

# The Financial Burden of Acute Nasopharynx and Acute Bronchitis of Children from Different Perspectives: The Cost-Of-Illness Study in the Czech Republic

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## Abstract

Acute nasopharyngitis and acute bronchitis are common childhood diseases. The problem is that the cost of these different subjects in the economy is unknown. This article aims at estimating the cost of acute nasopharyngitis and acute bronchitis per incidence from the perspective of society, employers, state budget, system of healthcare and households in children aged 4–15 years in the Czech Republic. We used an incidence-based Cost-Of-Illness study based on the typical course of disease. We estimated the mean societal cost per episode of acute nasopharyngitis at EUR 613 (children 4–10 years) and EUR 610 (children 11–15 years) and 1 episode of acute bronchitis at EUR 963 (children 4–10 years) and EUR 960 (children 11–15 years). Overall, the state budget and employers bear the highest costs in the Czech Republic. We estimated the share of cost from the perspective of the state budget at 47.3–49.7% and from the perspective of employers at 66.4–67.8%. The majority of these costs arise in indirect costs in connection with parents' absenteeism from work.

## Keywords

Cost-Of-Illness, Acute nasopharyngitis, Acute bronchitis, Children Perspective

## JEL Classification

H51, I13, I14, I18, I31

## Introduction

Acute nasopharyngitis and acute bronchitis are common childhood diseases. An integral part of these diseases is their economic burden, which is closely related to the treatment of the disease. The results of the National Institute of Public Health (NIPH, 2017) showed that 18.82% of children aged 5 to 17 suffer from recurrent nasopharyngitis (at least five times a year) and 8.67% of children suffer from frequent, repeated acute bronchitis (more than three times a year). Air pollution (NIPH, 2016) has a significant impact on disease prevalence.

In this paper, we estimate the cost of morbidity for these two common respiratory diseases using the Cost-Of-Illness method (COI). We evaluate costs from a social perspective, as well as from the perspective of the health care system, the state budget and households in 2020 prices. We are convinced that it is very important from a social point of view to look at the individual cost burden for the public sector and households. Although these are common non-serious diseases, which mainly appear in children during winter, they can represent a significant financial burden on public budgets.

The aim of this article is to estimate the costs of morbidity for acute nasopharyngitis and acute bronchitis in children aged 4 to 15 years using the Cost-Of-Illness method from the various perspectives of those who bear the costs. We will identify risks that the high prevalence of these diseases can bring to individual subjects. No similar study has been conducted in the Czech Republic. We consider it important to calculate the cost of common respiratory disease from different perspectives in order to know the main cost factors and the burden on the national economy subject.

The article is structured as follows: the first part contains a detailed description of the methodology used and the procedure for calculating direct and indirect costs, including data sources. The second part of the article presents the results of the economic evaluation of sickness costs from the individual perspectives of the bearers of the costs. The results are then discussed further, in particular the limitations of the study.

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## Literature Review

The Cost-Of-Illness method is quite commonly used to assess morbidity costs for various diagnoses. COI studies tend to be conducted for more severe diseases, such as cancer (Luengo-Fernandez et al., 2013), locomotive organs (Vargas et al., 2018), bowels (Bassi et al., 2004), asthma (Weiss et al., 2000), diabetes (de Lagasnerie, et al., 2018). These results were confirmed by a summary study by Brodzsky et al. (2019), which identified Cost-Of-Illness studies in the countries of Central and Eastern Europe. For common respiratory diseases, the cost of morbidity is rarely estimated. E.g. Srivastava and Kumar (2002) calculated the direct and indirect costs of bronchitis in Mumbai, and Quah and Boon (2003) calculated them for lower respiratory diseases in Singapore. Most studies then evaluate the financial burden of the disease from a social perspective, but only a few evaluate from an individual perspective. E.g. Hollinghurst et al. (2008) estimated the cost of one episode of acute cough and the annual costs for UK preschool children from the point of view of national health services and caregivers. The economic implications of treating lower respiratory tract infections in children aged 0–36 months in Germany were evaluated by Ehken et al. (2005) from a social, parental and third-party payer perspective. Schot et al. (2019) focussed on assessing the costs of respiratory tract infection from the perspective only of parents. The mean cost of acute respiratory disease was calculated by O'Grady et al. (2004). Also, they focussed on the main cost drivers of illness and the proportion of cost borne by the family. However, in the Czech Republic, a Cost-Of-Illness study for acute nasopharyngitis and acute bronchitis has not yet been undertaken. It is essential to assess the costs within the specific circumstances of the country, because as shown by the study by Brodzsky et al. (2019), in which Cost-Of-Illness studies in nine Central and Eastern European countries were identified, the results differ significantly in the methodology used, the publication practice and the clinical areas. Because of this diversity, it is difficult to transfer the results between countries.

