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Letter to the Editor

Real-world evidence of reduced disability costs during the Finnish Allergy Programme 2008-2018

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To the Editor,

New insights into immune regulation in modern, urban societies have challenged conventional thinking and motivated implementation of the nationwide, proactive Allergy Programme 2008–2018 in Finland (population ca. 5.5 million)¹. The main aim was to reduce the long-term burden, including costs, of allergic diseases and asthma by improving prevention and care.

Traditional strategy of avoidance was changed to emphasize immunological, psychological and societal resilience. Children and young people were prioritized as were severe clinical manifestations. Implementation was organized and monitored to adapt healthcare for new ideas and improve provision of care². During the 10 years, some 24 000 health-care professionals took part in 376 educational sessions. An information campaign targeted laypublic and 2.3 million Finns were reached.

Majority of the direct costs could be estimated using national registers. Direct healthcare costs included outpatient visits, hospital days, drugs, rehabilitation, and travel expenses. Drug costs were explored from the sales database. From indirect costs disability pensions were recorded by pension institutions and loss of productivity, absenteeism and presenteeism were based on questionnaire surveys (Supplementary Material).

In 2018, at the end of the Programme, the total costs of allergic diseases and asthma were estimated €1.5–1.8 billion (**Table S1**). The annual *direct costs* were €331 million: for asthma €203, allergic rhinitis €48 and atopic eczema €35 million (**Figure 1**). Drugs constituted 57% of the direct costs, €190 million (**Figure S1**). *Indirect costs* were estimated €1.2–1.5 billion. Reduced working capacity accounted 65%, sickness absences 25% and disability pensions 10% of these costs.

During the Programme, hospital days in secondary care decreased both in allergic diseases (-41%) and asthma (-54%), but the number of outpatient visits slightly increased (**Figure S2**). Thus, the direct healthcare costs did not decrease more than by 5%.

Since 2007, the number of subjects on disability pension decreased more in asthma (-62%) compared to allergic diseases (-30%) (**FigureS3**). Cost of lost working days due to permanent disability halved from €330 to 150 million (-55%). Criteria for disability pensions or sickness allowances have not changed during the Programme. The reimbursement statistics also indicated a marked decrease in sick leave absences.

From 2007 to 2018, the total (direct+indirect) comparable annual costs decreased by €201 million (-31%) from €649 to €450 million. If the total costs have remained at 2007 level, the deferred cumulated savings during the Programme would have been about €1.2 billion (**Figure 2**).

One detail about changing the strategy from avoidance to tolerance is the costs of cow's milk allergy in infants. From 2007, the number of children entitled to reimbursement for hypoallergenic products decreased by 3,000 (-71%) and the compensations from €6.2 to €1.7 million (-72%). Allergy diets at schools also decreased when the need of diets was critically evaluated, and doubtful diets discontinued³.

In 2018, the average cost per one patient with asthma was €1,440 and €650 per one patient with some allergic condition. Per one patient with asthma, the healthcare (direct) and disability (indirect) costs decreased by 38% from 2007 to 2018.

During the Finnish Allergy Programme 2008–2018, the burden of allergic diseases declined². The cost increase in healthcare levelled off and the patients are less disabled, which has resulted in marked cost savings both at the societal and patient level. The Programme was based on real-world data. All citizens were included without exclusion criteria or comparison populations. Therefore, it is not possible to state which of the changes were programme-specific. For example, hospital days in Finland have been decreasing in general, but more in asthma ja allergic diseases (Supplementary Material).

In Finland, the positive development is unusual compared to other chronic non-communicable diseases such as diabetes⁴ and inflammatory bowel disease. Decreasing burden of allergic diseases is also globally exceptional, as the number of people with allergic conditions and asthma have been increasing in both developed and developing countries along with rising costs^{5,6}.

ACKNOWLEDGEMENTS

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CONFLICT OF INTEREST

Anna Pelkonen has received personal lecturing fees from Orion Pharma; Tari Haahtela from GSK, Mundipharma, Orion Pharma, Sanofi; All other authors have nothing to disclose.

AUTHOR CONTRIBUTIONS

Juha Jantunen and Miika Linna collected and processed the data. All authors participated in planning the study, interpreting the data, and writing the paper. All authors decided to publish the paper.

