

# THE INDIRECT COSTS OF ALLERGIC DISEASES

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## Abstract

It is estimated that every third person living in Europe suffers from allergic diseases. Allergies are a growing health problem in Poland where 40% of the population have allergy symptoms, including 12% afflicted with asthma. The actual cost of allergic diseases is difficult to estimate due to the lack or incompleteness of the relevant data. The aim of this review is to present estimates of the indirect costs of allergic diseases in Poland and globally, using asthma, allergic rhinitis and atopic dermatitis as examples. The analysis also includes the impact of allergic diseases on the costs to the social welfare system and employers. The literature review of the indirect costs of allergic diseases shows that the indirect costs of a disease, which substantially exceed the direct costs, increase with the disease activity and severity. Interestingly, some studies have found that the indirect costs of lost productivity due to hours missed from work to take care of a sick child could be threefold higher than those of absence due to a worker's own illness. The indirect costs of a disease can be significantly reduced by early diagnosis and appropriate treatment. *Int J Occup Med Environ Health.* 2019;32(3):281–90

## Key words:

atopic dermatitis, asthma, allergy, allergic rhinitis, indirect costs, Europe

## INTRODUCTION

Allergies are a major cause of morbidity in children and adults under the age of 40. The incidence of allergic diseases has been steadily increasing over the last several decades, as documented by numerous published epidemiological studies, and now allergy and asthma affect over 30% of the population [1–3]. Interestingly, the increasing incidence is observed mostly in the countries where previously allergies were relatively rare [4]. The environmental factors, including housing conditions, occupational environment, chemical pollution and dietary habits, have a significant impact on the increasing incidence of allergies [1,2–4]. It is estimated that nowadays every third inhabitant of Europe suffers from allergies [1]. In Poland, signs and symptoms of allergy are found in ca. 40% of the population, including asthma confirmed by

a medical examination in 11%, and signs and symptoms of asthma in 12% [5].

All diseases are associated with direct, indirect and social costs. The direct costs are related to the provision of healthcare, which includes the cost of prevention, diagnosis, treatment, rehabilitation, etc. The indirect costs are linked to production losses resulting from lost productivity due to morbidity.

Mostly, the indirect costs of a disease are induced by premature departure from the labor market, absenteeism and presenteeism (coming to work despite illness, often resulting in reduced productivity). The social costs are defined as social welfare loss. Apart from lost production, the category of indirect costs includes any costs associated with pain and suffering, the loss of leisure time and an impaired quality of life due to a disease. It is very difficult to express

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social costs in monetary terms and their estimates could give rise to controversies.

Indirect cost studies are an important source of information for evidence-based policies. Considering the evidence-based national health policy decisions (e.g., prescription drug reimbursement), informed by the analyses of indirect and direct costs, makes an assessment of their consequences easier [6] and contributes to a more effective management of healthcare resources.

The main purpose of this study is to present the available data concerning the indirect costs of allergic diseases (asthma, allergic rhinitis and atopic dermatitis) in selected countries with respect to the databases reporting indirect costs in a given country. A rich body of knowledge (including the USA, Switzerland, Spain, and Sweden) provides an introduction to developing a new validated implementation tool in Poland.

The authors of this publication underline the need to develop an instrument for monitoring indirect costs, which will enable future cooperation based on the expertise and improvement of data analysis tools on the socioeconomic situation in Poland.

## ETIOLOGY AND EPIDEMIOLOGY OF ALLERGIC DISEASES

### Asthma

Asthma is a life-long or chronic inflammatory disorder of the airways, associated with their structural changes. The disease is also associated with bronchial hyperreactivity and obturation, which may be controlled by appropriate treatment [7]. Atopy, i.e., the genetic tendency to develop IgE-mediated hypersensitivity to common inhaled allergens, is the most frequently observed factor predisposing to asthma, especially in children [7]. Epidemiological studies have confirmed that asthma and allergy afflict over 30% of people worldwide [1–3]. The countries where asthma was previously rare are now characterized by its increasing incidence and prevalence [1,4]. Bron-

chial asthma is an incurable disease which may lead to permanent impairment of respiratory tract functions [8]. That is why asthma, with its troublesome chronic symptoms, has a considerable impact on the patient's work performance, and social as well as family life. Asthma is also associated with sickness absences from work, productivity loss and frequent hospital admissions in severe disease cases [9].

