and four independent questions. It was distributed among 107 hospital patients at high risk of adverse health effects from air pollution.

Results: Scores in part 1 of the survey were relatively high. Lower results were achieved in the

second part. Significant differences in responses to the surveys were found depending on gender, age and education. Patients' main sources of information are (in order): television, the Internet and radio. Access to information was mostly rated as insufficient. Few patients use anti-pollution facemasks or indoor air filters (5.8% and 2.9%, respectively).

Conclusions: Despite patients' decent awareness, access to information is poor among the most susceptible population and needs to be improved urgently. More reliable sources of information need to be provided.

Keywords: Air, pollution, awareness, survey, susceptible

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INTRODUCTION

Air pollution is currently one of the most important causes of death worldwide. According to the 2017 Lancet Commission on Pollution and Health, ambient air pollution was the cause of an estimated 4.2 million deaths worldwide in 2015, and another 2.9 million were caused by indoor air pollution [1]. The young and the elderly are at highest risk of disease and death due to pollution [1]. Other groups more susceptible to air pollution include patients with pre-existing respiratory or cardiovascular diseases, diabetes and chronic obstructive pulmonary disease (COPD) [2].

Health effects

Fine Particulate Matter (PM_{2.5}) are the best studied group of airborne pollutants. They have been linked with many conditions, such as ischaemic heart disease and myocardial infarction, cardiovascular mortality, arrhythmias and stroke, arterial hypertension, COPD and cancer [1]. Studies have also shown that exposure to PM_{2.5} exacerbates the course of allergic asthma [2,3]. Respiratory disease, cardiovascular disease, stroke, and cancer account for the largest proportion of the Disability Adjusted Life Years (DALYs) from pollution-related disease [4]. Air pollution is responsible for half of the DALYs associated with lower respiratory tract infections and chronic obstructive pulmonary disease worldwide, and for a quarter of the DALYs resulting from ischaemic heart disease and stroke [4]. Furthermore, pollution-related disease results in health-care costs that are responsible for up to 7% of health spending in middle-income countries [1]. Thus, reducing air pollution, apart from the direct health benefits, could improve health care systems' budgets and allow for more efficient treatment of other conditions.

Global and local intervention

Numerous interventions are undertaken worldwide against air pollution. Controlling urban air pollution by upgrading public transportation, encouraging active transport (walking and cycling), reducing sulphur content of motor fuels, promoting use of low-emission and zero-emission vehicles (while concurrently cleaning the energy supply), and restricting car and trucks from city centres are all achievable objectives. These interventions not only improve air quality, but also should reduce childhood asthma, reduce incidence of cardiovascular disease, stroke, and diabetes in adults, and enhance the quality of urban life [5,6].

The situation in Poland is dramatic compared to other countries in the European Union.

According to the 2016 WHO Global Urban Ambient Air Pollution Database, 33 of the 50 most polluted cities in the EU were in Poland [7]. In Warsaw, the quality of the air has barely changed between 2007 and 2016. PM_{2.5} concentrations at the Targówek station, close to the hospital where our research was carried out, averaged 24.5 μm^3 in 2007 and 22.1 μm^3 in 2016 [8,9]. The fact that the informing and alert levels of particulate matter concentrations (200 μm^3 and 300 μm^3 , respectively) are extremely high in Poland compared to other EU countries (e.g. alert at 80 μm^3 in France) also has a major negative impact on public health and information accessibility [10].

Personal intervention

Successful control of the air quality is the unquestionable goal, allowing people to live in a clean urban environment. However, large scale government projects to reduce pollution take a long time to be implemented and to yield the expected effect. During the time it takes to implement changes, people are continuously exposed to high levels of ambient air pollution. Protection is also needed in households, due to particle matter's ability to penetrate inside buildings and because of pollution generated indoors [11]. These effects can be at least mitigated by personal action and behavioural modifications, such as for example avoiding outdoor activity when pollution levels are high, wearing an anti-pollution mask outdoors and using HEPA air filters in households [12].

The efficiency of air filters and their beneficial effect on health has been demonstrated in many studies [13]. They have been shown to alleviate symptoms of asthma and improve users' vascular health [14].