REFERENCES

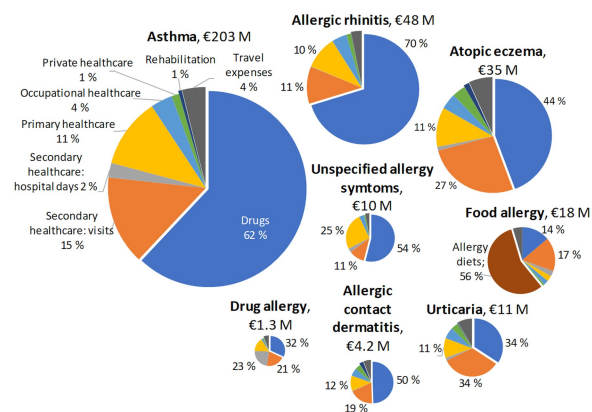
1. Haahtela T, von Hertzen L, Mäkelä M, Hannuksela M. Allergy Programme Working Group. Finnish Allergy Programme 2008–2018—time to act and change the course. *Allergy* 2008;63:634–45.

2. Haahtela T, Valovirta E, Saarinen K, et al. The Finnish Allergy Program 2008–2018: Society-wide proactive program for change of management to mitigate allergy burden. *J Allergy Clin Immunol* 2021 (in press)
3. Savolainen J, Mascialino B, Pensamo E, et al. Structured intervention plan including component-resolved diagnostics helps reducing the burden of food allergy among school-aged children. *Pediatr Allergy Immunol*. 2019;30:99–106.
4. Dehko. Prevalence, incidence, and costs of diabetes in Finland 1998-2007. The national diabetes programme Dehko 2009.
www.diabetes.fi/files/1146/englKustannusesite_2009_korj2.pdf
5. Nunes C, Pereira AM, Morais-Almeida M. Asthma costs and social impact. *Asthma Res Pract* 2017; 3:1.
6. Pawankar R. Allergic diseases and asthma: a global public health concern and a call to action. *World Allergy Organ J* 2014;7:12.

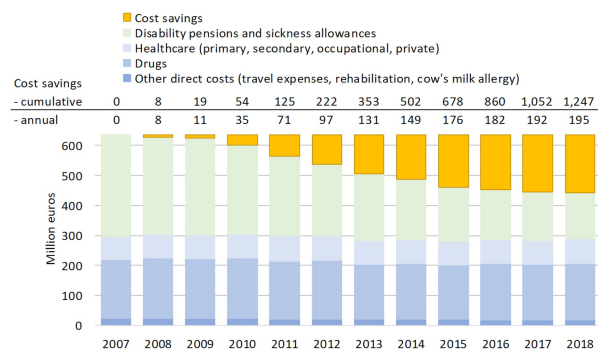
Legends

Figure 1. Direct healthcare costs of allergic diseases and asthma in Finland in 2018.

Figure 2. All comparable annual costs of allergic diseases and asthma, and the deferred cost savings in 2008–2018, if the costs would have stayed at the 2007 level.



