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# IMPACT OF THE NATIONAL ASTHMA PROGRAM ON ASTHMA STATUS IN FINLAND

A 30-year review of asthma status from a financial point of view

AUTHORS Heba Abdelsamad

Sahar Ahmed

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| Author(s)<br>Heba Abdelsamad<br>Sahar Ahmed  |                          |
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| <p>Abstract</p> <p>Asthma is a common chronic respiratory disease that has significant healthcare and economic consequences. The Finnish Asthma Programme has been widely appreciated for its comprehensive asthma management approach, which is aimed at addressing the burden of asthma in Finland. The Finnish Asthma Programme, launched in 1994 to reduce the prevalence of asthma and improve the quality of life for asthma patients through various interventions including education, early diagnosis, and optimized treatment options, was followed by an allergy program between 2008 and 2018. Both programs demonstrated significant cost-saving benefits for the healthcare system, by reducing emergency room visits, hospitalizations, and the overall burden of uncontrolled asthma.</p> <p>The purpose of this literature review was to evaluate the trends in the prevalence of asthma and its management in the general population of Finland from 1992 to 2022. The aims were (1) to explore the social and economic burden of asthma's impact on society, and (2) to assess the national asthma program and its efficacy on asthma management and cost reduction. A total of eleven (n=11) peer-reviewed articles, between 2000 to 2023 and sourced from reputable databases such as PubMed, Google Scholar, and ScienceDirect, were selected for analysis, employing content analysis methods as the research methodology.</p> <p>To conclude, the Finnish Asthma program has shown promising results in improving cost management within the healthcare system. The comprehensive approach to asthma management, including education and early intervention, has proven to be beneficial in improving asthma patients' quality of life and optimizing the use of healthcare resources.</p> |                          |
| <p>Keywords<br/>Asthma, Finland, National Asthma Management Program.</p>   |                          |

## CONTENTS

|       |   |    |
|-------|---|----|
| 1     | INTRODUCTION .....  | 5  |
| 2     | ASTHMA IN FOCUS: EXAMINING CURRENT STATUS AND PREVALENCE RATES..... | 7  |
| 3     | SOCIAL AND ECONOMIC BURDENS OF ASTHMA ON SOCIETY.....               | 9  |
| 4     | THE FINNISH NATIONAL ASTHMA PROGRAM .....                           | 12 |
| 5     | PURPOSE AND AIMS.....   | 16 |
| 6     | IMPLEMENTATION .....  | 17 |
| 6.1   | Literature review.....  | 17 |
| 6.2   | Data collection.....  | 18 |
| 6.3   | Content Analysis .....  | 20 |
| 7     | RESULTS .....   | 22 |
| 7.1   | The Impact of the Program on asthma prevalence in Finland.....      | 22 |
| 7.2   | The impact of Asthma Programs on cost management.....               | 25 |
| 7.2.1 | The Impact of the National Asthma Program (1994 – 2004).....        | 25 |
| 7.2.2 | The Impact of the Allergy Program (2008 – 2018).....                | 26 |
| 8     | CONCLUSION:.....  | 28 |
| 8.1   | Consideration of results.....                                       | 28 |
| 8.2   | Ethicalness and Reliability.....                                    | 28 |
| 8.3   | Professional Growth .....   | 29 |
| 8.4   | Applicability and development ideas.....                            | 29 |
|       | REFERENCES.....   | 30 |
|       | APPENDIX.....   | 36 |

## LIST OF FIGURES

FIGURE 1. The prevalence of asthma and current asthma in Helsinki

FIGURE 2. Direct annual costs distribution of asthma in Finland in the late 1990s

FIGURE 3. Flow chart of National asthma Program strategic planning, implementation, and evaluation

FIGURE 4. The strategic planning of the Finnish Allergy Program 2008-2018

FIGURE 5. Steps of Research Implementation

FIGURE 6. Process of Article selection and exclusion criteria

FIGURE 7. Process of content data analysis

FIGURE 8. Prevalence of physician-diagnosed asthma and asthma by gender from 1996 to 2016

FIGURE 9. Increase in number of asthmatic patients entitled to special reimbursement for their drug costs

FIGURE 10. Direct annual costs of asthma

## 1 INTRODUCTION

Asthma is a global chronic health problem, which brings considerable burdens and disability. The prevalence of asthma has been increasing in recent decades, with Finland also reporting an increase in prevalence rates. (Bousquet et al. 2008.) According to WHO, in 2019, approximately 262 million individuals were affected by asthma, leading to 455 000 fatalities. Furthermore, a majority of asthma-related fatalities occur in low- and lower-middle-income countries, posing challenges such as under-diagnosis and inadequate treatment. Within Europe, asthma affects almost 10 million individuals under the age of 45. The prevalence of asthma in the European Union (EU) is reported at 8.2% among adults and 9.4% among children. (Vos et al. 2020.) Asthma can be effectively managed with therapy based on established guidelines. However, despite the availability of guidelines, asthma remains inadequately treated and poorly controlled in Europe. Consequently, it represents a significant public health concern that requires further research and investigation. (Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention 2021., n.d.) Finland, akin to numerous other Western nations, has undergone substantial structural transformations in the post-war era. These transformations encompass urbanization, heightened educational attainment, reduced family sizes, enhanced hygiene practices in food and household water, and the successful prevention and treatment of diverse infectious diseases. Strikingly, nearly all of these factors have been linked to an elevated risk of asthma in Finland. Additionally, akin to other Nordic countries, the cold climate often triggers asthma symptoms, and various environmental factors play a pivotal role in both the prevention and treatment of asthma in Finland. (Kotaniemi et al. 2001.)

In 2013, the World Health Organization (WHO) projected that globally, asthma leads to the loss of 25 billion disability-adjusted life years (DALYs) annually. Specifically, within the European Union (EU), the impact of this condition results in the loss of 5.2 billion DALYs. In numerous countries, the overall expenses related to asthma treatment have been consistently increasing, primarily driven by the rising prevalence of asthma and the escalating costs associated with newer medications. (Bedouch et al. 2012.) In Finland, the prevalence of asthma among adults was approximately 6% during the 1990s, but it has since experienced an upward trend. (Kotaniemi et al. 2001; Pallasaho et al. 2002). Surveys conducted in the Helsinki capital area based on the population indicated a prevalence of physician-diagnosed asthma at 6.8% in 1996, a figure that rose to 9.4% in 2007 (Hisinger-Mölkänen et al. 2019). Among adults aged 25 to 64 years, the age-adjusted prevalence of physician-diagnosed asthma increased from 6.1% to 9.5% in men and from 7.8% to 10.8% in women between 1997 and 2012 (Jousilahti et al. 2016). In 2013, the Finnish Social Insurance Institution (SII) documented 247,583 patients diagnosed with asthma by physicians who were eligible for special reimbursement of drug costs, reflecting their ongoing need for medication to manage persistent disease. This number was three times greater than the count in 1987. It is crucial to highlight that during the same period, the population of Finland expanded from nearly 5 million to 5.4 million, indicating a growth of 10%.

To deal with this growing burden, the Finnish National Asthma Programme was implemented from 1994 to 2004, as well as the Finnish Allergy Programme between 2008 and 2018. Both programs

proved to be effective, resulting in a significant reduction in asthma-related expenses, hospital admissions, and the prevalence of allergy diets among children and adolescents. (Hisinger-Mölkänen 2022.) The Finnish Asthma Programme started in 1994 had a primary emphasis on the education of health care practitioners. Focusing on Inhaled corticosteroids as the initial treatment option and guiding the patients to self-treatment, which involved adapting their medication regimen based on their symptoms. According to the study by Haahtela et al., a significant reduction of 87% in hospital days and a 57% decrease in age-adjusted asthma mortality rates were observed as outcomes of the Finnish Asthma Programme. (Selroos et al. 2015.) The Finnish National Asthma Allergy 10-year program (1994–2004) served as a model for other European and non-European programs (Erhola et al. 2003). While the Finnish Allergy Programme, spanning from 2008 to 2018, had the primary goal of enhancing immunological tolerance. This objective was successfully achieved, as indicated by a 43% reduction in allergy diets and a 45% decrease in confirmed cases of work-related allergies. (Haahtela et al. 2021.)

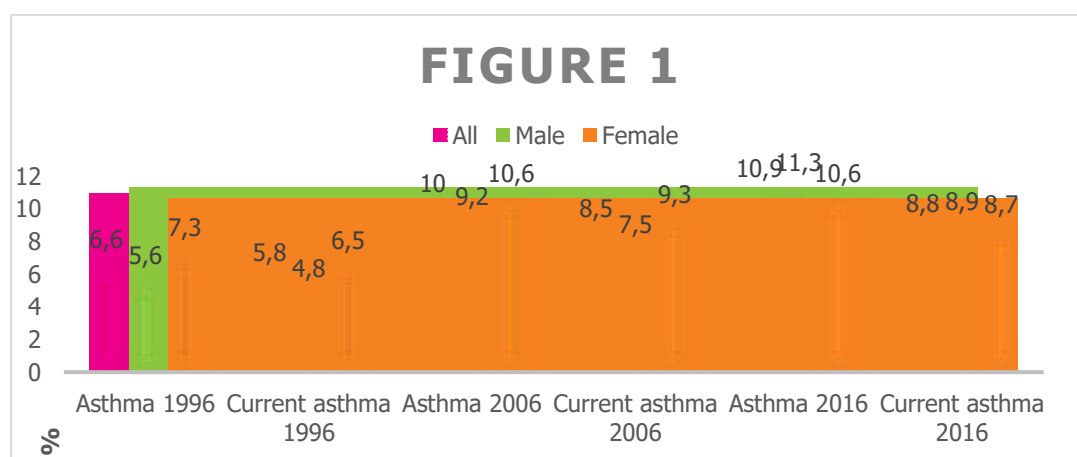
Evaluations of National Asthma programs in Europe indicate that conscientious efforts can improve patients' quality of life and reduce hospitalization, asthma mortality, sick leave, and disability pensions. Furthermore, both individual patients and society can benefit from significant reductions in both direct and indirect costs as a result of these programs. (Selroos et al. 2015.) This study aims to evaluate the trends in the prevalence of asthma and its management in the general population of Finland from 1992 to 2022. The aim is (1) To explore the social and economic burden of asthma's impact on society, and (2) to assess the national asthma program and its efficacy on asthma management and cost reduction. To achieve this purpose, researchers have set the following research question. How has the National Asthma program in Finland influenced the prevalence and cost of management in patients with asthma during the last 30 years?