Certified masks, e.g. N95 masks are also highly efficient appliances, capable of removing 95% of particles above 0.3 μm [15]. These masks are not currently widely recommended for protection due to limited research. However, two studies conducted on healthy individuals and coronary artery disease patients showed that masks have a positive impact on cardiovascular health in a polluted city [16,17]. These direct results, combined with the fact that masks filter out almost all the inhaled pollutants, suggest that masks could be beneficial for patients most susceptible to air pollution. Staying indoors when the pollution is high is also a way of reducing exposure, but due to the permeation of particulate matter, according to the Environmental Protection Agency an air filter should additionally be used [18].

Knowledge and attitudes

The Krakow Smog Alert conducted a survey among ca 1000 Polish people, demonstrating that the society knows little about the levels and types of

pollution or its effects on health [10]. People also did not feel adequately informed about pollution. Similar results were demonstrated in a shorter, government-run survey [19]. However, this report analysed the general population, not groups most susceptible to negative effects of air pollution. They also didn't properly address the important role of healthcare professionals [20,21]. Physicians have a double role to play in the efforts against pollution. Firstly to increase peoples' awareness of the problem and encourage them to take protective measures, and secondly to influence governments and organisations to reduce air pollution at the source [21]. One more recent study showed better results in terms of awareness and taking action against pollution, and found that access to information is not a problem, but the respondents were mainly young adults (only 1% over the age of 65) with higher education (88%), thus yielding biased results [22].

AIMS OF THE STUDY

The aim of our study was to assess the awareness of air pollution and its effects on health, access to information, sources of information, and attitudes towards action against air pollution among the most susceptible population of patients. We also assessed whether patients employ the abovementioned protective measures.

MATERIALS AND METHODS

The survey

Common issues with awareness, seeking information and personal protection were identified by talking with patients. Based on the gathered information and available reports, a survey consisting of 24 questions was constructed. A pilot study was conducted among 20 patients. After this pilot, 2 questions were identified as difficult to understand and were dropped. Due to the identical method, remaining questions being unchanged and no questions having been added, the results of the pilot were added to the study group.

The main part of the survey consisted of 18 questions with answers on a 5 point Likert-like scale. The survey was divided into 2 parts. Part 1 evaluated patients' awareness of air pollution and its' effect on health. Part 2 evaluated attitudes to personal protection and access to information about air pollution. In the actual questionnaire, questions from the 2 categories were scrambled. 4 additional questions were asked. Questions about demographic data (age, gender, size of the place of residence, marital status, number of children, education) were also included.

Patients

The survey was carried out anonymously in the cardiological and internal diseases wards in Mazovian Brodnowski Hospital (Warsaw, Poland). 137 patients were offered to participate in the survey and 107 agreed to participate. The main reasons of refusal were fatigue and lack of interest in the topic. Consent was acquired from all the participants. The patients were given the paper version of the survey personally by members of the research group and could ask questions regarding the questionnaire. 3 questionnaires were excluded due to incorrect completion, leaving 104 final respondents. Questionnaires with up to 1 unanswered question were kept in the database and the missing data was marked. The mean age of the participants was 57.6 years and 58 (56%) were males. All of the patients suffered from diseases which constituted risk factors for negative health effects of pollution, while 31 (30%) suffered from more than one such disease. The most common complaints were cardiovascular diseases (n=52), followed by diabetes mellitus (n=51). Most patients lived in a large city over 500 000 inhabitants (n=44), followed by patients from small towns 10 000 – 100 000 inhabitants (n=26) and rural environments below 10 000 inhabitants (n=19).

Analysis

The data were subsequently analysed using Statistica 13.3 software. The Cronbach's alpha test was used to estimate reliability. The set of 18 Likert-type scale questions had good internal consistency (Cronbach's $\alpha=0.81$), as did the 'Awareness' and 'Access to information and protection' parts (Cronbach $\alpha=0.75$ and 0.80 , respectively). Frequency tables were created to present the responses. Mann-Whitney U tests were used to assess the differences between patients depending on their age group (below 65 or above 65 years), level of education and gender. Mean scores for both parts of the survey were calculated after inverting the scores in question 18, as the statement it contains is false (The air quality in the Masovian Voivodship is good). The mean results were compared using Wilcoxon's test.