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Drugs

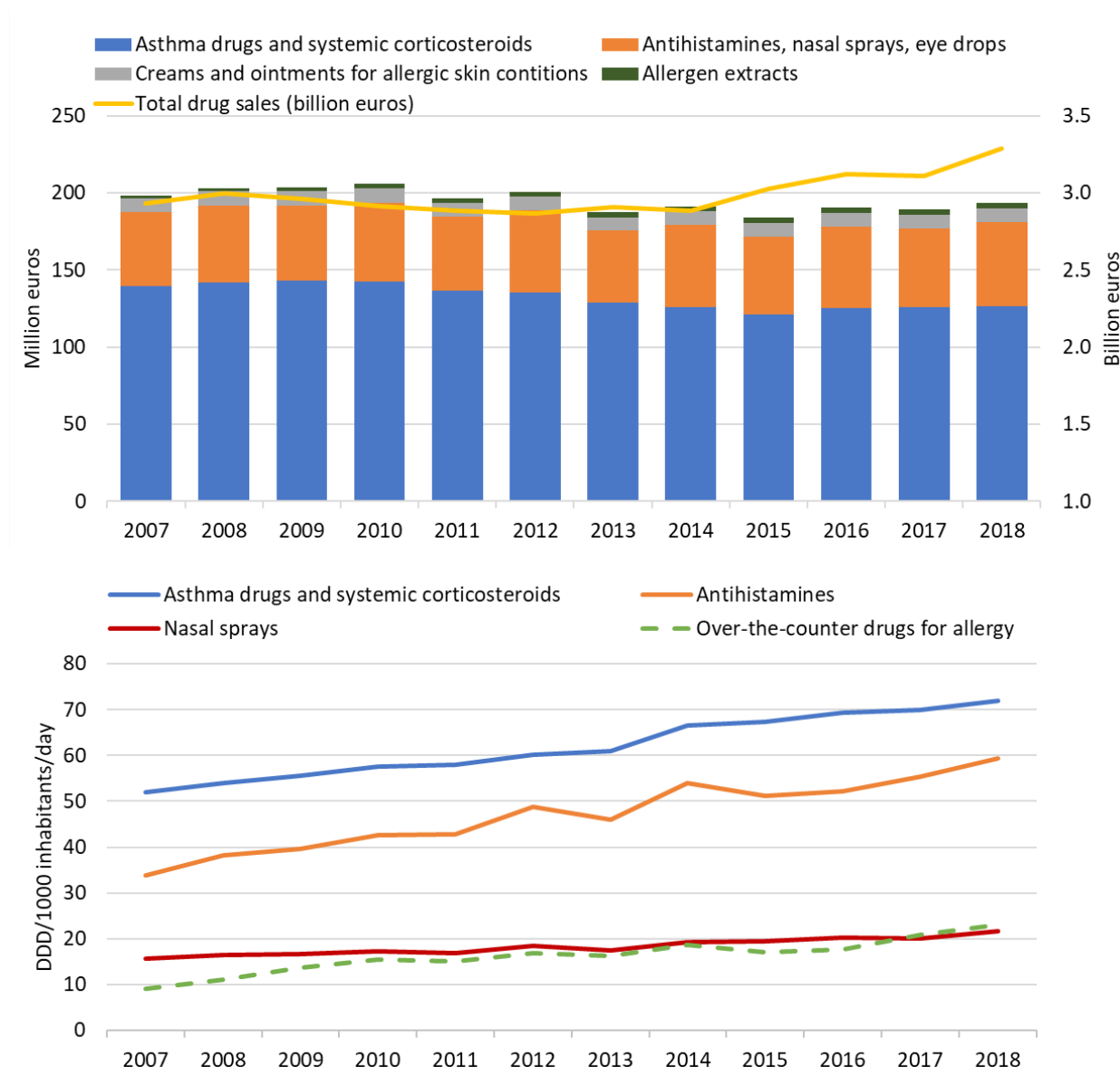


Figure S1. Costs and consumption of drugs for allergic diseases and asthma in 2000–2018. Drug costs decreased by 3% (€6.7M) although the consumption of asthma drugs (+38%) and antihistamines (+76%) has increased continuously. Consumption increased especially in over-the-counter drugs for allergic conditions (+153%). Drug costs have even decreased during the last 10 years due to price regulation¹. Lowering the prices and expanding the over-the-counter drug supply have markedly increased antihistamine use.

Supplemental references

1. Koskinen H. Pharmaceutical expenditures, the reference price system and competition in the pharmaceutical market. A register study. Helsinki: The Social Insurance Institution of Finland. Studies in social security and health 150; 2018. 80 p.