## 2 ASTHMA IN FOCUS: EXAMINING CURRENT STATUS AND PREVALENCE RATES

Asthma is a chronic condition marked by inflammation in the lower respiratory tract, resulting in obstructive ventilatory dysfunction. The associated functional impairment is largely reversible and exhibits variability in both character and symptoms among different patients. (Papi et al. 2018.) A better understanding of the heterogeneity in asthma phenotypes has been achieved via intensive research into this disease. Various pathways trigger inflammatory responses, ultimately resulting in a similar clinical presentation. (Halдар et al. 2008.) The predominant symptoms of asthma include coughing, wheezing, and shallow breathing. These symptoms vary in character and intensity, with some individuals experiencing more pronounced episodes known as asthma exacerbations. Over recent decades, there has been a global increase in the incidence of asthma, a trend attributed to various factors including smoking, environmental pollution, and a decreased burden of infections. (Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention 2021., n.d.) Several studies supporting the hygiene hypothesis suggest that diminished exposure to environmental factors plays a role in the development of asthma (Haahtela 2019).

In 2019, the World Health Organization (WHO) documented that asthma affected an estimated 262 million individuals globally, resulting in 455,000 deaths. Notably, a significant majority of asthma-related fatalities occurred in low- and lower-middle-income countries, where challenges such as under-diagnosis and insufficient treatment pose substantial challenges (Vos et al. 2020). In Europe, the prevalence of asthma in adults spans from 5.1% to 8.2% as reported by To et al. in 2012. However, it's important to note that significant disparities exist between European countries, with a notably low prevalence of 1.3% in Bosnia and a significantly higher prevalence of 17.6% in the United Kingdom. (Wecker et al. 2023.) The prevalence of asthma, including allergic asthma, is increasing, for instance, in Sweden, a significant increase in the prevalence of asthma was noted, with a rise from 8.4% in 1996 to 10.9% in 2016 (Backman et al. 2017). In Finland, the prevalence of physician-diagnosed asthma witnessed an increase in Helsinki from 1996 to 2006. However, by the year 2016, it had stabilized. A similar pattern was observed in the prevalence of current asthma, with an increase over that time frame, followed by stabilization in 2016 (FIGURE 1). (Hisinger-Mölkänen 2022.)

FIGURE 1. The prevalence (%) of asthma and current asthma in Helsinki, spanning from 1996 to 2016, stratified by gender (Modified from Hisinger-Mölkänen 2022).



Diagnosis of asthma relies on a combination of clinical history and the observation of variable airflow restriction through objective lung function assessments. Once a patient shows persistent typical asthma symptoms, they typically undergo spirometry, a subsequent peak expiratory flow (PEF), and follow-up tests. Asthma diagnosis can also be confirmed through a therapeutic trial involving inhaled corticosteroids, provided a significant improvement in lung function is observed during the trial. If necessary, additional confirmation of the diagnosis may involve the use of indirect or direct challenge tests. (Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention 2021. n.d.) Asthma onset can occur at any age from early childhood to late adulthood (Kankaanranta et al. 2017). Age should be taken into account when planning diagnostic testing. Among elderly individuals with asthma, it's expected to observe incomplete reversibility, which can be challenging in the process of distinguishing asthma from other medical conditions. (Benedictis & Attanasi 2016; Braman 2017.)

Asthma symptoms are non-specific, underscoring the importance of a thorough clinical history for establishing an asthma diagnosis. Differential diagnostics can be complex, as heart diseases, malignancies, or upper airway issues may present with similar symptom profiles. Therefore, a thorough assessment of differential diagnostic testing is essential when confirming an asthma diagnosis. On the other side, individuals with confirmed asthma may encounter asthma-like symptoms triggered by other medical conditions. Consequently, evaluating treatment responses becomes a crucial aspect of managing such cases. (Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention 2021. n.d.) In Finland, asthma diagnoses consistently involve objective lung function testing in conjunction with the typical clinical history, primarily due to the drug reimbursement system. This stringent approach to diagnosis ensures the reliability of asthma diagnoses in the country. For pediatric cases, reimbursement is provided for up to 5 years, and if asthma medication is prescribed into adulthood, diagnostic testing is required to be repeated to maintain the diagnosis's validity. (Duodecim 2022; Kela 2022; Pakkasela et al. 2023.)

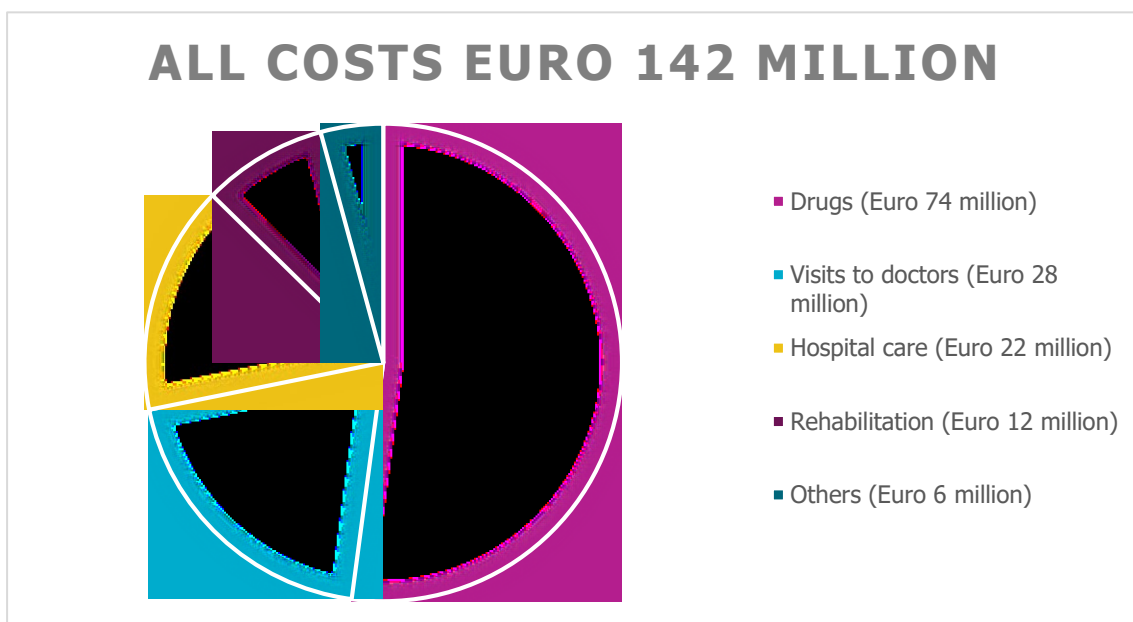


### 3 SOCIAL AND ECONOMIC BURDENS OF ASTHMA ON SOCIETY

Asthma is an inflammatory lung disorder that can affect individuals of all ages and represents a substantial cause of illness and mortality on a global scale (Bousquet et al. 1994; Riccioni et al. 2003). Asthma imposes a substantial disease burden, particularly in children under 5 and mid-childhood (5–14). It is a prevalent and significant chronic condition in these age groups, contributing significantly to disability-adjusted life years (DALYs). Notably, there are substantial global variations in the prevalence of asthma symptoms in children, with differences of up to 13-fold observed between countries. (Masoli et al. 2004; Braman 2006; Winer et al. 2012; Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention 2021. n.d.) While asthma poses a significant burden in children, its impact becomes relatively more pronounced with age, particularly in the elderly population. This effect is especially noticeable in women. (Slavin 2005.) If current trends persist, it is estimated that there could be an additional 100 million individuals with asthma by the year 2025. (Masoli et al. 2004).

The economic costs associated with asthma are regarded as among the highest among chronic diseases, primarily due to the significant healthcare utilization associated with this condition. Numerous studies have reported data on asthma costs, encompassing both individual patient-level costs and those at the societal level, whether at a regional or country level. (Gergen 2001.) On average, the annual cost per asthmatic individual is estimated to be around \$5,000 USD, with considerably higher costs associated with severe asthma cases (Cisternas et al. 2003). Asthma Cost Includes both direct and indirect components. Direct costs comprise both medical and non-medical expenses associated with the disease. Medical direct costs include expenses related to the prevention, treatment, and rehabilitation of asthma. Examples include hospital services, physician services, medications, and diagnostic tests. Non-medical direct costs encompass items such as transportation to and from healthcare providers, as well as the purchase of home healthcare equipment like wheelchairs, nebulizers, special diets, and home assistance. Other direct costs that are typically not included in existing datasets consist of over-the-counter medications, alternative or complementary medical services, costs related to constructing medical facilities, disease-specific research, and the expenses of training medical practitioners who treat the disease. (Gergen 2001.) In Finland, at the end of the 1990s, the direct costs associated with asthma treatment amounted to approximately 142 million Euros (FIGURE 2) (Haahtela et al., 2001).

FIGURE 2. Direct annual costs distribution of asthma in Finland in the late 1990s (Modified from Haahtela et al. 2001).



Indirect costs represent a distinct dimension of the impact of asthma and are often referred to as opportunity costs. These costs signify the value of resources lost due to time absent from work or other routine daily activities because of illness. (Gergen 2001.) Hodgson Ta defined indirect costs as “output lost because of cessation or reduction of productivity due to morbidity or mortality” (Hodgson 1983). Indirect costs include various aspects such as missed workdays, both in employment and housework, school days lost (due to caregivers needing to tend to the child), and the potential loss of future earnings due to premature death. Additionally, indirect costs may include the impact on the family's quality of life resulting from one member's illness and reduced productivity at work due to one's or a family member's illness, although these aspects are typically not accounted for in conventional assessments. (Gergen 2001.)

Self-reporting accounts for a substantial amount of indirect expenses, which can be influenced by an individual's view of their disease and social support network. Some people, for example, might choose to go to work regardless of their state of wellness, while others may call in sick at the first hint of illness. Additionally, the availability of childcare options for a family can determine whether a child's illness results in lost productivity for the parents. The human capital approach is utilized to estimate the economic value of wages lost due to illness and premature death. It calculates this value by assigning a salary level for lost wages based on the earnings of individuals in the reference population who share similar sociodemographic characteristics, such as education and training. However, it's important to note that this approach often assigns a lower value to lost wages for women and minority populations. (Hodgson 1983.)

Morbidity costs constitute the most significant component of indirect costs, contributing to approximately two-thirds to three-quarters of the total indirect cost of asthma (Krahn et al. 1996; Weiss et al. 1992, 2000). Within the demographic of individuals under 18 years, where there are relatively

few asthma-related deaths, morbidity costs make up approximately 80% to 90% of the total indirect costs (Weiss et al. 1992; Weiss et al. 2000). When examining non-mortality-related indirect expenditures across all age brackets, the collective instances of missed school days contribute to approximately one-third to one-half of the indirect costs linked with morbidity. The residual portion is ascribed to declines in employment, encompassing tasks both within and outside the household. (SMITH et al. 1997; Weiss et al. 1992; Weiss et al. 2000.) Upon a more detailed investigation of indirect costs related to employment, it was determined that the economic worth of lost household tasks represented roughly 24% to 28% of the non-mortality-related indirect costs connected to asthma (Weiss et al. 1992).