RESULTS

Our study group (n=104) consisted of 58 males (56%). 38 patients (37%) were above the age of 65. On average, women were older than men (mean age 62 vs 54, $p<0.05$).

The mean results of part 1 were significantly higher than those of part 2 (4.34 ± 0.52 vs 3.47 ± 0.60).

Poll charts (Figure 1) present the frequency tables of the ratings in the questions in both subscales.

The answers to the final 4 questions are presented as poll charts (Figure 2).

Significant differences ($p < 0.05$, Mann-Whitney U test) in ratings between the groups listed above in questions 1-18 are presented in Table 1. All questions not mentioned in the table did not show differences between the corresponding groups ($p > 0.05$, Mann-Whitney U test). Three of the questions were open ended. Common other reasons for not having an air cleaner (question 19) were: never having heard of them ($n=14$), uncertainty whether filters are effective ($n=4$), too little information about pollution ($n=2$). In question 20, common other reasons for not using facemasks were: having too little information about pollution ($n=7$), avoiding going outside when pollution levels are high ($n=4$), not having thought about a mask ($n=4$), uncertainty whether masks are effective ($n=4$). The only other source of information (question 21) was a smartphone application “Kanarek” ($n=3$).

DISCUSSION

This study analyses the knowledge, access to information and its sources and attitudes toward interventions against pollution among hospital inpatients.

This population is especially important to study due to the increased risk of adverse effects from pollution. We also inquired whether doctors properly inform their patients about air pollution. This is the first such study to be performed in a clinical setting instead of among the general population or e.g. students.

Part 1 - Awareness of air pollution and its impact on health

In the awareness questions, response scores were relatively high (Figure 1) compared to previous studies [10,19]. This difference may be attributed to large media coverage of the subject in recent years in Poland [23]. A partial explanation may also be the fact that some patients who didn't think pollution was a problem refused to participate in the survey. Almost all patients (96%) agree that pollution has a negative impact on health and most agree that it may be the cause of several diseases including cardiac, respiratory and neoplastic diseases. Most patients also agree that pollution may cause many symptoms and may affect daily activity. On the other hand, only 23% definitely agree that pollution causes millions of deaths worldwide (question 7), while the majority (49%) are unsure in that matter. This demonstrates that many patients aren't aware how serious the problem really is and may tend to underestimate it. It is in accordance with results of the ministerial survey, where only 39% of people considered air pollution an important environmental factor for their quality of life [19].

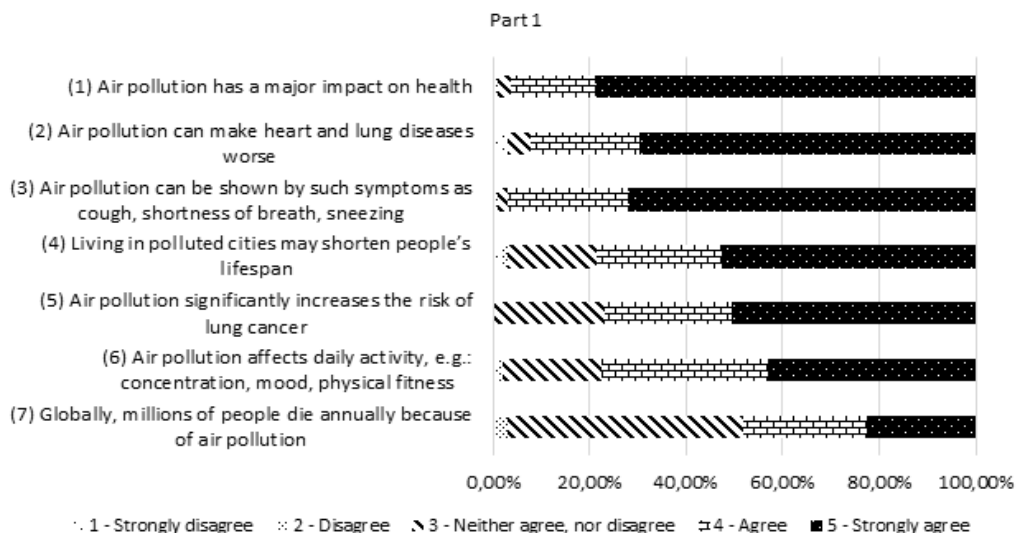


Figure 1. Bar chart representing the results of part 1 of the survey - Awareness of air pollution and its impact on health