Healthcare

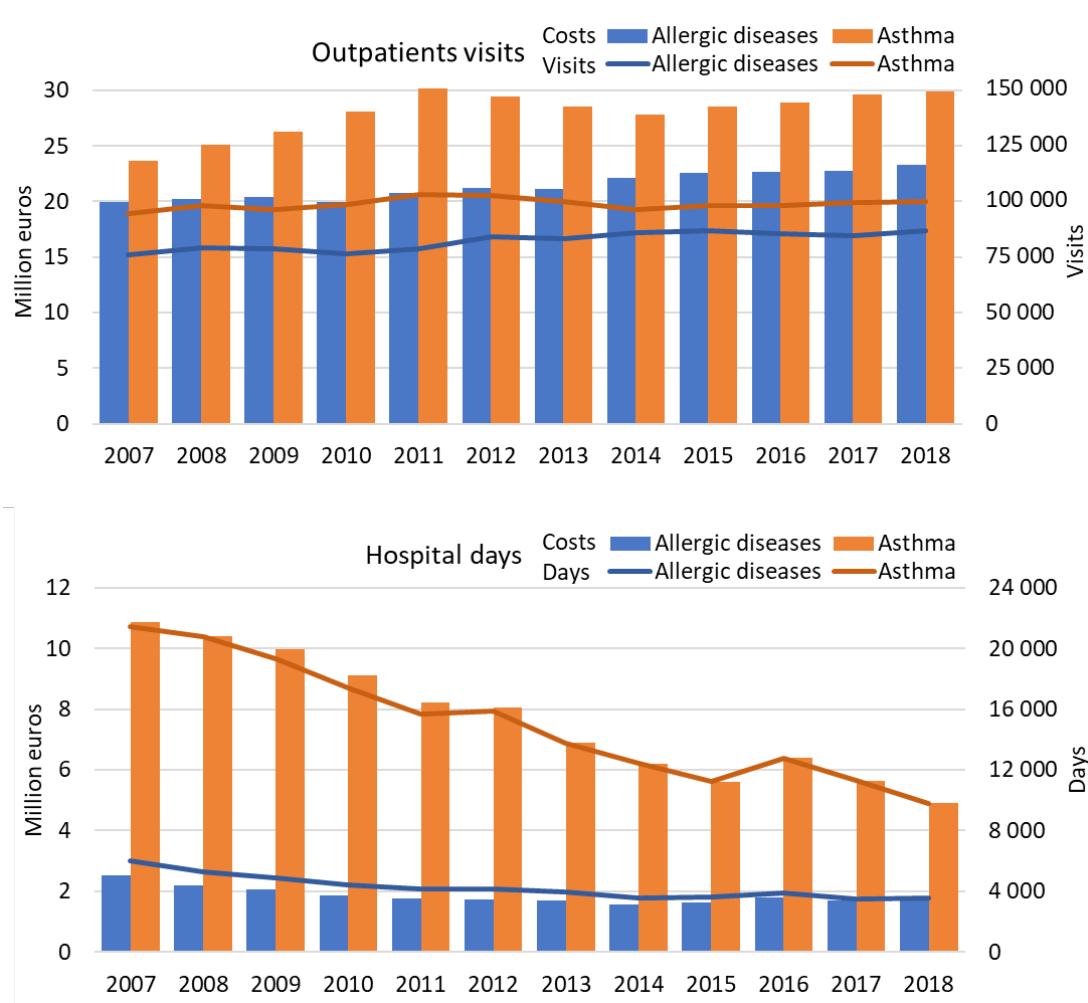


Figure S2. Outpatient visits, hospital days and costs of allergic diseases and asthma in secondary care in 2000–2018. Hospital days in secondary care decreased both in allergic diseases (-41%) and asthma (-54%) from 2007 to 2018. In the Finnish secondary care, hospital days in general are in decline (-12% in 2009–2018), but they have fallen more than average for allergic diseases and asthma (-45% in 2009–2018). At the same time, outpatient visits have increased less (7%) than the average (37%)¹. Emphasizing asthma control and proactive management of exacerbations have resulted in substantial cost savings in health care and improved working ability²⁻⁵. In Finland, asthma related hospitalizations, disability pensions and mortality began to decrease already during Finnish Asthma Programme (1994–2004), despite the increase in total number of patients^{4,6}. This trend has continued during the Allergy Programme (2008–2018). Since 2001, self-reported severe asthma symptoms decreased from 10% to 3.8% in 2010 and to 2.5% in 2016 with steady decline in need for emergency visits and hospitalizations^{7,8}.

Supplemental references

1. Martikainen V, Järvelin J. Non-psychiatric specialized health care 2018. Statistical report 51/2019. Finnish Institute for Health and Welfare. 23 p. (In Finnish, Abstract in English).
2. Dierick BJH, van der Molen T, Flokstra-de Blok BMJ, et al. Burden and socioeconomics of asthma, allergic rhinitis, atopic dermatitis and food allergy. *Expert Rev Pharmacoecon Outcomes Res.* 2020;20:5,437-453, DOI:10.1080/14737167.2020.1819793
3. Accordini S, Corsico A, G, Braggion M, et al. The Cost of Persistent Asthma in Europe: An International Population-Based Study in Adults. *Int Arch Allergy Immunol.* 2013;160:93–101. doi: 10.1159/000338998