According to the World Health Organization (WHO) estimates, globally, approximately 235 million people suffer from asthma [10]. Asthma-related deaths occur mostly in low and lower-middle income countries. According to the most recent WHO estimates released in December 2016, globally, there were 383 000 deaths due to asthma in 2015 [10].

According to the Centers for Disease Control and Prevention (CDC) estimates, some 24 million Americans suffer from asthma. The National Health Interview Survey (2011) estimated that in the USA nearly 40 million (12.9%) people, including 10.5 million (14%) children, had been diagnosed with asthma at some point in their lifetime. In the USA, the mortality rate due to asthma is nearly sevenfold higher in adults (13.7/1 million) than in children (2.6/1 million) [11].

In Poland, asthma is one of the most common respiratory diseases and a significant public health problem, since 12% of the Polish population suffer from its symptoms [5]. According to the Epidemiology of Allergic Diseases in Poland (Epidemiologia Chorób Alergicznych w Polsce – ECAP) study estimates, approximately 4 million people in Poland suffer from asthma [12]. Asthma confirmed by a medical examination was found in 11% of the children participating in the study [5].

The ECAP study found allergy confirmed by a medical examination in 40% of children, including asthma in 11% [5]. Of all the respondents with asthma diagnosed within the ECAP study, only 30% had been previously diagnosed with this disease. This shows that asthma may be under-

diagnosed in as many as 70% of patients from both urban and rural areas, and in 80% of children aged 6–7 years [5].

### Allergic rhinitis

Allergic rhinitis is a clinical syndrome comprising such symptoms as sneezing, itching, rhinorrhea and nasal congestion, which result from an IgE-mediated inflammatory response of the nasal mucosa exposed to the allergen [13]. The triggers of allergic inflammation of the airway include single proteins in foods, pollens, dust mites, mold spores, animal dander, fur, excretions and secretions [13]. Allergic rhinitis is a multifactorial disease resulting from genotype–environment interactions. Indoor (dust mites, molds, animal dander and fur, insects) and outdoor (molds and pollens) airborne allergens are the main causes of allergic rhinitis while food allergens are considered its rare triggers. Agents found in the workplace may cause rhinitis via allergic and non-allergic mechanisms. Allergic rhinitis may be also triggered by household and atmospheric air pollution [14]. According to the Allergic Rhinitis and its Impact on Asthma (ARIA, 2008) classification, allergic rhinitis is now divided into persistent allergic rhinitis and intermittent allergic rhinitis [14]. Allergic rhinitis is a common disease, which affects people irrespective of their country of origin, age or ethnicity. The symptoms of allergic rhinitis have a significant impact on the patient's quality of life and cause such problems as sleep deprivation, or less effective work or school performance [13]. It has been estimated that, globally, allergic rhinitis affects 10–30% of the population [15].

The increasing incidence of allergic diseases, including allergic rhinitis, observed in recent years, has prompted a number of studies to estimate the scale of this trend. One of these studies was the European Community Respiratory Survey (ECRHS), the first multicentre study conducted on a representative sample of people aged 20–44 years [14]. According to the survey, the lowest prevalence of allergic rhinitis occurred in Spain (11.8%)

and the highest in Australia (46%). In Europe, the mean prevalence rate is 20.9% [16]. The International Study of Asthma and Allergies in Childhood II (ISAAC II) conducted in a large number of centers around the world in 6–7-year-olds and 13–14-year-olds estimated the mean prevalence of allergic rhinitis at 42.1% of the study population, with the lowest rates in Georgia (19.2%) and Albania (21%), and the highest rates in Brazil (47.2%) and Chile (48%). In Western Europe, 39.8% of the study population had allergic rhinitis and in North-Eastern Europe – 35.1%. The highest prevalence rates were found in Ireland (45.1%) [13]. In Poland, according to the results of the ECAP study, the mean prevalence of allergic rhinitis in the study population was 22.54%, with allergic rhinitis diagnosed in 23.6% of 6–7-year-olds, 24.6% of 13–14-year-olds, and 21% of adults [17]. As evaluated by physicians, persistent allergic rhinitis was more common than intermittent allergic rhinitis (52.3% vs. 47.7%) [13].