Part 2 – Personal protection and access to information

The results of the second part are significantly lower than the first. This is consistent with the results of the Krakow Smog Alert's report (Alert 2015), which also concludes that access to information is very poor. Furthermore, the lower scores in part 2 suggest that despite people's awareness, they do not take action or seek information about pollution. A survey conducted in Spain demonstrated a similar relationship, where despite the fact that 74-85% of respondents considered pollution dangerous, only 14-22% sought additional information [24].

Only 43% of the patients agree that they know where to find information (question 11) and 39% know when official pollution alerts are issued (question 12).

Also, one third of the patients do not agree that it is possible to check a pollution forecast, which is essential for adjusting outdoor activity to air pollution. This shows that information about current pollution levels is not readily accessible to most patients. If people are unaware of alerts and generally uninformed, they will not be able to protect themselves [12].

The lack of information is especially serious among the older and uneducated groups of patients as seen in the disproportion in the answers to questions 10 and 11 (Table 1).

This indicates that special effort needs to be made to reach those groups, by creating easily understandable instructions for them and spreading them by appropriate channels, e.g. by family physicians. Only 48% of the respondents agreed that they are more at risk than the average adult (question 14) which, given that all our patients belong to risk groups, is definitely too few. This may be linked to the fact that only a third of the patients agree that they have been well informed by a healthcare professional (question 8) and therefore many patients are probably unaware of their disease or age being risk factors. A recent survey demonstrated that only 0.5 percent of Polish doctors have adequate knowledge about air pollution [23]. Therefore, it is no surprise that doctors do not properly inform patients. However, most patients agree that pollution is an urgent problem which needs to be solved, thus expressing their support for systemic changes and most have a positive attitude towards personal protection (questions 9,13,15,17).

This positive attitude may be seen as a teaching opportunity and could be used to encourage people to take action against pollution. Better access to information can also be a driving force for changing the environment [25].

Applying personal protection

Questions 19 & 20 (Figure 2) evaluated whether patients employ personal protection and identified what issues people see with masks and home air cleaners. Only 3% of the patients use air cleaners. Most (43%) do not own one simply because they never thought about it, which is probably again related to the low quality of public information. Although home air filters may be of little use to active people who spend much of their day at work, commuting or outdoors, they could offer significant benefits for older patients who spend much of their time at home [13]. The cost of air filters was a main factor only for 7% of the patients, but this result may be underestimated because of people who do not know the prices of such devices due to the lack of interest in purchasing them. Few people use facemasks and the main reason for not using them is a lack of perceived need (35%). We found that discomfort from wearing them was not a common problem, which is in accordance with previous studies [17]. These low results strongly contrast with the answers to questions 13 & 17, where 69% agreed that it is good to have filters at home and 72% agreed that it is good to wear facemasks. The large discrepancy between attitudes and actual action is probably due partly to patients being unaware of being more susceptible, which is essential for personal protection [12]. Another reason could be that patients are rarely informed by professionals and therefore are not sure what actions might be beneficial for their health.

Rating of information

Only 28% of patients rate the availability of information well (Figure 3). This is similar to the Ministry's report [19], showing that unfortunately access to information has not improved in the past 3 years. Furthermore, people from the most susceptible population constituting our study group are not better informed than the general population.

Sources of information

We identified patients' main sources of information are television, the Internet and radio (Figure 4), which are often unreliable [26]. The sources which are reliable and should be the most important for patients, i.e. medical professionals and public information campaigns occupy the last two places. This could be changed in several ways, e.g. by aiming information campaigns at family physicians who would in turn inform their patients or by designing media campaigns to be delivered via the most commonly used channels, i.e. television and the Internet. Recently, experts from the European Respiratory Society advised that physicians should

inform their patients about air pollution and ways of protection, especially focusing on simple, practical advice [20]. It was also recommended that local guidelines should be created for informing patients. The smartphone application “Kanarek” was also mentioned as an important source of information by 3 patients. It is an application developed by an anti-

pollution activist and uses data from the Chief Inspectorate of Environmental Protection to present them as notifications, a widget and simple graphs. Given that 64% of the Polish population own smartphones, such a solution could be promoted to improve the awareness of current pollution levels [27].