4. Haahtela T, Herse F, Karjalainen J, et al. The Finnish experience to save asthma costs by improving care in 1987–2013. *J Allergy Clin Immunol*. 2017 Feb;139(2):408-414.e2. doi: 10.1016/j.jaci.2016.12.001.
5. Jantunen J, Haahtela T, Salimäki J, et al. Multimorbidity in Asthma, Allergic Conditions and COPD Increase Disease Severity, Drug Use and Costs: The Finnish Pharmacy Survey. *Int Arch Allergy Immunol*. 2019;179:273–280. doi: 10.1159/000498861
6. Haahtela T, Tuomisto LE, Pietinalho A, et al. A 10 year asthma programme in Finland: major change for the better. *Thorax*. 2006 Aug;61(8):663–70. doi: 10.1136/thx.2005.055699.
7. Kauppi P, Peura S, Salimäki J, Järvenpää S, Linna M, Haahtela T. Reduced severity and improved control of self-reported asthma in Finland during 2001–2010. *Asia Pac Allergy*. 2015;5:32–39.
8. Jantunen J, Haahtela T, Salimäki J, Pelkonen A, Mäkelä M, Kauppi P. Asthma and allergy are becoming less severe in Finland – pharmacy barometer surveys 2010 and 2016. *Suom Lääkäril (Finnish Med J)*. 2018;73:367–371. (In Finnish, Abstract in English).

Indirect costs

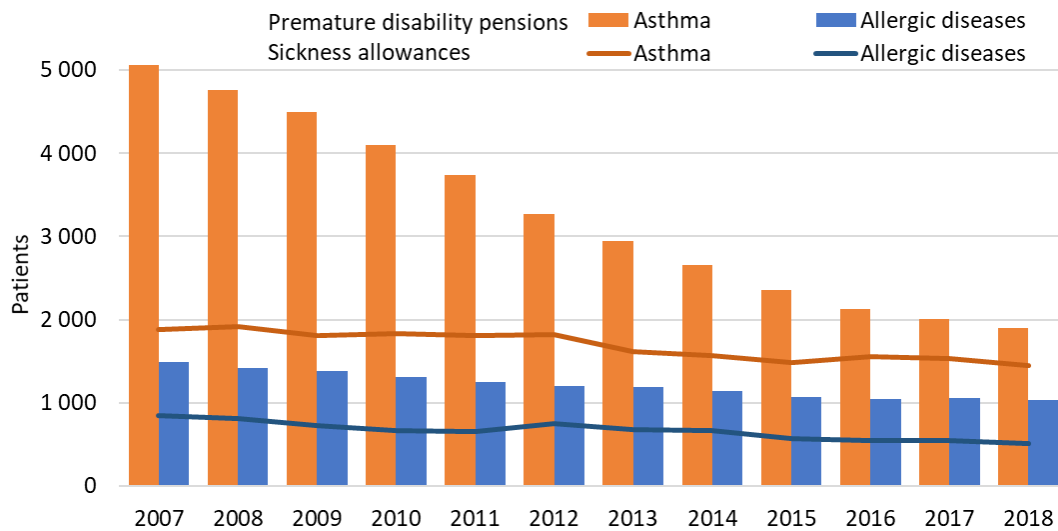


Figure S3. Figure S3. Annual number of patients with allergic diseases or asthma receiving premature disability pension (pension databases), and those with sickness allowances lasting more than 9 days in 2007–2018 (National Health Insurance database). Since 2007, cost of lost working days due to permanent disability halved from €330 to 150 million (-55%). The number of reimbursed days decreased from 108,500 to 69,600 days (-36%) and paid allowances from €6.3 to €3.8 million (-40%).