In various nations, noncommunicable diseases such as asthma may not have been accorded high priority within healthcare systems. Consequently, this lack of prioritization can lead to restricted access to routine preventive care, encompassing limitations associated with both human resources and medications. Moreover, financial constraints may impede the formulation of effective strategies for the control and prevention of chronic diseases such as asthma. In these circumstances, a considerable number of individuals with asthma may depend predominantly on emergency rooms or hospital admissions for their treatment. Ten years ago, only a handful of countries had implemented national asthma programs with an emphasis on disease control, mirroring practices observed in the USA and certain European nations like Finland, France, and Portugal. Beyond societal influences, including disparities in the availability and nature of health insurance and healthcare systems, there are patient-specific factors such as literacy, knowledge, beliefs, attitudes, and language that can impact both asthma-related costs and healthcare utilization. (Braman 2006.)

## 4 THE FINNISH NATIONAL ASTHMA PROGRAM

The inception of the program in Finland was prompted by the escalating prevalence of asthma and the growing societal burden of the disease in the 1980s and 1990s. During this period, asthma had ascended to become the third most prevalent chronic disorder requiring prolonged medication, following hypertension and coronary heart disease. From 1986 to 1995, there was a steady increase in the number of new asthma cases, identified through patients eligible for special reimbursement for anti-asthma medications. This rise was particularly notable among children and adolescents during this period. In 1993, acknowledging asthma as a substantial public health concern, the Ministry of Social Affairs and Health in Finland instituted a working group with the mandate to formulate a national program. The objective of this program was to prevent and alleviate the challenges posed by asthma, with a particular emphasis on reducing the associated costs. The working committee strategically opted to establish an action program that places significant emphasis on implementing guidelines and conducting thorough follow-up, aspects that are frequently overlooked in consensus reports concerning asthma treatment. (Haahtela & Laitinen. 1996.) In 1994, the prevailing belief was that "Once asthma is always asthma, it cannot be cured but only controlled." However, the working group adopted a more optimistic perspective, emphasizing the following points mentioned in TABLE 1. (Haahtela et al. 2001)

**TABLE. 1**

- Many patients have a mild form of the disease.
- Inflammation of the bronchial mucosa and lung function issues can be detected early.
- Early intervention often results in complete recovery, even though individuals may still have a predisposition to asthmatic reactions.

This 10-year program was officially initiated in 1994 (Haahtela & Laitinen 1996.) The goals of prevention and treatment, as stated, are as Mentioned in (TABLE 2). To reduce the annual treatment costs per patient by 50% through more effective prevention and symptom management, the following measures mentioned in (TABLE 3) were undertaken. The fundamental concept underlying the formulation of the Finnish action program was the recognition of asthma as a fundamentally inflammatory disorder that could be identified in its early stages and effectively managed. This understanding served as the cornerstone for the development and implementation of the program. The flow chart of National asthma Program strategic planning, implementation, and evaluation of the program are mentioned in (FIGURE 3). (Haahtela et al. 2001).

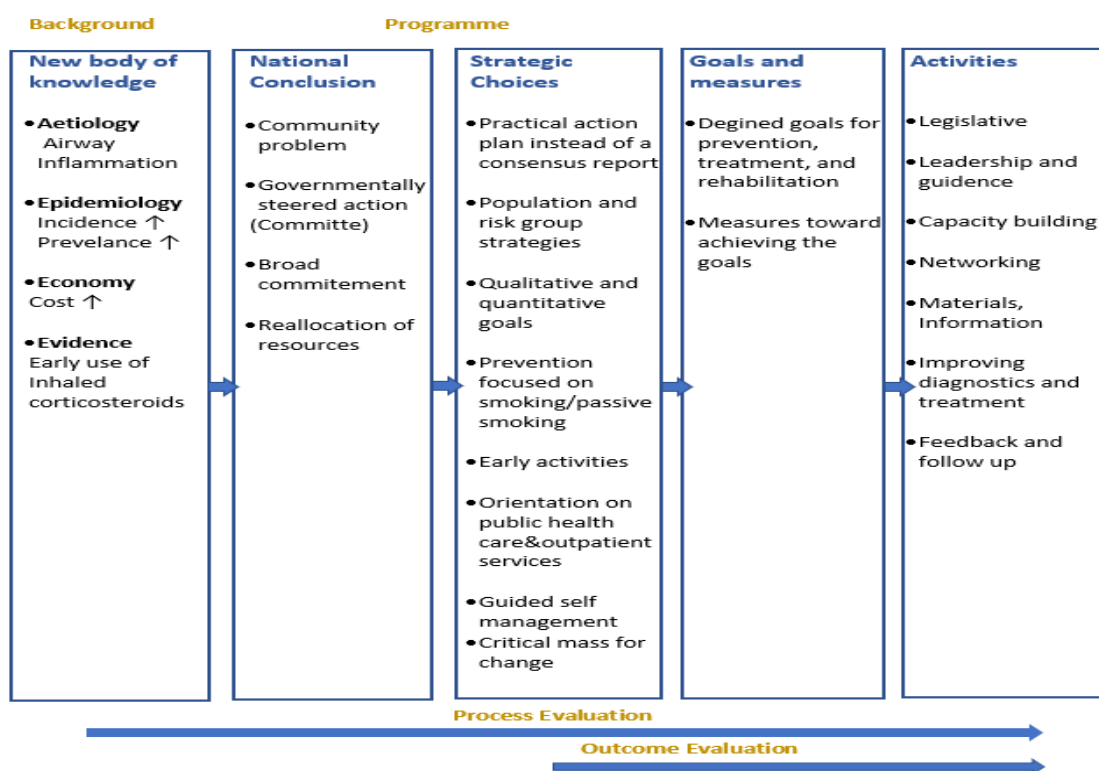
**TABLE. 2 Goals of the Finnish National Asthma Program (1994 – 2004)**

- To achieve recovery for as many patients as possible with early-stage asthma.
- To ensure that asthmatic patients experience a good quality of life, including the ability to work and function at a level consistent with their age.
- To reduce the percentage of patients with severe and moderate asthma from the current 40% to 20%.
- To decrease the number of hospital bed days for asthmatic patients by 50% by the year 2000, aiming for 50,000 bed days annually.

**TABLE. 3 Measures taken for effective prevention and symptom management**

- Early diagnosis and proactive treatment.
- Promoting guided self-management as the primary mode of treatment.
- Decreasing exposure to respiratory irritants, particularly smoking and tobacco smoke.
- Implementing outpatient rehabilitation in conjunction with standard treatment, tailored to individual needs and appropriately timed.
- Enhancing knowledge about asthma within key groups.
- Supporting and promoting scientific research focused on asthma.

FIGURE 3. Flow chart of National asthma Program strategic planning, implementation, and evaluation of the program (Modified from Haahtela et al. 2001.)

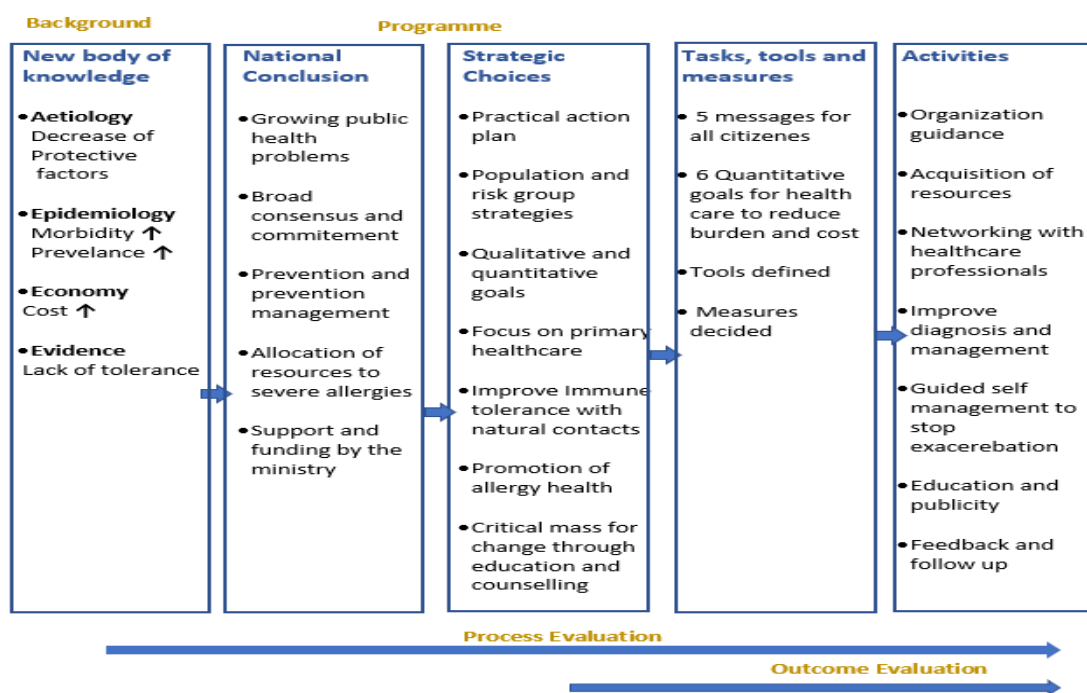


The Finnish case illustrated that the methodical adoption of optimal clinical practices can lead to substantial transformation within a relatively brief timeframe. Expanding upon the accomplishments of the National Asthma Programme, Finland initiated the Finnish Allergy Programme 2008–2018 to combat the allergy epidemic. This novel undertaking prioritizes the augmentation of immunological tolerance and the advancement of secondary prevention strategies. (Haahtela et al. 2008.) The formulation of the Finnish Allergy Program stemmed from a thorough examination of emerging perspectives on immune regulation and the importance of a connection to nature (Von Hertzen et al. 2009). The primary objective of the Finnish Allergy Program was to shift the approach from avoidance to tolerance and resilience, with a specific emphasis on allergy health, which means enabling people to lead a good life despite allergies. The program aimed to reduce unnecessary treatments

and measures, particularly for children and families, and also placed a significant focus on addressing severe allergies and asthma. Goals for the healthcare included standardization of diagnostics, a 50% reduction in the prevalence of food allergy diets, and a 20% decrease in the overall costs associated with allergic diseases and asthma. (Heinzerling et al. 2005.)