## Methods

### *The conception of the Cost-Of-Illness study and its Perspective*

The Cost-Of-Illness method estimates all treatments in monetary terms and thus represents an estimate of the overall burden on society (Jo, 2014; Byford et al., 2000). It is, therefore, one of the forms of economic evaluation in health care. It assesses the economic burden on society in terms of the consumption of health care resources and production losses (Tarricone, 2006), while the traditional approach includes the analysis of direct costs, which mainly consist of health care costs, and indirect costs or loss of productivity related to morbidity. The resulting costs can be considered a conservative estimate and a lower limit to the real costs (e.g. Abdullah et al., 2017; Hoagland et al., 2009; Ried, 1996).

The estimation of direct and indirect costs is based on a predetermined model of the disease that reflects its standard course without complications or co-morbidities. In this study, direct costs include health costs that are the result of illness. They include expenditure on medical care, in particular expenditure on diagnosis, treatment and medicines. The valuation of indirect costs is based on the traditional human capital approach (HCA), which estimates the value of the potential loss of production (wages) due to illness. HCA assesses the disease burden in terms of lost opportunities, and it measures productivity loss in terms of expected future income (Tarricone, 2006). HCA looks at lost production from the worker's perspective, counting every hour that was not worked by them.

The COI study can be conducted from several perspectives, through which the burden on different subjects can be assessed. The social perspective is the most comprehensive because it involves both direct and indirect costs for all members of society and thus provides a complete analysis useful in e.g. Cost-Benefit Analysis, Cost-Effectiveness Analysis and Cost-Utility Analysis. Comprehensive studies such as these, which analyse costs from all perspectives, provide the most relevant basis for decision-making in public policy (Weissman and Rosselli, 2017; Clabaugh and Ward, 2008; Dolan and Edlin, 2002; Segel, 2006). It should be added here that for these cost bearers, which include costs covered, the resources are not used but rather redistributed (e.g. transfer payments).

The social costs in this article include only those costs that actually pass through the market and that are directly attributable to the diseases in question. In case of direct costs, we did not include for example, health and public health research expenditure, health programmes, preventative programmes, administrative costs, capital (infrastructure, machinery) (Health Canada, 2002) are not included in the evaluation. Costs for the state budget, such as indirect taxes, are also not included. For those, it would be very problematic and inaccurate to estimate the company's lost production due to the absence of 1 worker. In case of indirect cost we conducted an assessment only for mothers inside the labour market, also the mothers of children over four years of age, which is the highest age limit in the Czech Republic for receiving a parental allowance. Overall calculation of cost show following formulas:

- [1] *Total social cost = direct social cost + indirect social cost*
- [2] *Direct social cost = treatment cost + cost of medication*
- [3] *Indirect social cost = loss of value of work + sickness insurance benefits + compulsory insurance paid by the employer*
- a. *Loss of work value =  $\left(\frac{\text{average monthly wage}}{21 \text{ working days}}\right) \times \text{number of days of illness}$*
- b. *Sickness insurance benefits = 60% of daily assessment base for caring for a sick person  $\times$  number of days of illness*
- c. *Compulsory insurance paid by employer = (% social insurance + % health insurance)  $\times$   $\left(\frac{\text{average monthly wage}}{21 \text{ working days}}\right) \times \text{number of days of illness}$*

The following tables (Table 1, Table 2) show the basic calculation of Cost-Of-Illness including data sources from individual perspectives. The chapter Methods and Data introduces a specific procedure of calculation of individual types of costs in the Czech Republic.