Table S1. Direct healthcare and indirect costs of allergic diseases and asthma in 2007 and 2018. All comparable direct and indirect costs are summed in the last line. The sums exclude visits in primary healthcare (not available in 2007). Sick leaves and reduced working capacity are estimates from questionnaire surveys. In the survey studies, allergy symptoms were estimated to reduce working capacity by 15% (1.3 h/day) and asthma symptoms by 24% (1.9 h/day). Respondents reported an average of 23 days with severe and 76 days with mild allergy symptoms per year. For asthma, the respective figures were 21 and 80 days. Only, 4% of the allergic participants and 5% of asthmatics did not report any symptoms during the last year. Although allergy symptoms disturbed work less than asthma, the large number of allergic people increased the cost of presenteeism to €580–750 million, which was markedly higher than the €180–220 million for asthmatics. The cost of absenteeism was almost equal for those with allergic diseases (€130–160 M) and with asthma (€150–180 M). Asthma caused absences for an average of 3.1 days a year, allergic diseases for 0.8 days, and a child's allergy or asthma symptoms for 0.2 days. Allergic diseases caused absences for one in ten individuals and asthma one in four.

Costs	2007 € million	2018 € million	Change %
Direct costs			
Secondary healthcare			
Inpatient hospital days	13.4	6.6	-46
Outpatient visits	43.5	53.2	20
Primary healthcare			
Inpatient hospital days	5.3	2.2	-55
Outpatient visits [†]	–	34.9	
Occupational healthcare	9.5	12.8	35
Private healthcare	5.8	5.4	-7
Travel expenses	12.9	14.0	9
Drugs	196.3	189.6	-3
Rehabilitation	3.8	2.0	-47
Allergy diets at schools and preschools	14.0	8.3	-41
Cow's milk allergy in infants	6.2	1.7	-73
Direct costs in total	–	331	
Indirect Costs			
Disability retirement	332	150	-55
Sick leave cost [‡]	–	280–340	
Sickness allowances [§]	6.3	3.8	-40
Reduced working capacity [‡]	–	760–970	
Indirect costs in total	–	1,200–1,500	
All direct and indirect costs	–	1,500–1,800	
All comparable direct and indirect cost	649	450	-31

[†] Outpatient statistics in 2007 are lacking. Compilation of data began in 2012.

[‡] Estimate is based on a population survey. Range is derived from the prevalence of allergic diseases allergy (25%–33%) and asthma prevalence (8%–10%).

[§] Allowances are paid, if the sickness absence lasts for over 9 days (sickness absences according to Finnish health insurance statistics).

Material and methods

Costs of allergic diseases and asthma were analyzed from national data sources in collaboration with government officials. Direct cost analyses included outpatient visits in public, occupational, and private healthcare, hospital days, travel expenses, rehabilitation, and drugs. Costs of food allergy were estimated by calculating costs of cow's milk allergy in infants and allergy diets in school and preschool.

Indirect costs comprised of premature working disability (disability pensions), sickness absences and reduced working capacity due to allergic conditions and asthma. Main data sources were *Care Register for Healthcare* (Finnish Institute for Health and Welfare, THL), *Consumption and Sales Register for Medicinal Products* (Finnish Medicines Agency, FIMEA), *statistics of Rehabilitation and National Health Insurance* (Social Insurance Institution of Finland, SII), and *pension databases* (SII, Finnish Centre for Pensions, Finnish Workers' Compensation Centre, the Farmers' Social Insurance Institution). Demographic statistics, employees, salaries and labor costs, and price indices were searched in the databases of *Statistics Finland*.

Analyses of outpatient visits in healthcare and hospital days included primary diagnosis of asthma (ICD-10 codes J45, J46), allergic rhinitis (J30), atopic and allergic contact dermatitis (L20, L23), urticaria (L50) and drug allergy (T80.5, T88.6-7). Also, unspecific allergic (L27, T78) and asthmatic reactions (R05, R06.1-2) were included. Visits in private physicians and occupational health care were estimated using statistics of reimbursements by the National Health Insurance ¹, and also analyzing the data of one of the largest private healthcare provider in Finland (Terveystalo). The number of outpatient visits and hospital periods were used to estimate travel expenses. Unit costs were calculated from national reports of health and social care ². Cost of rehabilitation was based on database search using disease codes.

Drug costs were explored from the database of medicines sold by drug wholesalers to pharmacies and hospitals. Drugs included were non-steroid topical calcineurin inhibitors (ATC codes D11AH01-02), nasal sprays (R01AC, R01AD), systemic antihistamines (R06), eye drops for allergic symptoms (S01GX), and allergen extracts (V01). Eighty percent of drugs for obstructive airway diseases (R03), 50% of systemic corticosteroids (H02A), and 80% of corticosteroids ointments (D07AA-AB) were estimated to be used for treatment of allergic diseases and asthma ³. Costs were calculated in retail prices. Over-the-counter drugs were included in the data.