The asthma problem was already becoming evident in the 1980s, which prompted the publication of the first allergy management guideline in Finland. It remained a concern in 1998 when a consensus report was created to address the issue. (Haahtela et al. 2021.) In the 1990s, there was a rise in the number of patients grappling with allergies and asthma, and both children and adults encountered suboptimal allergy care. In response, the 10-year Finnish Asthma Program was established, incorporating fresh insights that defined asthma predominantly as an inflammatory disease. (Haahtela et al. 2022.) Within a concise timeframe, management was improved, and costs were reduced by enhancing early diagnostics and transitioning from the utilization of beta-2 agonists to inhaled corticosteroids as the primary first-line medications. (Haahtela et al. 2006, 2017). However, the fundamental challenge of preventing asthma and allergic diseases from occurring in the first place persisted. The strategic plan for addressing the allergy issue is delineated in FIGURE 4 (Haahtela et al. 2021).

FIGURE 4. The strategic planning of the Finnish Allergy Program 2008-2018 (Modified from Haahtela et al. 2021.)



The primary messages of the Allergy program were directed at the entire population (TABLE 4). For healthcare professionals, the program established six goals, five of which were quantitative, and associated indicators were tailored (TABLE 5). Each goal came with specific tasks, tools, and evaluation methods. The tasks represented the actions or objectives in achieving the goal (what to do), while the tools were the means to carry out these tasks (how to do it). The outcomes underwent thorough assessment and validation. The program not only concentrated on clinical disease but also underscored "allergy health." It acknowledged mild symptoms, especially in childhood, as a natural

aspect of immune development that did not require specific guidance or intervention. (Pelkonen et al. 2012.)

TABLE 4. Key messages of the Finnish Allergy Program 2008- 2018 (Modified from Pelkonen et al., 2012).

**TABLE 4. Key messages of the Finnish Allergy Program 2008- 2018**

- Endorse health, not allergy
- Strengthen tolerance
- Adopt a new attitude to allergy, and avoid allergens only if mandatory
- Recognize and treat severe allergies early, and prevent exacerbations
- Improve air quality, and stop smoking

TABLE 5. Main goals and key results of the Finnish Allergy Program 2008-2018 (Modified from Pelkonen et al., 2012).

| TABLE 5. Main goals and key results of the Finnish Allergy Program 2008-2018   |  |   |
|--|--|---|
| Finnish allergy program goals  | Program outcomes   | Potential impact on planetary health  |
| Prevent allergy Indicator:<br>(asthma, rhinitis, and atopic eczema prevalence reduced by 20%)  | Prevalence of allergic rhinitis and asthma leveled off and symptoms decreased  | Changes in environment and lifestyle are primary causes of allergic diseases, asthma, and other NCDs. They are largely prevented by nature relatedness, active mobility, and sustainable diet, which have large planetary impacts   |
| Improve tolerance/resilience Indicator:<br>prevalence of food allergy diets reduced by 50%<br>• Strengthen immunity by increasing contact with natural environments and by following healthy diets (eg, the traditional Mediterranean or Baltic diet)<br>• Use antibiotics only out of necessity | Prevalence of food allergy diets in day care decreased by 43%-65%<br>In Finland, new recommendations regarding healthy diets for families and children were launched in 2019<br>Contact with nature has been improved (eg, in day care by adopting the concept of Nature Step) | The biodiversity hypothesis of health should be applied in everyday life<br>• Turn cities green<br>• Conserve and regenerate nature<br>• Use healthy food and sustainable food production for human and planetary health<br>• Protect populations from epidemics of infection (antibiotic resistance) |
| Improve allergy diagnostics Indicator:<br>allergy testing practiced in certified testing centers   | All major allergy diagnostic centers have been educated, certified, and audited  | Quality control improves patient care, saves societal resources, and reduces the planetary impact on health care  |
| Reduce work-related allergies Indicator:<br>incidence of occupational allergies reduced by 50%   | Incidence of occupational allergies was reduced by 45%   | Better control of working conditions saves lives, affects quality of life, and increases productivity. It also has a major impact on planetary health   |
| Focus on severe forms of disease and treat them early Indicator:<br>asthma-related emergency department visits reduced by 40%  | During the program, asthma-related emergency department visits decreased by 6% (by 53% in children), and 35% in the 2000s.<br>Hospital days decreased by 50%, and by 73% in the 2000s  | Fewer hospitalizations and medications save societal resources and reduce carbon footprint of health care, with planetary impact  |
| Reduce allergy and asthma costs Indicator:<br>Allergy costs reduced by 20%   | Health care and disability costs decreased by 30% (€200 million) in 2018 compared with in 2007   | Enormous potential for global savings resulting from prevention and better care of individuals with NCDs  |

The Finnish Allergy program has been successfully concluded, signifying a triumphant change management initiative at the national level (Haahtela et al. 2021). In this review, we highlight the primary outcomes of both asthma programs and explore the potential for sharing this experience with other countries and continuing its success into the future.

## 5 PURPOSE AND AIMS

The purpose of this study is to assess the prevalence trends of asthma and asthma management in the general population in Finland from 1992-2022. The aim is (1) To explore the social and economic burden of asthma's impact on society, and (2) to assess the national asthma program and its efficacy on asthma management and cost reduction.

To achieve this purpose, researchers have set the following research question.

How has the National Asthma program in Finland influenced the prevalence and the cost of management in patients with asthma during the last 30 years?



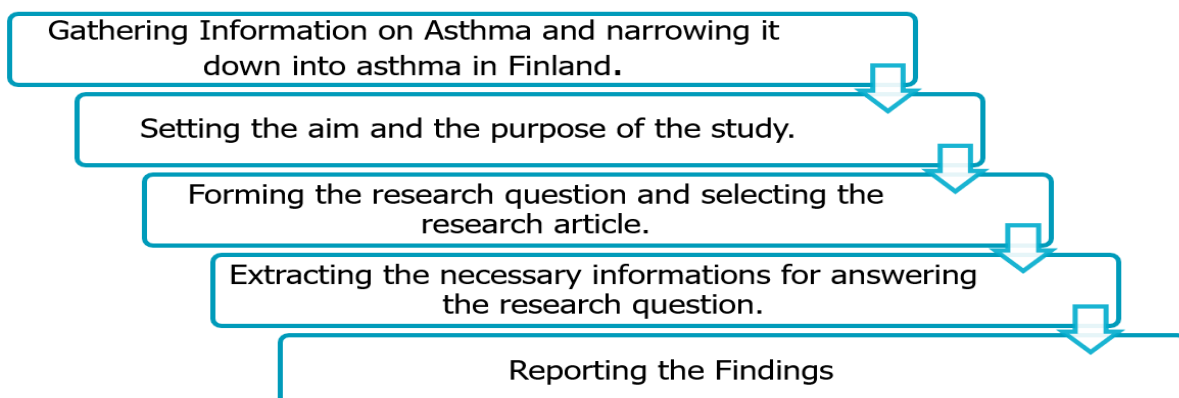
## 6 IMPLEMENTATION

### 6.1 Literature review

This research adopts a literature review as its methodology. The literature review constitutes a thorough examination and interpretation of various sources, including research articles, books, presentations, and other publications, relevant to the subject of interest. (Aveyard 2014.) The initial step in the reviewing process is to delineate the objective and purpose of the literature review. The goal is to precisely identify the aspects that the authors will investigate, facilitating a reasoned argument for the subject. Subsequently, the research question is formulated in alignment with the defined objective and purpose. The entire review process is then conducted to furnish a comprehensive response to the research questions. Another important step is the search for literatures that answer the research question. A meticulous search and analysis of existing literature are imperative to offer a more comprehensive and valuable insight into the subject of interest. An additional step involves synthesizing all the information and knowledge gathered from various research articles and literature. The authors' reflections on everything they have, summarizing the findings, and coming up with conclusions as to research questions and topics of review are the last but not least steps in their review. Additional recommendations for further improvement in the subject matter can also be made or added by the authors. (Coughian & Cronin 2021.)

The review commenced by conducting a search for research publications on global asthma conditions, which was then narrowed down to European countries, with a further focus on Finland. This search was carried out using three primary electronic databases: PubMed, Science Direct, and Google Scholar. Upon reading the retrieved articles and synthesizing the information, a specific area of need was identified. Subsequently, the research question was formulated to provide more detailed insights into the research topic. To address these research questions, a careful selection was made, focusing on the most pertinent and recent studies, with a preference for reviewed papers. These studies centered around topics such as the prevalence of asthma, the social burden associated with asthma, the National Asthma Program, and the effectiveness of the program in controlling asthma and achieving cost savings. Our supervisor played a pivotal role in further refining the selection of articles suitable for the development of this work. The summarized steps followed are illustrated in FIGURE 5.

FIGURE 5. Steps of Research Implementation.