**Table 1.** Direct costs - calculation and data.

Perspective	Direct Costs	Source
Household	Medication	State Institute for Drug Control
Employer	Not relevant	Not relevant
System of Healthcare	Medical procedures and medication	Decrees of the Health Ministry, State Institute for Drug Control
State Budget	Not relevant	Not relevant

**Table 2.** Indirect costs - calculation and data.

Perspective	Indirect Costs	Source
Household	(Daily net salary - daily care allowance) $\times$ number of days of illness	Average gross wage in the Czech Republic by the Czech Statistical Office
Employer	Hourly labour costs $\times$ 8 working hours per day $\times$ number of sick days	Labour costs by the Czech Statistical Office
System of Healthcare	(13.5% health insurance $\times$ average gross wage) / 21 working days $\times$ number of sick days	Average gross wage in the Czech Republic by the Czech Statistical Office
State Budget	(31.5% health insurance $\times$ average gross wage) / 21 working days $\times$ number of sick days	Average gross wage in the Czech Republic by the Czech Statistical Office

### **Characteristics and treatment of the disease**

We estimated the direct and indirect costs associated with a given disease based on a model course of the disease including diagnosis, outpatient care, medication and disease duration. The description of the disease (manifestations, limitations and duration) is based on Ščasný et al. (2005) and adjusted after consultation with pediatricians. Information on the health care process and related medical interventions we established in consultation with GPs for children and adolescents. We anticipated the classical course of the disease, without complications, other comorbidities (on the topic more Cortaredona and Ventelou, 2017), and therefore without hospitalization. Furthermore, we anticipated only the regular procedures of the doctor with which the pediatric patient is registered.

Acute nasopharyngitis is an infection of the mucosa which does not affect the tonsils. We consider an uncomplicated course not requiring antibiotic treatment. The child has a cough, a cold, an elevated temperature, is tired, has a headache and has enlarged and painful lymph nodes on the neck. S/he does not go to school for a maximum of five working days, and the mother or another relative is at home for five working (seven calendar) days. The elevated temperature, difficulty breathing and other symptoms last for seven days. As it is a rather common examination for a disease which is not too difficult to diagnose, the doctor usually performs a stethoscope examination to determine the auditory finding, a palpation examination of cervical lymph nodes, or a throat swab, and less often nasal swabs when there are persistent problems or an otoscopy for ear pain. For these reasons, only essential cultivation examinations of material from the respiratory tract we included in the

estimation of specially reimbursed operations (this is a reimbursement to the laboratory, but it is still a payment within public health resources). The direct health costs for households are not relevant. The check-up included in the capitation payment is performed once. The treatment of this disease does not require further special outpatient care, and mainly includes the use of medicines. Commonly prescribed medications are nasal drops, cough drops or syrup and temperature-reducing drugs. The doctor also usually recommends the use of serum to cleanse the nasal mucosa.

Acute bronchitis is an infectious disease of the respiratory system (lower respiratory tract). It manifests itself with a strong and constant cough. The child has difficulty breathing and wheezes. At first s/he has a dry cough, then coughs up mucus and has chest pain. S/he has a headache and fever with chills. The child takes antibiotics and other supportive medications. The mother or another close person is at home with the child for at least ten days (eight working days). The child should not take part in any sports activities for another fourteen days. Diagnosis of this disease includes a stethoscope examination to determine the auscultation finding, a palpation examination of the cervical nodules, and a swab from the throat and nose. To differentiate between viral or bacterial infection, the physician performs a C-Reactive Protein (CRP) test or a blood sample from a vein to determine the blood count. To estimate the costs of the classic course of the disease, which includes a performance payment, a throat swab, a nose swab and a CRP test we included in the calculation. The direct health costs for households are not relevant. The check-up examination, which is included in the capitation payment, is performed 1x–2x. The treatment of this disease does not require further special outpatient care, and mainly includes the use of medicines. Antibiotics, nasal antibiotic drops, a cough syrup, symptom relief and temperature-reducing drugs are usually prescribed. Probiotics should be taken with antibiotics. The most commonly used drugs for one course of the disease we took into consideration.