### Atopic dermatitis

Atopic dermatitis (AD) is a chronic, recurrent inflammation of the skin with severe pruritus as the primary symptom, and a typical location and morphology of the skin lesions. The patient and/or family members may also present with other features of atopy [17]. Atopic dermatitis is often the first manifestation of atopy, and early diagnosis and intervention may slow down or stop the atopic march [7]. The risk factors linked to the increasing incidence of AD include housing conditions, urban environment and smoking, as well as the educational level and socio-economic status [18]. At present, the incidence of AD is increasing worldwide [7].

According to the ECRHS and ISAAC estimates, AD may affect 10–15% of the population, and it is more prevalent in children (20%) than in adults (1–3%) [17]. In highly industrialized countries, the incidence of AD has increased two- to threefold in the last decade. According to the Asthma and Allergy Foundation of America (AAFA) estimate

of 2012, 8.8 million of American children had skin allergy, with 0–4-year-olds affected more frequently than any other age group. According to the National Health Interview Survey (1997–2011), the incidence of skin allergies decreases with age (the incidence rates are 14.2% in children  $\leq$  4 year of age, 13.1% in 5–9-year-olds, and 10.9% in 10–17-year-olds) [19]. The data also confirm a continuing growth of the AD incidence rate in children, from 8% in 1997 to 12% in 2010–2011 [20]. In the USA, the National Survey of Children's Health (NSCH, 2007–2008) found mild AD in 67% of children, moderate AD in 26%, and severe AD in 7% [20]. According to the ISAAC III study, the prevalence rates  $>$  15% were found in 4 of the 9 study regions, in Africa, Latin America, Finland and Oceania [21]. The same study found that in the countries with the previously highly prevalent AD (United Kingdom and New Zealand) the rates leveled off [22,23] at about 20% [18]. Atopic dermatitis is the most prevalent in Scandinavia (15.6–22.3% of the study population, depending on age) and the United Kingdom (10.6–16%), and the least prevalent in Lithuania (1.8–3%) and Albania (2–3%). In Poland, AD is estimated to affect 11.5% of 6–7-year-olds and 8.5% of 13–14-year-olds. The ECRH study in adults (20–40 years of age) estimated the prevalence of AD at 7.1%. Among adults, AD was the most prevalent in Estonia (17.6%), the United Kingdom (8.1%) and Scandinavia (8–9%), and the least prevalent in Switzerland (2.2%) [18]. In Poland, in the ECAP study, 3.9% of the study population had AD (5.3% of 6–7-year-olds, 4.3% of 13–14-year-olds, and 3% of adults), and the rates of AD prevalence in all age groups were found to be much lower than the mean prevalence for Europe [18].

## METHODS OF CALCULATING THE INDIRECT COSTS OF A DISEASE

### The human capital approach vs. the friction cost approach

The indirect costs of a disease are related to lost production as a result of the disease, disability or premature

death. The indirect cost is linked to a disease, not to a medical technology, while a particular medical technology can contribute to reducing the indirect cost of a particular disease [24]. Two main models are used for the assessment of the indirect costs of a disease, each with significant limitations. One model assumes that productivity loss generates an additional economic burden and, hence, it should be recorded as costs. The other model, based on the health status assessment, assumes that productivity loss is essentially associated with a reduced quality of life and the effects of this parameter are seen in the health outcome rubric [25].