For food allergy costs, reimbursements for cow's milk allergy and hypersensitivity to conventional feeding formulas in infants were included. All Finnish children are served a free lunch in school, preschool and kindergarten. Allergy diets increase the cost of a meal by €1.30. Allergy diets were analyzed from the data of major food service providers in 17 cities covering a third of the Finnish population. The data was scaled up for the whole country.

Indirect costs were based on disability pensions, absenteeism and presenteeism. Disability to work was based on annual statistics of four major Finnish pension institutions. The cost of lost labor input due to early retirement was calculated using a mean salary (x 1.5 due to payments for social security by the employer).

Cost of temporary sickness absences and reduced working capacity were based on population surveys ⁴. The first was carried out in 2013 and included 1179 participants (56% females, 52% younger than 50 yrs). The second one in 2019 included 718 participants (68% females, 45% younger than 50 yrs). Participants with allergic diseases and asthma were asked: (1) how many

days they have been on sick leave due to allergy or asthma during the last 12 months, (2) how many days they had mild or severe symptoms, and (3) how they evaluate their working capacity, when they had symptoms (100% productivity without symptoms)? The participants were also inquired how many days they have been at home due to children's allergy or asthma. The two surveys were analyzed together to improve the reliability of the results. Thus, there were 1002 employees with an allergic disease (678+324) and 268 (130+138) with asthma.

Cost of sickness absences and reduced working capacity was calculated using prevalence of allergic diseases and asthma, and the total number of employees in Finland (Statistics Finland). Prevalence was studied by a telephone interview in 2013 (n=1001) ⁴. Thirty-three percent of respondents had a physician diagnosed (24.4%) or a self-diagnosed (8.4%) allergic condition. Physician diagnosed asthma was reported by 7.3% of subjects. By adding 2.1% of respondents having asthma symptoms without a diagnosis, the sum corresponds to other Finnish estimates ^{5,6}. The total number of employees with some allergic condition was estimated at 640,000–835,000 (25–33% of all employees), and with asthma 205,000–250,000 (8–10%).

Reduction of working capacity caused by active symptoms was converted to time lost during a working day. Severe allergic symptoms reduced the working capacity for eight hours, and mild symptoms for one third of the working time. Actual sick leave absences were deducted from the sum of lost time. Lost work was converted into average salary of employees in the same way as for disability pensions. Trends of absenteeism were followed by using Finnish health insurance statistics.

Asthma and anaphylaxis mortality were excluded in the analysis because of its rarity in Finland. In the population under the age of 65 years, on average 7 asthma deaths per year were recorded in 2016–2018 compared with 21 deaths per year in 2000–2003 (*Finnish mortality statistics*).

Costs per person were calculated using the total costs and prevalence of diseases. Changes in allergy and asthma costs were compared between 2007 and 2018. All costs are reported at the 2018 price level.

Supplemental references

1. Statistical Yearbook on Social Welfare and Health Care 2019. Helsinki: National Institute for Health and Welfare; 2019. 327 p.
2. Kapiainen S, Väisänen A, Haula T. Terveysten- ja sosiaalihuollon yksikkökustannukset Suomessa vuonna 2011. [The unit costs of health and social care in Finland in 2011.] Reports 3/2014. Helsinki: National Institute for Health and Welfare; 2014. 125 p. (In Finnish).
3. Klaukka T. Allergisten sairauksien aiheuttamat kustannukset Suomessa v. 2004–2005. In: National Public Health Institute: Sietokyky ja sen parantaminen allergiassa. Publications of the National Public Health Institute, B5/2007;9–13. (In Finnish).
4. Jantunen J. Allergy and asthma costs in Finland in 2011. Helsinki: Kela, Social security and health research: Working papers 85, 2014. 55 p. (In Finnish, Abstract in English).
5. Pallasaho P, Juusela M, Lindqvist A, Sovijärvi A, Lundbäck B, Rönmark E. Allergic rhinoconjunctivitis doubles the risk for incident asthma-results from a population study in Helsinki, Finland. *Respir Med.* 2011;105:1449–1456.
6. Hisinger-Mölkänen H, Pallasaho P, Haahtela T, Lindqvist A, Sovijärvi A, Piirilä P. The increase of asthma prevalence has levelled off and symptoms decreased in adults during 20 years from 1996 to 2016 in Helsinki, Finland. *Respir Med.* 2019;155:121–126.