### **Direct Costs**

Direct costs comprise health costs resulting from illness and include medical costs, including costs of diagnosis, treatment and check-ups, and expenditure on medicines used. In the Czech Republic, a system of reimbursement of health care is used to finance health care costs, which varies according to the type of health service provider. The basis of the system is to determine the number of points for specific procedures, for which a value is given in CZK through a public regulation each year (hospital care works on a different principle). Procedures include direct, overhead costs and an increase in the personal costs of those who carry them out. The direct costs are the sum of the personal costs of those who carry out the procedure, the cost of the equipment used in the procedure, the cost of the medical materials used in the procedure, and the cost of the medicinal products directly used in the procedure. Overheads include consumption of materials, energy consumption, services, other personal costs, taxes and other costs. The setpoints value of the procedure is then based on the average direct costs of such a procedure (Ministry of Health of the Czech Republic, 2021), and so this approach can be used for economic evaluation.

A system of a combination of capitation and fee-for-service payment is used to cover the costs of health care by general practitioners for children and adolescents. Physicians in the Czech Republic are remunerated through capitation payments with a fixed monthly rate for each registered patient. The other part of their reimbursement consists of a fee-for-service component, which includes health procedures not included in the capitation payment, for which the point value for 2020 was set at CZK 1.20 (EUR 0,04<sup>1</sup>) (Decree No. 268/2019 Coll. on the determination of point values, the level of reimbursement of paid services and regulatory restrictions for 2020). Most medical procedures, however, relate to laboratory examinations, where the point value for 2020 was set for the field of expertise 802 - medical microbiology, at a point value of CZK 0.85 (EUR 0,03) (Decree No. 268/2019 Coll.). For this reason, it is not possible to ascertain the exact healthcare costs, but only an approximate estimate, due to this reimbursement mechanism based on a fixed payment, but also due to further regulatory measures in the healthcare sector.

The first step to quantify the direct costs of morbidity is to determine the corresponding medical interventions according to Decree No. 268/2019 Coll., which publishes a list of medical interventions with point values, as amended, and then to multiply this value in CZK. As the combined capitation/fee-for-payment system remunerates general practitioners for children and adolescents, not all payments are covered by the reimbursement payment, but the vast majority of them are included in the capitation component. The capitation component is not taken into account in the calculation of direct costs because it applies to each registered patient, regardless of the number of visits to the health centre.

Treatment of the disease is based primarily on the use of medicines. After consultation with doctors, for each disease, the most often prescribed specific products were chosen. In the case of food supplements, where there are many product variants on the market, we chose products which have been certified and are commercially available, with an appropriate package size for the length of use and a reasonable price, to avoid overestimating the costs. We included the full cost package to the estimation of direct costs, as recommended by Rozan (2001).

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<sup>1</sup> Average rate of the Czech National Bank in 2020 – 1 EUR = 26.444 CZK.

### Indirect Costs

We calculated indirect costs resulting from absence from work for parents caring for sick children. From a social perspective, we calculated indirect costs by the sum of the loss of value of work, sickness insurance (caring) benefits and the amount of mandatory statutory health and social insurance. All of which were based on the average gross wage in the Czech Republic of EUR 1,346 for 2020 (Czech Statistical Office, 2021a). The average gross wage we calculated by the average daily income divided by the average number of working days (21 days per month). The total indirect costs we calculated by multiplying the average daily income by the length of absence from work, which is given by the average duration of illness according to the model (classical) course of the illness. This average gross daily wage also includes taxes and statutory insurance paid by the employee. Another component of productivity loss is sickness insurance benefits, which are an essential part of the total social loss due to a child's illness. In the absence of (or reduction) of pollution and thus a corresponding impact on health, these transfer payments could be allocated differently, e.g. for increasing other benefits or indeed to decrease the insurance premium of this payment, leading to an increase in real wages and hence the growth of social well-being (Ščasný, 2005). The amount of the care allowance we calculated from average gross wages. However, the care allowance is not paid to all people but is intended primarily for employees participating in sickness insurance<sup>2</sup>. The last component of social costs consists of mandatory statutory social and health insurance, which we calculated at 25% of the gross salary for social insurance and 9% of the gross salary for health insurance. The estimation of indirect costs from various perspectives of economic subjects, is based mainly on the average gross wage. Table 3 shows the calculation of the individual cost component, the losses of which due to illness of a child we assigned to individual economic entities.