In the first model, 2 methods of calculating the indirect costs of a disease are used, i.e., the human capital approach (HCA) and the friction cost approach (FCA). In the human capital approach, any loss of productivity due to an individual's disease is treated as a cost born by the society. According to the friction cost approach, a burden on the society associated with the patient's productivity loss is limited to the transaction costs associated with the replacement of the patient in the workplace. Accordingly, under the human capital approach, an individual leaving the workplace with invalidity pension is seen as generating indirect costs until they reach non-working age, while under the friction cost approach, the cost relates to the length of time needed to find the replacement, which is usually a few months. [26].

Overestimating the productivity loss as perceived by the society is the major limitation of the human capital approach. Workers who depart from the labor market due to a disease may be replaced in a shorter time than the time required to reach non-working age, and the human capital approach does not take into account the stages of the business cycle. Estimating the potential maximal, but not actual, productivity loss is another weakness of the approach. [26]. The friction cost approach assumes that absence from work due to illness (absenteeism) contributes to a reduction of unemployment in the population although there are no available

data to confirm this association in the long term. Another limitation of the friction cost approach is its assumption of an almost ideal labor market, with large numbers of candidates ready and suited to replace the workers who have left. The approach may be used to estimate the value of productivity loss in the workplace, but not to value the loss of household productivity [26].

### **Productivity loss: absenteeism and presenteeism**

The costs of productivity loss include the costs associated with absenteeism, presenteeism, non-formal care, unpaid work and the loss of leisure time [25]. Productivity of individuals suffering from a disease may be assessed relative to gainful employment, unpaid work or leisure time. With gainful employment, the indirect costs may result from absence from work due to illness (absenteeism) or reduced productivity resulting from coming to work despite illness (presenteeism).

The term absenteeism generally refers to 2 types of absence from work. One is short-term absenteeism (sickness absence) measured in days or hours of absence, or days on a sick leave. Sickness absence may include a paid annual holiday or leave of absence for precautionary reasons when they are spent on treatment or rehabilitation, as well as leaving work early, being late for work or working shorter hours due to illness [24].

Long-term absenteeism includes permanent incapacity for work and premature death. In the case of permanent incapacity, a patient suspends or ceases gainful employment, which is usually associated with a temporary incapacity benefit or invalidity pension. When considering productivity loss, premature death is defined as the death which occurs before a person reaches the upper limit of working age [25].

Presenteeism, also referred to as at-work-productivity loss or at-work-disability, when a worker is incapable of fulfilling their responsibilities, is another factor generating the indirect costs of lost productivity. The indirect costs of presenteeism result from a reduced productivity and qual-

ity of work performance, or from longer rest breaks due to experiencing disease symptoms [24,25].

### **Sources of data on indirect costs**

The issue of indirect costs gives rise to a number of controversies. In the absence of hard data, all analyses are based on estimates characterized by different degrees of accuracy. In Poland, the basic data on short- and long-term absenteeism are provided by the Social Insurance Institution (Zakład Ubezpieczeń Społecznych – ZUS), and can be accessed through its Statistical Portal. These include information on medically certified temporary incapacity for work, or temporary incapacity benefits or invalidity pensions granted to the patients [27]. The Social Insurance Institution provides information on first-time and repeatable statements on fitness for work, issued by physicians, along with the number of medical certificates issued and the total number of days missed from work, presented using the coding system of ICD-10. The Agricultural Social Insurance Fund (Kasa Rolniczego Ubezpieczenia Społecznego – KRUS) does not release statistics on medically certified incapacity for work. The ZUS data are often insufficient for the analysis of lost productivity costs, even of the costs of a disease [25].

The studies on the scale of absenteeism, published internationally, in addition to official data, rely on the survey data collected directly from respondents and include information on the duration of sickness absence, reflecting the patient's state of health and disease progression or the interventions used [24]. None of the public institutions in Poland is concerned with estimating the scale and impact of presenteeism. The only available data on disease-associated productivity loss come from studies on patient populations and are focused on productivity loss. The scale of presenteeism is usually estimated with specifically designed questionnaires, a dozen of which are currently used worldwide. In Poland, the Polish version of the *Work Productivity and Activity Impairment* (WPAI) questionnaire [25] has been mainly employed.