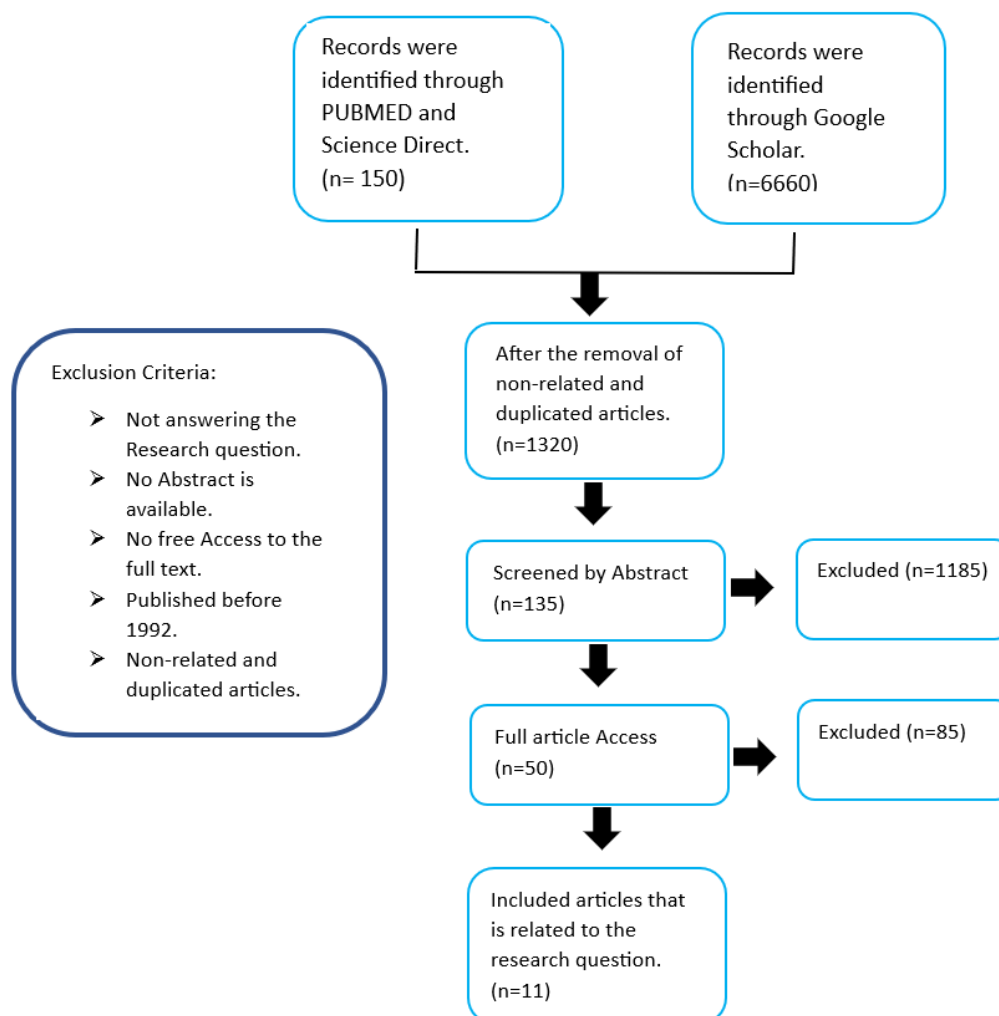
## 6.2 Data collection

A few basic elements, such as a logical search process and strategies, are involved in the data collection process. In order to meet the eligibility criteria and respond to research questions it is necessary that both search and strategy plans are good enough. The data collection process may necessitate multiple iterations, employing the most effective strategic or logical search methods. An essential step in this process involves selecting databases for the search. Striking a balance between specificity and sensitivity is a crucial aspect of the data collection process. If the search is overly specific, only a limited number of articles may be retrieved. Additionally, transparency, documentation, and replicability by others are key considerations in ensuring that the search for data is conducted using a clear and well-documented strategy. (Pursell & McCrae 2020.)

After a thorough review of all the information and data sources available to this thesis, it has been made possible to collect these data by means of digital databases. We narrowed our search down to three large databases, PubMed, Google Scholar, and ScienceDirect, after consultation with the supervisor and librarian. In the fields of medicine and life sciences, PubMed provides over 30 million research articles and literature. (National Center for Biotechnology Information s.a.) A large bibliographic database of scientific and medical publications published by the Dutch publisher Elsevier is available on the ScienceDirect website. It's got over 18 million pieces of content from over 4,000 scientific journals and 30,000 electronic books published by this publisher. (Scientometrics. 106: 263–280.) Google Scholar stands as a reliable and extensive source, providing a substantial volume of information on qualified research articles and academic literature across various fields, including nursing sciences (Google Scholar).

The incorporation of the findings in this project not only enhances the replicability of the results but also contributes to their authenticity. The exclusion criteria for the articles are outlined in Figure 6. It is also appropriate to specify the inclusion criteria for these articles. Articles that answer a research question or mainly deal with articles not confined to one site in Finland have been particularly included as they are published in English. To update the thesis, new articles which were not published until 1990 have been selected. Each of the articles underwent a peer-review process conducted by researchers and scholars within the same field. A peer-reviewed article is one that presents an evaluation conducted by an individual academic or researcher in the corresponding field of study. (Pursell & McCrae 2020.) A search using four keywords "Asthma," "cost-benefit analysis," "National program," and "Finland" yielded 150 articles in PubMed and Science Direct, and 6660 articles in Google Scholar. Given the substantial number of results, this proved to be an extensive dataset. A total of 135 articles were selected, following a review of the titles in particular on the theme of the thesis and research question. Following a review of the abstracts, the initial number was narrowed down to 50. From this subset, eleven articles were selected and incorporated into the project with the guidance of our supervisor.

FIGURE 6. Process of Article selection and exclusion criteria



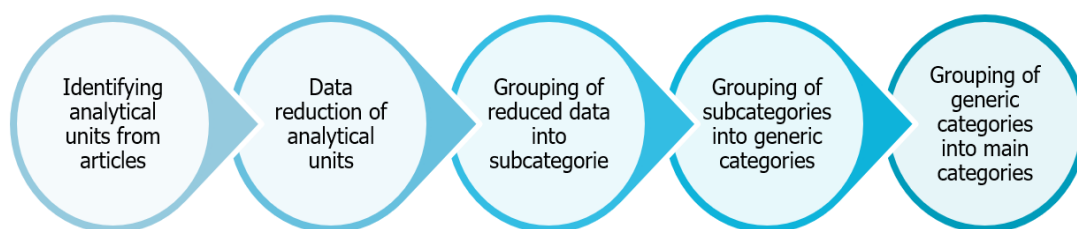
### 6.3 Content Analysis

Content analysis is used to analyze the data obtained from both quantitative and qualitative research. Moreover, based on the beginning point, research may be divided into deductive or inductive studies. In general, quantitative research is deductive, whereas qualitative research is inductive. There are different philosophical foundations for these two types of research, and they are conducted in different ways. (Kyngäs et al. 2019.)

In this study, the data and findings from the reviewed articles were amalgamated and summarized to enhance understanding of the asthma status in Finland. The focus was on comprehending the national asthma program and evaluating its effectiveness, as evidenced by prevalence rates and cost savings. The objective was to comprehensively depict the effectiveness of the program in alleviating both human suffering and societal costs, as initially demonstrated in Finland. The achievement of this objective was facilitated by the systematic and objective analysis of various article categories through content analysis. Content analysis serves as a valuable tool for the classification, quantification, and description of subjects within a study. It provides an opportunity to categorize and discuss these subjects' using models that can amalgamate and generalize the phenomena under investigation. Nevertheless, achieving this objective requires a meticulous examination of the research materials by the authors. (Kyngäs & Vanhanen 1999.)

In this study, we employed deductive content analysis as our primary research method. Deductive content analysis is an analytical approach designed to assess the applicability of existing categories, concepts, models, theories, or hypotheses in a new context. There are two reasons why researchers usually use deductive content analysis. Firstly, they may want to compare certain concepts in another context. In addition, the study of specific theoretical structures in a new context is another reason for researchers to perform deductive content analysis. The deductive content analysis has been carried out at various phases or stages, e.g., reducing data, grouping of data, and categorization of information collected to answer research questions. Reading the materials, organization, and integration of data, categorization, and theme formation by looking at material differences and similarities with those considered in this study have been part of the contents analysis process. (Kyngäs et al. 2019.)

FIGURE 7. Process of content data analysis



The major themes and categories of data relating to research articles had been identified based on a careful examination of materials. The phrases and sentences of the main articles were chosen as an analytical unit to assist in answering the research question. After the collection and repeated examination of the reduced data, the analytical units have been simplified and subcategorized. Subsequently, subcategorized data have been placed under generic categories. The final phase was to place generic categories in the main categories derived from research questions in FIGURE 7 and TABLE 6, respectively. Generally, we extracted eleven original expressions (n = 11), two sub-categories (n = 2), two generic categories (n = 2), and one main category (n = 1).

TABLE 6. Examples of content analysis:

| Analytical units from article   | Reduction of data  | Sub-category                                 | Generic category                               | Main Category  |
|---|--|--|--|--|
| <p>In Finland, a nationwide management program based on a better understanding of disease pathophysiology resulted in improved care and significant cost savings over a 26-year period. A special focus on particularly at-risk groups might provide further improvements. (Haahtela et al., 2017)</p> <p>Although conditions may vary in different practice settings, a common set of principles for successful guideline adaptation and implementation are now available, are gaining wider use and their effectiveness has been confirmed, even in resource-poor settings. (Boulet et al., 2012)</p> <p>This review shows that clear improvements have been seen in asthma care in countries where asthma programs have been initiated. (Selroos et al., 2015)</p> <p>The 10-year results (2008-2018) are favorable, patients are less disabled, practices and attitudes in healthcare have changed, and major cost savings have been obtained. Views of the lay public and patients are slow to move. The Finnish experience scaled up to the European level would be a step to better health and moving towards economic and environmental sustainability. (Haahtela et al., 2022)</p> <p>Several factors have contributed to the positive trends of asthma in Finland. Although the disease may have become milder, the active national program has contributed to this favorable development. (Haahtela et al., 2001)</p> <p>It is possible to reduce the morbidity of asthma and its impact on individuals as well as on society. Improvements would have taken place without the program, but not of this magnitude. (Haahtela et al., 2006)</p> <p>During the program, the prevalence of allergy and asthma leveled off, but the possible impact of primary prevention remains to be verified. (Haahtela et al., 2021)</p> <p>The gain from applying the national program is huge, both in reducing human suffering as well as the societal costs. (Kupczyk et al., 2010)</p> | <p>Significant cost savings</p> <p>Good Implementation</p> <p>Innovated strategies to reduce asthma mortality and morbidity across Europe</p> <p>Change in behavior and attitude</p> | <p>Positive program results</p>              | <p>Evaluation of the program</p>               | <p>The Impact of The National Asthma Program on Asthma Status in Finland</p> |
| <p>Asthma tends to be a lifelong condition with a high burden. The economic burden of asthma is an important measure of its effect on society. Although it is recognized that asthma is a costly illness the total cost of asthma to society has not been estimated in most countries. (Nunes et al., 2017)</p> <p>The previously observed increase of physician-diagnosed asthma prevalence in adults seems to be leveling off in Helsinki, and patients have fewer symptoms than 20 years ago. (Hisinger-Mölkänen et al., 2019)</p> <p>The increase previously seen in asthma prevalence in Helsinki has plateaued in the general adult population. The prevalence still increased among smokers. The prevalence of most respiratory symptoms has decreased from 2006 to 2016 in the general population. (Hisinger-Mölkänen, 2022)</p>  | <p>Explore the social and economic burden of asthma's impact on society.</p> <p>Assess the prevalence trends related to symptoms.</p>  | <p>High prevalence and high-cost burdens</p> | <p>Description of Asthma status in Finland</p> |  |