**Table 3.** Calculation of cost components from average gross wage (EUR, 2020).

Cost components	Calculation	Sum (EUR)
Average gross wage		1,346
Social insurance paid by employer	25%	337
Health insurance paid by the employer	9%	121
Super gross wage	Gross wage + soc. and health insurance paid by the employer	1,804
Advance tax on super gross wage	15%	271
Reduction for a taxpayer	EUR 79 / month	78
Tax reduction per dependent child	EUR 42 / month	48
Advance tax after deduction of discounts	Super gross wage tax advance payment - taxpayer discount - dependent child reduction	144
Employee social insurance	6.5%	88
Employee health insurance	4.5%	61
Net monthly wage	Gross wage - advance payment after deduction of discounts - social insurance paid by the employee - employee health insurance	1,054
Daily net wage	Net monthly wage / 21	50

**From the perspective of households**, indirect costs we expressed as lost income due to caring for a sick child. The resulting amount is an estimate of the loss of the average net daily income, which we obtained after deducting social and health insurance expenditure and may differ in the amount of tax relief applied. The starting point of the estimate is the application of the basic tax relief to the taxpayer and the deduction of the non-taxable amount per dependent child. The calculation was based on an estimate of the average gross wage in the Czech Republic in 2020. The daily net wage is estimated at EUR 50, according to the Czech taxation and insurance system. The amount of care allowance is EUR 24 for one day of caring for a sick family member and is deducted from the net daily income. The loss of the net daily income after the deduction of the care allowance is EUR 26 per working day. The total loss of household income, i.e. the total loss of productivity from a household perspective, is obtained by multiplying the number of working days spent caring for the child. As the care allowance is also paid for non-working days, EUR 48 is deducted from the resulting amount as the amount of the care allowance for two non-working days.

The costs from the **perspective of the employer** are the value of the employee's work expressed in wages for work performed, including wage compensation, which is an average of EUR 10 (2020 prices) (Czech Statistical

<sup>2</sup> According to the Czech Social Security Administration (2021), an employee who is unable to work because of nursing a sick member of the household is entitled to a carer's benefit from the first day of illness for 9 calendar days (16 calendar days for a single employee). The amount of the carer's benefit from the first calendar day is 60% of the reduced daily assessment base per calendar day.

Office, 2021b). We obtained the total costs by multiplying the 8-hour working time by the number of days of illness. The loss expressed from the perspective of the employer and the employee reflects a partial loss of wages, including actually the same 'money', only from a different perspective.

**The perspective of the health care system** includes loss of income from compulsory health insurance payments paid by both the employer at 9% of the gross salary and the employee at 4.5%, which due to absence from work is not paid to health insurance companies and is therefore a cost (loss) for the health care system. We calculated the resulting expense as a monthly levy divided by the number of working days in the month (assuming 21 days) and multiplied by the number of days of illness.

**Costs from the perspective of the state budget** include unpaid statutory social insurance payments (EUR 2 / day at a gross wage of EUR 1,346), which include sickness insurance, pension insurance and contributions to the state employment policy. These payments of 25% (employers) and 6.5% (employees) are made into the budget through the Czech Social Security Administration. Another component of the state budget expense is tax losses calculated from super-gross wages (EUR 7 / day). Those payments of statutory social insurance and taxes are two significant items that do not flow into the budget because of absence from work. Thus there is a lower assessment base from which these transfers are calculated. Also, the state budget will lose other resources in the form of care allowance, which is paid to parents as compensation for wages when caring for a sick child (EUR 21 / day at a gross wage of EUR 1,346).

## Results

### Direct Costs

Table 4 summarizes all the direct costs associated with the treatment of the disease, including the GP's medical interventions and medications used from individual perspectives. The health care system (costs of health insurance companies) includes the redistribution of funds within public health insurance, while household costs show their expenditures for the purchase of medication.