Supplemental discussion: costs compared to other countries

In 2018, the total average cost per person was €1,440 for asthma (including direct costs €410) and €650 for allergic diseases (including direct costs €85). The numbers were low reflecting the large number of mild cases in the Finnish population. In this study, five per cent of the survey participants, with an allergic condition or asthma, had no symptoms during the last year, 87% had no sickness absences, and 10% estimated that their mild symptoms do not affect their working capacity. In the Finnish pharmacy study, self-reported costs of medication and healthcare were much higher ¹. Allergic customers purchasing drugs with a prescription estimated their annual direct costs at €468 and asthmatic customers at €1,161. The highest personal, annual costs were over €10,000.

Studies of health economics are difficult to compare between countries due to heterogeneity in study design, methods, measures, and outcomes, in addition to national differences in healthcare systems ²⁻⁵. Direct annual costs of allergic rhinitis per patient were estimated at €159 in France ⁶, €210 in Sweden ⁷ and €554 in Spanish patients receiving specialist care ⁸. Indirect costs were usually two or threefold compared to medical costs. Nunes et al. ³ estimate of the annual asthma cost per patient in most of European countries ranged from €500 to €1,500, the highest costs being in Germany and UK (€ >2,000).

Globally the number of people with allergic conditions, asthma and other noncommunicable diseases have been increasing in both developed and developing countries along with rising costs ⁹.

Supplemental references

1. Jantunen J, Haahtela T, Salimäki J, et al. Multimorbidity in Asthma, Allergic Conditions and COPD Increase Disease Severity, Drug Use and Costs: The Finnish Pharmacy Survey. *Int Arch Allergy Immunol*. 2019;179:273–280. doi: 10.1159/000498861
2. Dierick BJH, van der Molen T, Flokstra-de Blok BMJ, et al. Burden and socioeconomics of asthma, allergic rhinitis, atopic dermatitis and food allergy. *Expert Rev Pharmacoecon Outcomes Res*. 2020;20:5,437-453, DOI:10.1080/14737167.2020.1819793
3. Nunes C, Pereira AM, Morais-Almeida M. Asthma costs and social impact. *Asthma Res Pract*. 2017 Jan 6;3:1. doi: 10.1186/s40733-016-0029-3.
4. Vandenplas O, Vinnikov D, Blanc PD, et al. Impact of Rhinitis on Work Productivity: A Systematic Review. *J Allergy Clin Immunol Pract*. 2018 Jul-Aug;6(4):1274–1286.e9. doi: 10.1016/j.jaip.2017.09.002.
5. Zuberbier T, Lotvall J, Simoens S, Subramanian SV, Church MK. Economic burden of inadequate management of allergic diseases in the European Union: a GA(2) LEN review. *Allergy*. 2014 Oct;69(10):1275–1279. doi: 10.1111/all.12470.
6. Belhassen M, Demoly P, Bloch-Morot E, et al. Costs of perennial allergic rhinitis and allergic asthma increase with severity and poor disease control. *Allergy*. 2017 Jun;72(6):948–958. doi: 10.1111/all.13098.
7. Cardell L-O, Olsson P, Andersson M, et al. TOTALL: high cost of allergic rhinitis—a national Swedish population-based questionnaire study. *NPJ Prim Care Respir Med*. 2016;26. 15082; doi:10.1038/npjpcrm.2015.82;
8. Colás C, Brosa M, Antón E, et al. Rhinoconjunctivitis Committee of the Spanish Society of Allergy and Clinical Immunology. Estimate of the total costs of allergic rhinitis in specialized care based on real-world data: the FERIN Study. *Allergy*. 2017 Jun;72(6):959–966. doi: 10.1111/all.13099.
9. Probst-Hensch N, Tanner M, Kessler C, Burri C, Künzli N. Prevention—a cost-effective way to fight the non-communicable disease epidemic: an academic perspective of the United Nations High-level NCD Meeting. *Swiss Med Wkly*. 2011 Sep 7;141:w13266. doi: 10.4414/smw.2011.13266.