## 7 RESULTS

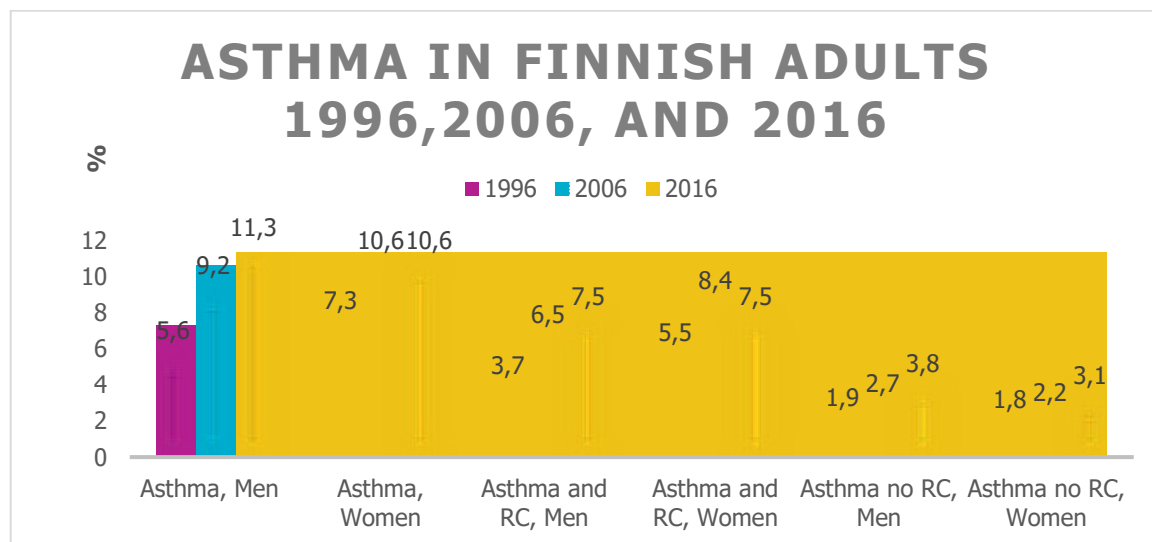
### 7.1 The Impact of the Program on asthma prevalence in Finland

As per a survey conducted in 2016, the focus was on monitoring the prevalence of asthma and rhinitis, coupled with associated symptoms and medication usage. The survey aimed to offer a comprehensive overview of trends over a 20-year period, comparing the results of the 2016 survey with data from 1996 and 2006. This longitudinal approach helps to assess how the prevalence and management of these conditions have evolved over the years. The prevalence rates of asthma diagnosed by physicians, present asthma cases, and asthma accompanied by rhinoconjunctivitis experienced a notable rise in the initial decade of the observation period. However, these rates stabilized from 2006 to 2016. In 1996, the prevalence of physician-diagnosed asthma was 6.6%, which increased to 10.0% in 2006 and 10.9% in 2016. The prevalence of current asthma was 5.8% in 1996, 8.5% in 2006, and 8.8% in 2016, while asthma with rhino conjunctivitis was reported at 4.7% in 1996, 7.6% in 2006, and 7.5% in 2016. Asthma without rhino conjunctivitis showed a slight increase from 2006 to 2016, both in men and women and in smokers and non-smokers. The development of the asthma prevalence is given in TABLE 7 and FIGURE 8. (Hisinger-Mölkänen et al. 2019.)

TABLE 7. All responders. Prevalence of asthma and asthma related symptoms from 1996 to 2016. Current asthma = physician-diagnosed asthma AND wheeze OR dyspnea OR use of asthma medication. Asthmatic wheeze = wheeze AND dyspnea with wheeze AND wheeze without cold (Hisinger-Mölkänen et al. 2019.)

| SYMPTOM                            | 1996         | 2006         | 2016         | p-value<br>1996 vs<br>2016 | p-value<br>2006 vs<br>2016 |
|------------------------------------|--------------|--------------|--------------|----------------------------|----------------------------|
| physician-dg asthma                | 398 (6.6%)   | 245 (10.0%)  | 437 (10.9%)  | 0.000                      | 0.240                      |
| Current asthma                     | 352 (5.8%)   | 208 (8.5%)   | 351 (8.8%)   | 0.000                      | 0.692                      |
| Asthma with rhinoconjunctivitis    | 286 (4.7%)   | 186 (7.6%)   | 300 (7.5%)   | 0.000                      | 0.893                      |
| Asthma without rhinoconjunctivitis | 112 (1.8%)   | 59 (2.4%)    | 137 (3.4%)   | 0.000                      | 0.021                      |
| Asthma medication                  | 363 (6.0%)   | 229 (9.4%)   | 464 (11.6%)  | 0.000                      | 0.005                      |
| Asthma symptoms                    | 784 (12.9%)  | 371 (15.1%)  | 574 (14.4%)  | 0.014                      | 0.383                      |
| Prolonged cough                    | 1207 (19.9%) | 463 (18.9%)  | 720 (18.0%)  | 0.055                      | 0.377                      |
| Sputum production                  | 734 (12.1%)  | 271 (11.1%)  | 328 (8.2%)   | 0.000                      | 0.000                      |
| Wheeze                             | 440 (7.3%)   | 177 (7.2%)   | 279 (7.0%)   | 0.856                      | 0.705                      |
| Past year wheeze                   | 1210 (20.0%) | 542 (22.1%)  | 756 (18.9%)  | 0.007                      | 0.002                      |
| Dyspnea with wheeze                | 627 (10.3%)  | 268 (10.9%)  | 313 (7.8%)   | 0.000                      | 0.000                      |
| Wheeze without cold                | 788 (13.0%)  | 339 (13.8%)  | 423 (10.6%)  | 0.000                      | 0.000                      |
| Morning dyspnea                    | 1512 (25.0%) | 592 (24.2%)  | 854 (21.4%)  | 0.000                      | 0.009                      |
| Asthmatic wheeze                   | 444 (7.3%)   | 189 (7.7%)   | 213 (5.3%)   | 0.000                      | 0.000                      |
| Rhinoconjunctivitis                | 2234 (36.9%) | 1045 (42.7%) | 1561 (39.0%) | 0.000                      | 0.000                      |

FIGURE 8. Prevalence (%) of physician-diagnosed asthma and asthma with and without rhino conjunctivitis by gender from 1996 to 2016. Statistical comparison between 1996 and 2006 and between 2006 and 2016 (\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ , ns = non-significant). For all subjects, asthma prevalence, with or without rhino conjunctivitis, did not increase between 2006 and 2016. RC = rhino conjunctivitis (Modified from Hisinger-Mölkänen et al. 2019).



In the demographic of young men aged 20–29 years, there was a noteworthy exception, as the incidence of physician-diagnosed asthma increased from 2006 to 2016 (refer to TABLE 8). Concerningly, 40% of this group reported smoking, in contrast to the 18.8% reported a decade earlier. Although an increase in asthma prevalence was also observed among individuals aged 40–49 years, the rise was not statistically significant when analyzed separately for men and women. For women, the prevalence of physician-diagnosed asthma exhibited stability from 2006 to 2016, both among non-smokers 9.7% vs. 9.1% and smokers 12.4% vs. 12.8%. (Hisinger-Mölkänen et al., 2019.)

TABLE 8. All responders. The prevalence of physician-diagnosed asthma, and in men and women by age group from 1996 to 2016 (Hisinger-Mölkänen et al. 2019.)

| ALL       | 1996       | 2006       | 2016        | P-VALUE      | P-VALUE      |
|-----------|------------|------------|-------------|--------------|--------------|
| AGE GROUP |            |            |             | 1996 vs 2016 | 2006 vs 2016 |
| 20–29     | 80 (6.3%)  | 46 (9.6%)  | 104 (13.9%) | 0.000        | 0.026        |
| 30–39     | 81 (5.4%)  | 54 (11.3%) | 88 (10.1%)  | 0.000        | 0.486        |
| 40–49     | 81 (5.8%)  | 37 (7.8%)  | 76 (11.6%)  | 0.000        | 0.035        |
| 50–59     | 66 (5.8%)  | 60 (11.1%) | 87 (10.5%)  | 0.000        | 0.759        |
| 60–69     | 90 (11.5%) | 48 (10.1%) | 82 (9.1%)   | 0.286        | 0.570        |
| MEN       |            |            |             |              |              |
| 20–29     | 31 (6.1%)  | 16 (8.0%)  | 50 (17.2%)  | 0.000        | 0.003        |
| 30–39     | 23 (3.5%)  | 20 (8.9%)  | 51 (13.0%)  | 0.000        | 0.127        |
| 40–49     | 34 (5.7%)  | 18 (7.6%)  | 32 (11.3%)  | 0.012        | 0.157        |
| 50–59     | 20 (4.1%)  | 23 (10.5%) | 34 (9.6%)   | 0.001        | 0.711        |
| 60–69     | 37 (10.7%) | 23 (11.2%) | 25 (6.7%)   | 0.099        | 0.061        |
| Women     |            |            |             |              |              |
| 20–29     | 49 (6.5%)  | 30 (10.8%) | 54 (11.8%)  | 0.003        | 0.684        |
| 30–39     | 58 (7.0%)  | 34 (13.4%) | 37 (7.7%)   | 0.004        | 0.013        |
| 40–49     | 47 (6.0%)  | 19 (7.9%)  | 44 (11.8%)  | 0.003        | 0.123        |
| 50–59     | 46 (7.1%)  | 37 (11.5%) | 53 (11.3%)  | 0.023        | 0.946        |
| 60–69     | 53 (12.1%) | 25 (9.2%)  | 57 (10.9%)  | 0.483        | 0.473        |

The rise in the prevalence of asthma over the preceding decades has been a subject of discussion (Jousilahti et al. 2016; Backman et al. 2017). Certain researchers have delved into the prospect that the escalation in asthma prevalence and symptoms could be a result of heightened disease awareness and improved diagnostic methodologies (Barraclough et al. 2002). Several studies have indicated a potential plateau in asthma prevalence trends (Wilaya 1996; Wennergren et al. 2010). The 2006 survey in Helsinki showed a continued rise in prevalence, but it has since stabilized (Kainu et al. 2013). Worldwide asthma prevalence is influenced by numerous factors including rapid urbanization, changes in environment and lifestyle (Global Asthma Network 2018; Haahtela et al. 2015; Hanski et al. 2012), and economic development (Hisinger-Mölkänen et al. 2019). Additionally, decreasing rates of smoking and reduced exposure to tobacco smoke in several countries have likely contributed to the declining prevalence (Belvisi et al. 2018). It is encouraging to observe that the upward trend in asthma prevalence seems to be stabilizing in Helsinki. Moreover, individuals with asthma reported fewer symptoms in 2016 as opposed to 2006, and there has been a notable decrease in the prevalence of self-reported rhinoconjunctivitis. While these alterations may appear modest, they hold significance within a sizable population. The effective implementation of the national Asthma Programme (1994–2004) and Allergy Programme (2008–2018) likely played a key role in changing asthma management and increasing public awareness, contributing to these positive outcomes. (Hisinger-Mölkänen et al. 2019.)