**Table 4.** Direct costs of treatment of respiratory diseases (EUR, 2020).

Perspective	Medical procedures	Medication	Household costs	Total
	System of healthcare	System of healthcare		Social costs
Acute nasopharyngitis				
4–10 years	2	0	14	16
11–15 years	2	0	11	13
Acute bronchitis				
4–10 years	10	6	20	36
11–15 years	10	6	17	33

The cost of treating acute nasopharyngitis and acute bronchitis does not depend on age. Diagnosis involves identical examinations for children of all ages. Although drug consumption may increase as children get older, the cost always involves purchasing the entire packet of medication. The difference in the cost of households in the age category results from the fact that the cost of a packet of medication for smaller children is usually higher than for older children.

Table 5 includes all direct costs from all different perspectives. The results show that the burden in terms of direct costs is significant, especially for households. Medicines for these relatively common, non-serious diseases are not reimbursed (apart from antibiotics) by the health insurance company; these are often classic medications to relieve problems such as high temperature, runny nose and cough or recommended dietary supplements.

**Table 5.** Direct costs of treatment of respiratory diseases from different perspectives (EUR, 2020).

Perspective	Social		Healthcare system		State budget		Employers		Households	
	EUR	%	EUR	%	EUR	%	EUR	%	EUR	%
Acute nasopharyngitis										
4–10 years	16	100	2	12.5	-	-	-	-	14	87.5
11–15 years	13	100	2	15.4	-	-	-	-	11	84.6
Acute bronchitis										
4–10 years	36	100	16	44.4	-	-	-	-	20	55.5
11–15 years	33	100	16	48.5	-	-	-	-	17	51.5

### Indirect costs

Indirect costs include several economic entities. Households, employers, but also the budget and health care system all bear part of the total social cost. The social costs reflect the total costs of all entities. In order to make the most accurate estimate in the Czech Republic, which would reflect all types of costs, we worked with the average gross wage in the Czech Republic. Based on this, we estimated the individual social cost items, such as loss of work, loss of statutory contributions paid by employers (social and health insurance), and sickness insurance benefits. It is therefore a matter of the total economic losses that are incurred by the various economic entities throughout society. Table 6 shows the total social costs calculated from the above cost components.

**Table 6.** Total social indirect costs of the disease, (EUR, 2020).

Illness	Loss of work value	Sickness insurance benefits	Statutory insurance	Social indirect costs
Acute nasopharyngitis	320	168	109	597
Acute bronchitis	513	239	174	927

Note: Carer's benefit (sickness insurance) is also calculated in the Czech Republic for non-working days (seven days for acute nasopharyngitis, ten days for acute bronchitis).

Table 7 provides an overview of cost items from different perspectives. Indirect costs are due to parents not being at work due to the care of a sick child. In terms of age, the costs do not show any differences, given that they are children from 4 years of age upwards, which in the Czech Republic represents the maximum threshold for receiving a parental allowance. The most significant burden due to people not being at work is for the employers, as it leads to lower productivity. For the state, it is a burden in the form of lower social security contributions and taxes, while on the other hand, there are higher costs of care benefits. In the case of households, the costs represent the real loss of wages after deduction of care benefits.

**Table 7.** Indirect costs of treatment of respiratory diseases from different perspectives (EUR, 2020).

Perspective	Social		Healthcare system		State budget		Employers		Households	
	EUR	%	EUR	%	EUR	%	EUR	%	EUR	%
Acute nasopharyngitis										
4–15 years	597	100	43	7.2	303	50.8	407	68.1	82	13.7
Acute bronchitis										
4–15 years	927	100	69	7.4	456	49.2	651	70.2	160	17.3

### Social costs of treatment of illness

The social cost distribution (Table 8) shows that indirect costs account for a significant majority of the total costs. In the overall context, the costs directly linked to the treatment of the disease constitute only a part of the total cost, although in this case, they are primarily a burden on households. The largest share is represented by indirect costs associated mainly with a loss of wages, which reach 96.6–97.9%.