Table 1. Significant differences in answers to the survey between the respondents based on age, sex and education

Question	Mean score		p
	<65 years	>65 years	
I am more at risk of harm from air pollution than the average adult	3,3	4,2	<0,001
Globally, millions of people die annually because of air pollution	3,5	4,0	0,005
I know where to find reliable information about the current air quality	3,3	2,6	0,034
I remain at home when air pollution levels are dangerously high	2,8	3,4	0,032
	Female	Male	
Air pollution can make heart and lung diseases worse	4,5	4,6	0,026
Air pollution can be shown by such symptoms as cough, shortness of breath, sneezing	4,7	4,6	0,004
Air pollution significantly increases the risk of lung cancer	4,2	4,4	0,033
I am more at risk of harm from air pollution than the average adult	3,3	4,2	<0,001
It's possible to check a pollution forecast			
I remain at home when air pollution levels are dangerously high	3,5	3,3	0,040
It's good to use an anti-pollution facemask	2,8	3,4	0,038
	Primary education	Secondary or higher education	
I know when the Main Inspectorate of Environmental Protection raises a pollution alarm	1,6	3,1	0,001
I know where to find reliable information about current air quality	1,7	3,2	0,003

¹ Mann-Whitney U test

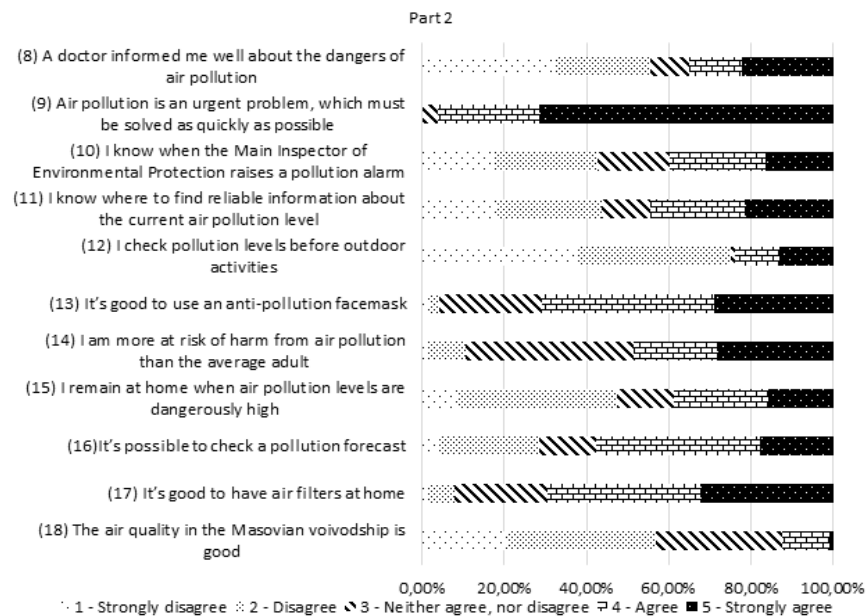


Figure 2. Bar chart representing the results of part 2 of the survey – Personal protection and access to information