## 7.2 The impact of Asthma Programs on cost management

### 7.2.1 The Impact of the National Asthma Program (1994 – 2004)

The data indicates that despite a considerable rise in the asthmatic population, costs associated with asthma in Finland have diminished, primarily attributed to effective programs and enhanced management (see FIGURE 9). In 1993, prior to the initiation of the program, the aggregate direct costs stemming from asthma and work disability were approximately J218 million (J1611 per patient), with these figures adjusted for the inflation rate (refer to FIGURE 10). A decade later, the overall costs had slightly decreased to J213.5 million a 2% reduction, and the costs per patient J1031 had notably diminished by 36%. The decrease in costs per patient was substantial, potentially saving J128 million in 2003 alone. The increase in total costs might have been much higher without the program's intervention. The improvements in healthcare and treatment, coupled with the program's efforts, have contributed to these positive outcomes. Sales of anti-asthmatic medicines in outpatient care have also increased, reflecting better access to medications and potentially contributing to improved asthma management. (Haahtela et al. 2006.)

In 2005, the anticipated costs associated with asthma, encompassing healthcare, medications, disability, and production loss, were forecasted to fall within the range of €500–800 million. However, the actual incurred costs amounted to approximately €230 million. (Reissell et al., 2010.) While the cost prediction represents a theoretical model, it underscores the substantial potential for cost savings through enhanced treatment. This outcome was primarily attributed to the early and more effective utilization of anti-inflammatory medications, especially inhaled corticosteroids (ICS), as well as the successful coordination and collaboration among healthcare professionals to identify asthma early, prevent exacerbations, and maintain the disease under control. The Finnish case serves as an exemplar, demonstrating how the methodical implementation of optimal clinical practices can lead to significant changes within a relatively brief timeframe. (Kupczyk et al. 2010.)

FIGURE 9. Increase in number of asthmatic patients entitled to special reimbursement for their drug costs, increase in drug costs per patient, decrease in death rate, and decrease in hospital days due to asthma. Numbers are relative changes after 1981 (index, 1981 = 100) (Modified from Haahtela et al. 2006.)

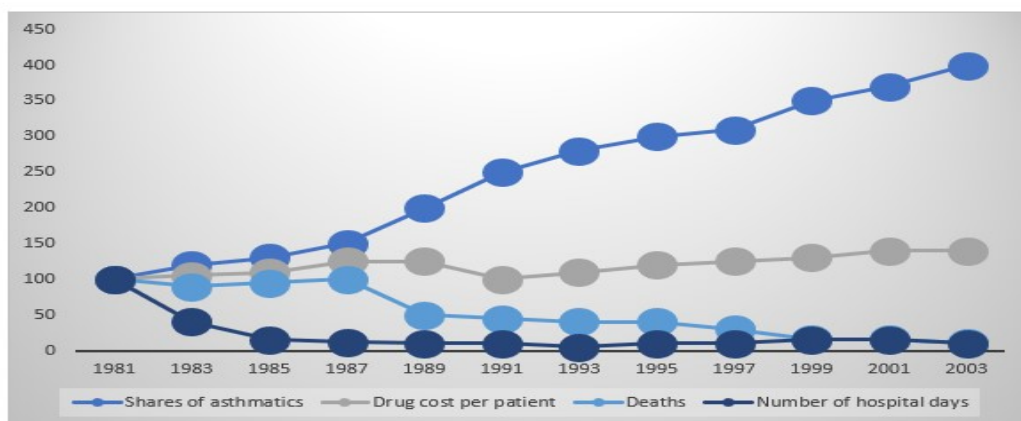
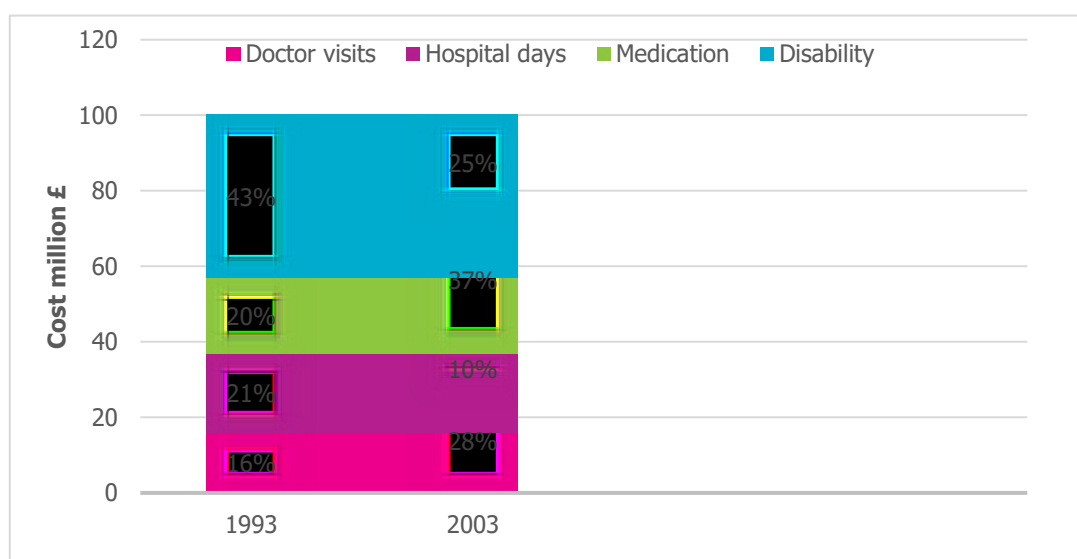


FIGURE 10. Direct annual costs of asthma (medication, hospital days, doctor visits) and compensation for disability pensions and days off work in Finland, 1993 (218 million £, 1611£ / patient) and 2003 (213 million £, 1031 £ / patient). Data from Social Insurance Institution (Modified from Haahtela et al. 2006.)



### 7.2.2 The Impact of the Allergy Program (2008 – 2018)

In 2018, the estimated total costs of allergic diseases and asthma in Finland reached approximately €1.5–1.8 billion. A significant portion of these costs, around €1.2–1.5 billion, was attributed to indirect costs. Within the realm of indirect costs, reduced working capacity constituted 65%, sickness absences accounted for 25%, and disability pensions contributed to 10%. Direct healthcare costs totaled €331 million, with asthma representing €203 million, allergic rhinitis €48 million, and atopic eczema €35 million. When comparing the costs of allergic diseases and asthma in 2018 to those in 2007, there was a nearly one-third decrease, amounting to €195 million. This reduction was primarily attributable to a substantial improvement in working ability and a decline in the number of individuals on disability pensions. Over the entire program duration, cumulative cost savings reached €1.2 billion. (Haahtela et al. 2022.)

Data from diverse sources consistently reinforced each other, depicting a decline in disability pensions, sickness absences, and hospital days. This trend suggested that asthma and allergy conditions have become less severe over the course of the program. Substantiating this conclusion, studies such as the Finnish Pharmacy study (Kauppi et al., 2015; Juha Jantunen et al., 2018) and surveys conducted by the City of Helsinki in 1996, 2006, and 2016 further supported the observed improvements (Hisinger-Mölkänen et al. 2019). Additionally, estimating the improved quality of life, for example, in cases of food allergy or asthma, through cost-utility or cost-effectiveness analyses (Greenhawt et al. 2021; de Silva et al. 2022), could potentially lead to even greater cost savings. Cost savings in healthcare are achieved through improved treatment and the rationalization of medical practices. Hospital days in Finland, as a general trend, have been decreasing, with more significant reductions observed in the case of asthma and allergy. (Järvelin 2019.) While drug usage for allergic diseases and asthma has seen a gradual increase, costs have actually decreased in recent

years due to price regulation (Hanna Koskinen 2018). Comparing health economics and cost-saving measures between different countries can be challenging due to variations in study design, methods, measures, outcomes, and the unique characteristics of national healthcare systems. However, conducting follow-up studies within a single country, as demonstrated in the Finnish case, is a more feasible approach for assessing the impact of health interventions. (Zuberbier et al., 2014; Nunes et al., 2017; Dierick et al., 2020.) The Finnish initiative, while not perfect, serves as a valuable guide for others to create more effective models. From a public health perspective, a comprehensive approach to addressing allergic disorders appears to be beneficial. Various "light versions" of the Finnish Program can be adapted and applied in different contexts. The international dimensions of such efforts provide platforms for sharing experiences and learning from others around the world. (Haah-tela et al. 2022.)

## 8 CONCLUSION:

### 8.1 Consideration of results

This study's investigation into the impact of the National Asthma Program on asthma status in Finland over a 30-year period, with a particular emphasis on the financial aspects of asthma management, reveals a multifaceted and compelling narrative. The Finnish National Asthma Program, launched in 1994 for a duration of 10 years, followed by the Allergy Program introduced in 2008 and continuing until 2018, have led to both an increase in asthma prevalence and improved disease control in Finland. The notable rise in asthma prevalence suggests the effectiveness of these programs. Some researchers have raised the question of whether the observed increase in asthma and asthma symptoms may be attributed to greater disease awareness and improved diagnostic techniques. The program's early diagnosis, targeted intervention measures, and promotion of healthier lifestyles, including smoking cessation and allergen management, have all played critical roles in mitigating asthma risk factors. From a financial perspective, the program has yielded substantial benefits for the healthcare system, evident in reduced hospitalizations, emergency room visits, and outpatient care costs. The emphasis on evidence-based practices and personalized treatment plans has enhanced cost-effectiveness. These findings highlight the program's potential to allocate resources efficiently and alleviate financial strain on the healthcare system. Furthermore, this research suggests that the National Asthma Program's impact is not only substantial but also sustainable. As the program continues to evolve and adapt, it remains a beacon of success in asthma management. This study underscores the importance of comprehensive, long-term strategies for addressing chronic health conditions and provides valuable insights for policymakers, healthcare professionals, and researchers in their pursuit of improved asthma care and a more efficient healthcare system.

### 8.2 Ethicalness and Reliability

It's commendable that ethical principles of research were rigorously followed during this study (Kananen 2011; Finnish Advisory Board on Research Integrity TENK 2012). Each phase of this study was executed meticulously to the best of our ability. The research primarily drew upon recent and high-quality review articles on the subject, thus making an earnest attempt to encompass all significant research findings within the European region. Only reliable, ethically sound, and widely recognized databases and academic materials accessible within the academic institution were employed as sources for the research. However, it is important to acknowledge some notable limitations within this study. These include the relatively small number of articles covered. This limitation can be attributed to the scarcity of research articles worldwide on the topic of asthma programs. Moreover, despite the limited presence of asthma programs globally, there is also a lack of comprehensive evaluation data for countries that do have specific programs in place. Furthermore, it's important to recognize that this study, being a bachelor's thesis, naturally has constraints in its scope and depth of analysis.