**Table 8.** Total social direct and indirect costs of respiratory diseases (EUR, 2020).

	Direct costs		Indirect costs		Total costs	
	EUR	%	EUR	%	EUR	%
Acute nasopharyngitis						
4–10 years	16	2.6	597	97.4	613	100
11–15 years	13	2.1	597	97.9	610	100
Acute bronchitis						
4–10 years	36	3.7	927	96.3	963	100
11–15 years	33	3.4	927	96.6	960	100

If we look at the total cost of illnesses from different perspectives (Table 9), the highest burden is beared by employers (66.4–67.8% of the total social cost) state budget (47.3–49.7% of the total social cost). This result is caused due to the dominance of indirect cost. Absentee at work causes for employer loss from missed work and for state budget unpaid statutory social insurance payments, tax losses and care allowance paid to parents. The costs of households for nasopharyngitis is EUR 96 for children aged 4 to 10 years and EUR 93 for children aged 11 to 15, and for bronchitis, EUR 180 and EUR 177 per case of illness. The share for the average wage is 7% for nasopharyngitis, and 13.2% for bronchitis. We calculated the costs per case of the disease. Given the high incidence of illness in particularly polluted areas, where children become ill several times a year, high morbidity can be a source of financial problems related to loss of income. However, the overall costs from different cost-bearer perspectives should be considered a conservative estimate. We anticipate the classical course of the disease, without complications, other comorbidities, and therefore without hospitalization. Furthermore, we anticipate only the standard procedures of the doctor with which the pediatric patient is registered.

**Table 9.** Total costs of respiratory diseases from different perspectives (EUR, 2020).

Perspective	Social		Healthcare system		State budget		Employers		Households	
	EUR	%	EUR	%	EUR	%	EUR	%	EUR	%
Acute nasopharyngitis										
4–10 years	613	100	45	7.3	303	49.4	407	66.4	96	15.6
11–15 years	610	100	45	7.4	303	49.7	407	66.7	93	15.2
Acute bronchitis										
4–10 years	963	100	85	8.8	456	47.3	651	67.6	180	18.7
11–15 years	960	100	85	8.9	456	47.5	651	67.8	177	18.4

## Discussion

Comparison of the results with other studies using the Cost-Of-Illness method is quite problematic due to the broad generality of the method and therefore often different approaches to estimating total values, such as the choice of variables or the method of data collection. Comparison with the cost of morbidity with other states is then quite challenging due to the different ways in which health care is financed. Cost-of-Illness studies are also used for symptom studies, for example the cough (Dal Negro et al., 2018; Hollinghurst et al., 2008) or the common cold (Hellgren et al., 2010). The most significant difficulty, however, is the impossibility of comparisons due to the absence of similar studies aimed at analysing the morbidity of similar diseases. As mentioned at the outset, Cost-Of-Illness studies tend to focus on more serious diseases: with respiratory diseases, these are mainly chronic bronchitis (Accordini et al., 2017; Weissflog et al., 2001), asthma (Ferreira de Magalhães et al., 2017; Gendo et al., 2003), chronic obstructive pulmonary disease (Ehteshami-Afshar et al., 2016; Mäkelä et al.) or lower respiratory tract infections (Schot et al., 2019; Ehlken et al., 2005).

However, we should look at the individual cost components from the different perspectives of their bearers. According to the results of Lambert et al. (2008), acute respiratory infections in children represent a significant cost burden for families and society. Indirect costs have proved to be the key cost drivers, i.e. the time spent taking care of a child outside the usual activities. The assessment of the costs due to acute respiratory infections with cough in Australia has been addressed by Lovie-Toon et al. (2018). Compared to the conclusions of our study, the results showed a different structure of cost bearers. Caretakers, the public health system and employers incurred 44, 39, and 17% of the costs per episode, respectively. The high share of household costs was mainly due to the different way in which health care is financed. Family costs included general practice visits, after-hours general practice visits or specialist visits, which when added to the time off work with unpaid leave and time off non-work activities, which were not the subject of our study, contributed to the relatively high share of



household costs. The significant proportion of the public health care system was mainly due to the cost of doctors' services, which were not included in our assessment in the Czech Republic due to visits to the doctor being part of the capitation component. Similarly, the cost estimates of Hollinghurst et al. (2008) for acute coughs in children in the UK have shown that the cost for health service providers resulting from consultations with GPs is particularly significant. The costs for families were mainly due to travel and expenditure on over-the-counter preparations, suggesting that the child's illness could cause financial problems due to loss of earnings.