In this context, it should be underlined that indirect costs vary considerably, depending on the country, and these differences result, among others, from the level of development of a given region. Poland has a relatively cheap labor force, so comparing data from Poland to data from western countries entails a certain risk of bias. The amount of indirect costs is related to the epidemiology of diseases, as well as to the labor market and the economy. In Poland, a serious problem is also posed by the limited access to epidemiological data, for example, the lack of statistical data from KRUS (over 40% of the insured people in Poland). Therefore, the epidemiological data and costs, calculated on the basis of these data, may be underestimated. According to the 2014 data, 1 432 725 people were insured in KRUS [28].

## THE INDIRECT COSTS OF ALLERGIC DISEASES

### Asthma

#### USA

In most patients with asthma attacks, the mean duration of a single sick leave is 5.6 days. When hospital admission is required, the average number of days missed from work is 13 days, including 4 days of average hospitalization [29]. A study covering the years 2002–2007 estimated the cost of work days lost due to asthma at 301 USD/year/person in gainful employment and at 93 USD/year/student [29]. In 2007, the continuously increasing economic burden of asthma to the society was 56 billion USD for the entire population [29]. The average indirect costs of asthma were assessed at 1732 USD/person, including 1062 USD (61%) of the cost associated with total work cessation attributed to asthma, and the remaining cost related to sickness absence and reduced work hours [30].

#### Europe

In Switzerland, according to the Swiss Federal Statistical Office, the mean annual indirect cost related to asthma is 1019 CHF (1050 USD) per patient (30 CHF [31 USD]

per child and 1264 CHF [1302 USD] per adult) [31,32]. The productivity loss attributable to workers on a sick leave for family care purposes (caregiver absenteeism) constituted the largest proportion of the indirect costs of lost productivity, at 946 CHF (978 USD) per year vs. 318 CHF [329 USD] related to absence due to the worker's own illness [31,32].

Ojeda et al., in their study conducted in Spain in 2013 on 1098 patients with asthma, aged 18–65 years, concluded that the mean monthly cost of work days lost due to asthma was 286 EUR/patient (95% CI: 253–319 EUR) [33].

#### Poland

According to the report published by the Lazarski University Institute of Healthcare Management [34], 500 medical certificates of illness due to asthma were issued in 2013, with the average sickness absence of 6.4 days/patient, which translated into 0.2% of public expenditure associated with temporary incapacity. When incapacity was related to status asthmaticus, the costs due to the incapacity benefits and sickness absence amounted to 56.4% and 43.5% of the expenditure, respectively [34]. At the same time, the study by Jahnz-Różyk et al., conducted in 2012 on 128 patients with asthma, determined the average indirect cost of the disease, using the human capital approach, at 4288 EUR/person [35].

### Allergic rhinitis

#### USA

Based on the results available in the U.S. literature, it was estimated that in 2003 the indirect costs of allergic rhinitis varied from 0.1 billion USD to 9.7 billion USD, with the mean indirect cost of 593 USD/worker with allergic rhinitis vs. 85 USD/worker with asthma [36,37].

#### Europe

According to a Swedish study conducted in 2008, 37% of the study population reported at least 1 day missed from