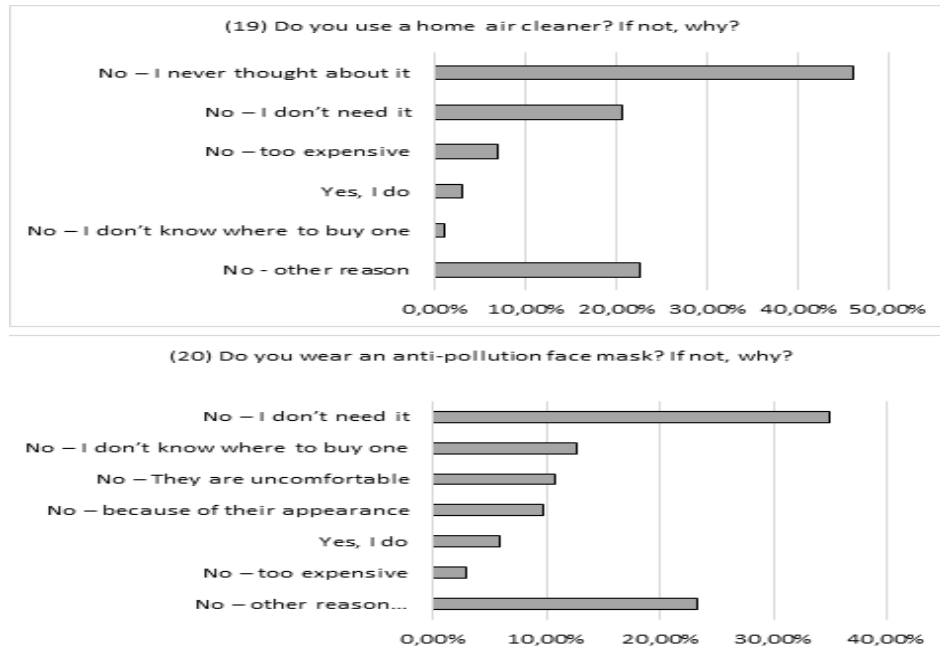


Figure 3. Bar charts representing the answers to questions 19 and 20

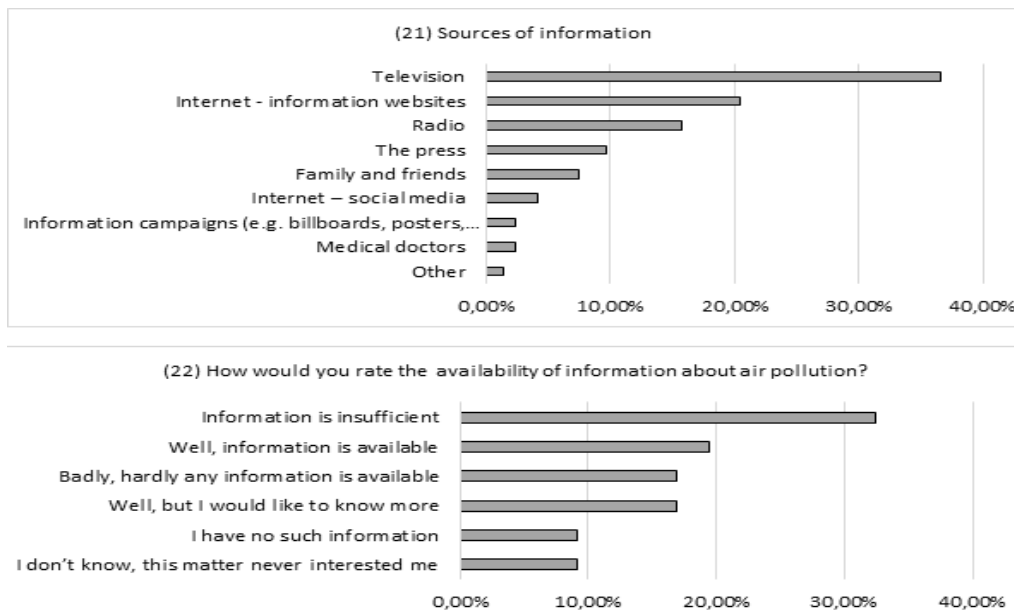


Figure 4. Bar charts representing the answers to questions 21 and 22

CONCLUSIONS

Our study stresses the urgent need to inform patients, above all: whether they are in a more susceptible group, where to find reliable information

about current pollution levels and what action can be taken for personal protection. Special attention needs to be paid to providing information accessible to the older and uneducated patients, who we found have most difficulties in accessing it. Pollution alerts should

also be known by everyone, which our study demonstrates is not currently the case. Due to the demonstrated tendency towards underestimating the effect of pollution on health, patients should be informed that air pollution is an important cardiovascular and respiratory risk factor. Further work should be devoted to preparing precise guidelines for doctors pertaining to air pollution.

Study limitations

A limitation is that some patients did not agree to participate in the study due to a lack of interest in the subject. These patients could potentially have the least knowledge and thus the results could slightly overestimate the knowledge. Further limitations are a small study group and the use of a non-validated questionnaire. Also, the study group was selected from cardiological and internal diseases wards and is not representative for the entire population of hospital patients.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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