The cost of acute cough health care providers for preschool children is high; most of these costs result from consultations with GPs. Parents experience certain personal costs due to travel and buying over-the-counter products, and they can suffer greatly if they have a loss of earnings. There is scope for evaluating interventions designed to reduce this burden. To summarise, the differences between individual studies are mainly due to different approaches to average cost estimates and different ways of financing health care. This leads to different proportions between the individual cost bearers.

When conducting COI studies, there are generally some methodological problems, which makes comparison difficult. A relatively significant limit of the COI study is the lack of a generally valid methodology. How published COI studies are conducted often differs between different diagnoses and studies. Determining the direct costs of treating a given diagnosis also does not say anything about the effectiveness of the resources used (Larg and Moss, 2011). Thus, COI studies can show which diseases require a higher allocation of resources for treatment or prevention (Jo, 201), but since the method is not designed to measure benefits, it cannot be used to determine how to allocate these resources (Drummond, 1992). The COI method only measures ex-post costs that arise in connection with treatment. It does not take into account any changes in defensive costs (market goods purchased by individuals to improve health) (Dickie and Gerking, 2002). Máca (2005) considers the complicated compilation of an incidence profile, such as the number of asthma attacks, to be a major negative. He also points out that it is impossible to determine the cost of healthcare accurately. Another drawback that can make it more difficult to compare results and can also lead to the costs being underestimated is that some costs that are not directly health expenses but are directly related to treatment are not included.

These are e.g. expenditures on health and public health research, health and preventative programmes, education, construction, administration, infrastructure. However, these costs are often omitted from COI studies because of the difficulty or rather the inability to assign partial costs to specific diseases. Another reason is that expenditures in one period are not necessarily associated with the disease in that period. For example, equipment built, research and training funded in one year will only bring benefits in the years to come (Health Canada, 2002; Hodgson and Meiners, 1982).

Other costs that may be included in some studies are travel costs or the loss of leisure time. However, these costs were omitted from this study. Finally, we have to conclude, that the costs are estimated on the basis of our methodology based on a predetermined model of the disease, its course, treatment and use of medication. For this reason, the resulting estimates can be sensitive to a change in the individual cost types included.

## Conclusion

This article analyses the health cost of common respiratory diseases in pediatric populations aged 4 to 15 from the different perspectives of economic subjects. The results are based on the Cost-Of-Illness method, which includes the direct costs of treating the disease and the indirect costs of absenteeism due to caring for a sick child. We found that the costs directly linked to the treatment of the disease are of marginal importance, with indirect costs being the most significant contributor to the total cost. Overall, the state budget and employers bear the highest costs in the Czech Republic. Given that the total cost for households per case of acute nasopharyngitis is about 7% of the average monthly wage and about 13.2% for acute bronchitis, repeated incidences of the analysed diseases may lead to an excessive burden on households. Since 2021, the super-gross wage has been abolished in the Czech Republic, which will lead to a particular reduction in the financial burden on households, on the other hand, even more significant tax losses for the state budget.

Acute nasopharyngitis and acute bronchitis are common respiratory diseases that affect the majority of the child population (especially in the winter months) and which cannot be avoided altogether, especially when in contact with children. As these diseases recur more frequently by up to 10% in areas with deteriorated air quality, reducing pollution and research related to it is key to reducing disease incidence and the associated financial costs. We see effective preventive measures as a significant solution for reducing these costs, especially in cities and other areas with unsatisfactory air quality. These may include, for example, vitamin use, outdoor recovery programmes, installation of air purifiers inside buildings, road cleaning. Further research into the prevention of these common respiratory diseases would be desirable to reduce the overall economic burden for all economic entities.

The policy implications of the research could involve pointing out the importance of main cost factors and the burden on the national economy subject to the decision-making process in health policy or social policy. Many studies were conducted for more serious illnesses, but very little for mild illnesses. But as we showed, the

significant financial burden was confirmed on common respiratory illnesses such as acute nasopharynx and acute bronchitis.

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