work due to the troublesome symptoms of allergic rhinitis. The mean productivity loss for all workers, associated with absenteeism, presenteeism or taking care of a child with allergic rhinitis (caregiver absenteeism), was 5.1 days, which translated into a 22% decrease in the mean productivity level [38]. The total annual cost of lost productivity was 653 EUR/worker (absenteeism 286 EUR, presenteeism 242 EUR, and care of a child with allergic rhinitis 124 EUR) [38]. The estimated total indirect costs associated with allergic rhinitis and the common cold exceeded 2.7 billion EUR in 1 year, including 44% due to absenteeism, 37% due to presenteeism, and 19% due to absence from work to take care of a family member suffering from allergic rhinitis [38]. It was demonstrated that reducing absenteeism by 1 day per each allergic rhinitis patient could save 528 million EUR/year or 20% of all costs [38]. In the years 2000–2007, Valdenplaas et al. studied patients with allergic rhinitis and observed symptoms that were associated with self-reported substantial impairment of at-work performance in 79.2% of patients although the extent of difficulties due to allergic rhinitis was not fully defined [39]. The study conducted in Spain in 2015 by Colas et al. presented the indirect costs of allergic rhinitis. The mean absenteeism was estimated at 3.12 days/year while 137.35 work hours were lost per year due to presenteeism. The total indirect costs were 1773 EUR/year (presenteeism 1683 EUR, absenteeism 90 EUR) [40].

#### Poland

There are no data on the indirect costs of allergic rhinitis available from studies published in Poland. This provides the basis for the Polish healthcare system for developing an original (based on experts' experience and solutions used in other countries) tool, patterned after reporting systems from all over the world. The Polish healthcare model is constantly developing and striving for the creation of the world-class database that would include data from all over the world. This platform will facilitate the flow of infor-

mation on the current state of allergic diseases between all the countries. The progressive phenomenon of allergic diseases requires an increased control of the indirect cost rates and, hence, the implementation of procedures reducing the social consequences of allergies.

#### Atopic dermatitis

##### USA

The study conducted by Filanovsky et al. [41] in the years 2011–2013 demonstrated that in the USA the indirect costs accounted for most of the total costs associated with the treatment of AD. The mean indirect cost was 199 USD/worker/year, with a wide difference between patients who had commercial insurance (436 USD) and patients with Medicaid (164 USD) [41]. As many as 40.5% of the respondents took a leave of absence for the care of a child with AD, which translated into 20 work hours missed a year, while 6.3% of the workers paid for childcare [41].

At present, there are no data available on the indirect costs of AD in Europe, including Poland.

In contrast to the measurable indirect costs in bronchial asthma, there are no such data on AD and allergic rhinitis in Europe (including Poland). Therefore, it is necessary to develop a common tool for data transfer in European countries.

Indirect costs form a significant part of all the costs related to allergic diseases. According to the report published by the Lazarski University Institute of Healthcare Management [34], the Polish National Health Fund spent 6 863 070.53 thousand PLN on the reimbursement of prescription drugs [34]. Medicines used for respiratory diseases accounted for 13.54% of the total amount of reimbursement, followed by drugs used in bronchial asthma with 8.39% [34].

#### CONCLUSIONS

As far as the measurable costs of civilization diseases are concerned, it is worth developing a tool similar to the already existing reporting databases that work very well in

the Polish healthcare system. Considering the fact that the problem of allergic diseases is increasing, the development of this platform will facilitate the monitoring of the current situation and allow taking the appropriate steps to reduce the scale of this problem.

Despite the limitations of the review, a number of facts deserve attention. Firstly, the analysis of the cost of lost productivity associated with allergic diseases shows that the indirect cost, in terms of lost productivity, is higher with caregiver absenteeism than with work days lost due to one's own illness. Secondly, in many countries around the world there has been a steady increase in the number medically certified sick leaves and the total number of days of sickness absence due allergic diseases, which reflects a growing problem with an increasing impact on the labor market. Thirdly, the findings of the Spanish study showed that, in the case of allergic rhinitis, the indirect costs are much higher than the direct costs borne by the payer [40]. The case of allergic rhinitis shows how the costs rise with the increasing disease activity. An adequate disease control not only leads to an improved quality of a patient's life but also substantially decreases the indirect costs of a disease.

Allergic diseases are increasingly the cause of sickness absence from work. Their troublesome symptoms result in temporary or permanent incapacity for work, productivity loss and a financial burden to both employees and employers. Early diagnosis and appropriate treatment could lead to reducing the burden to the national economy associated with absenteeism and presenteeism, and their costs.

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