### 8.3 Professional Growth

Writing a bachelor's degree thesis, particularly a systematic literature review, offers a transformative experience that nurtures essential professional growth. Through extensive research and critical thinking, we were able to learn how to sift through vast amounts of information, evaluating sources and synthesizing existing knowledge to identify patterns and gaps. This process not only enhances information literacy but also sharpens analytical skills, enabling us to make informed decisions in various contexts. The demands of structuring coherent arguments, presenting evidence, and adhering to academic writing standards refine communication skills, which are invaluable in professional documentation and reports. Additionally, managing time effectively and mastering project management are vital aspects of thesis work, honing skills that are crucial in any career. As students navigate challenges such as limited access to resources or unexpected findings, we developed problem-solving abilities and resilience. Furthermore, the emphasis on academic integrity and ethics ensures a strong foundation for ethical conduct in research and professional settings. Lastly, the opportunity to network with supervisors and the feedback provided by our supervisor has been incredibly valuable. Incorporating this constructive feedback has been a crucial learning experience that we believe will be invaluable in our future pursuits. In essence, the journey of writing a bachelor's thesis equips us with a robust skill set and a wealth of experiences, shaping us into adept, confident, and knowledgeable professionals.

### 8.4 Applicability and development ideas

"The Impact of the National Asthma Program on Asthma Status in Finland: A 30-year Review of Asthma Status from a Financial Point of View" holds significant applicability across various sectors. It serves as a valuable resource for health policymakers, offering insights that can inform future policy decisions by evaluating the effectiveness and financial implications of long-term national health programs. Financial analysts and economists within the healthcare sector will find the study instrumental in understanding the economic dimensions of managing chronic diseases, such as asthma. Additionally, the research's international relevance allows for comparative studies, aiding other countries in evaluating the effectiveness of their health initiatives. Healthcare providers and insurance companies can utilize the findings to optimize resource allocation and coverage policies, while asthma patients and advocacy groups can advocate for improved policies and funding allocation. To further enhance the study, potential development ideas include extending the analysis longitudinally, conducting a comprehensive cost-benefit analysis, exploring the impact on specific subgroups within the asthma population, such as children, the elderly, or individuals with different asthma severity levels which can reveal variations in the effectiveness of the program, integrating qualitative research for deeper insights, comparing initiatives globally, providing actionable policy recommendations, and investigating technological solutions. These avenues of exploration will not only enrich the thesis but also enhance the relevance and impact of the research in addressing the financial and health challenges associated with asthma management.

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## APPENDIX

## SELECTED ARTICLES

The authors names are written in alphabetical order of the first author's name and year of publication, where 2 articles have the same first author.

|   | Authors, title, Country, and year of publication  | Purpose  | Participants      | Study design   | Main Findings  |
|---|---|--|-------------------|----------------|--|
| 1 | <p>Boulet LP, FitzGerald JM, Levy ML, Cruz AA, Pedersen S, Haahtela T, Bateman ED.</p> <p>A guide to the translation of the Global Initiative for Asthma (GINA) strategy into improved care.</p> <p>Eur Respir J. 2012 May;39(5):1220-9</p>     | <p>This report is intended to draw on examples of successful asthma programmes that have been published in different countries, including Finland.</p>   | Literature review | Review Article | <p>Although conditions may vary in different practice settings, a common set of principles for successful guideline adaptation and implementation are now available, are gaining wider use and their effectiveness has been confirmed, even in resource-poor settings</p>  |
| 2 | <p>Haahtela T, Herse F, Karjalainen J, Klaukka T, Linna M, Leskelä RL, Selroos O, Reissell E.</p> <p>The Finnish experience to save asthma costs by improving care in 1987-2013.</p> <p>J Allergy Clin Immunol. 2017 Feb;139(2):408-414.e2.</p> | <p>Evaluated the changes in costs during 26 years from 1987 to 2013.</p> <p>Direct and indirect costs were calculated by using data from national registries.</p>                              | Literature review | Review Article | <p>In Finland, a nationwide management program based on a better understanding of disease pathophysiology resulted in improved care and significant cost savings over a 26-year period. A special focus on particularly at-risk groups might provide further improvements.</p>   |
| 3 | <p>Haahtela T, Jantunen J, Saarinen K, Tommila E, Valovirta E, Vasankari T, Mäkelä MJ</p> <p>Managing the allergy and asthma epidemic in 2020s-Lessons from the Finnish experience.</p> <p>Allergy. 2022 Aug;77(8):2367-2380</p>                | <p>Present the flow of the allergy Program from 2008 to 2018 from the original ideas to implementation, main outcomes, lessons, and a short prescription on how the campaign was designed.</p> | Literature review | Review Article | <p>The 10-year results are favorable, patients are less disabled, practices and attitudes in healthcare have changed, and major cost savings have been obtained. Views of the lay public and patients are slow to move.</p> <p>The Finnish experience scaled up to the European level would be a step to better health and moving towards economic and environmental sustainability.</p> |

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| 4 | <p>Haahtela T, Klaukka T, Koskela K, Erhola M, Laitinen LA; Working Group of the Asthma Programme in Finland 1994-2004.</p> <p>Asthma programme in Finland: a community problem needs community solutions.</p> <p>Thorax. 2001 Oct;56(10):806-14.</p>   | <p>Evaluates the first national asthma programme in Finland at the end of 2000.</p>  | <p>The target groups were:</p> <p>(1) in 1998 chief physicians in hospital pulmonary units (31 respondents, response rate 94%).</p> <p>(2) in 1998 asthma contact persons in health centers (757 respondents, response rate 54%).</p> <p>(3) in 2000 contact persons in those pharmacies which were stated to have a contact person (417/589 responders, response rate 71%)</p> | <p>Clinical review</p> <p>(Three surveys were conducted using structured questionnaires).</p> | <p>Several factors have contributed to the positive trends of asthma in Finland. Although the disease may have become milder, the active national program has contributed to this favorable development. This paper evaluates the programme at the end of 2000. It gives the Finnish perspective to the development of the morbidity and describes a comprehensive approach to decrease the impact of asthma to individuals as well as to society.</p> |
| 5 | <p>Haahtela T, Tuomisto LE, Pietinalho A, Klaukka T, Erhola M, Kaila M, Nieminen MM, Kontula E, Laitinen LA.</p> <p>A 10-year asthma programme in Finland: major change for the better.</p> <p>Thorax. 2006 Aug;61(8):663-70.</p>   | <p>Evaluated the first national asthma program 1994-2004</p>   | <p>Literature review</p>  | <p>Review Article</p>   | <p>It is possible to reduce the morbidity of asthma and its impact on individuals as well as on society. Improvements would have taken place without the program, but not of this magnitude.</p>   |
| 6 | <p>Haahtela T, Valovirta E, Saarinen K, Jantunen J, Lindström I, Kauppi P, Laatikainen T, Pelkonen A, Salava A, Tommila E, Bousquet J, Vasankari T, Mäkelä MJ; Allergy Program Group.</p> <p>The Finnish Allergy Program 2008-2018: Society-wide proactive program for change of management to mitigate allergy burden.</p> <p>J Allergy Clin Immunol. 2021 Aug;148(2):319-326.e4</p> | <p>Present the Finnish Allergy Program 2008- 2018 main outcomes and discuss the possibilities of scaling up the experience for other countries and extending it into the future.</p> | <p>Literature review</p>  | <p>Review Article</p>   | <p>During the program, the prevalence of allergy and asthma leveled off, but the possible impact of primary prevention remains to be verified.</p>   |

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| 7  | <p>Hisinger-Mölkänen, Hanna.</p> <p>The prevalence and determinants of asthma, asthma symptoms and rhinitis in a population-based study in Finland.</p> <p>Helsinki 2022 November.</p>  | <p>To assess the prevalence trends of asthma and asthma symptoms in the general population in Helsinki in 1996-2016.</p>  | <p>Random population sample as a part of the FinEsS-study in Helsinki in 1996, 2006, and 2016.</p>  | <p>Doctoral Dissertation (A cross-sectional postal survey)</p> | <p>The increase previously seen in asthma prevalence in Helsinki has plateaued in the general adult population. The prevalence still increased among smokers. The prevalence of most respiratory symptoms has decreased from 2006 to 2016 in the general population.</p>                          |
| 8  | <p>Hisinger-Mölkänen H, Pallasaho P, Haahtela T, Lindqvist A, Sovijärvi A, Piirilä P.</p> <p>The increase of asthma prevalence has levelled off and symptoms decreased in adults during 20 years from 1996 to 2016 in Helsinki, Finland.</p> <p>Respir Med. 2019 Aug;155:121-126.</p> | <p>Evaluated prevalence trends of asthma, asthma symptoms, and allergic rhinoconjunctivitis in adults aged 20-69 years during a 20-year period from 1996 to 2016 in the city of Helsinki, the capital of Finland.</p> | <p>Random population samples 10 years apart. In 1996, 2006, and 2016, a total of 6062 (response rate 75.9%), 2449 (61.9%), and 4026 subjects (50.3%) took part, respectively.</p> | <p>Cross-sectional postal surveys</p>                          | <p>The previously observed increase of physician-diagnosed asthma prevalence in adults seems to be leveling off in Helsinki, and patients have fewer symptoms than 20 years ago.</p>  |
| 9  | <p>Kupczyk M, Haahtela T, Cruz AA, Kuna P</p> <p>Reduction of asthma burden is possible through National Asthma.</p> <p>Allergy 2010; 65: 415–419</p>   | <p>Present examples from Finland, Poland, and Brazil, to show that the asthma burden can be reduced using varied strategies in quite different societal, Economic, and health care environments.</p>                  | <p>Literature review</p>  | <p>Review Article</p>  | <p>The gain from applying the national program is huge, both in reducing human suffering as well as the societal costs.</p>   |
| 10 | <p>Nunes C, Pereira AM, Morais-Almeida M.</p> <p>Asthma costs and social impact.</p> <p>Asthma Res Pract. 2017 Jan 6;3:1.</p>   | <p>Explore the social and economic burden of asthma's impact on society.</p>  | <p>Literature review</p>  | <p>Review Article</p>  | <p>Asthma tends to be a lifelong condition with a high burden.</p> <p>The economic burden of asthma is an important measure of its effect on society. Although it is recognized that asthma is a costly illness the total cost of asthma to society has not been estimated in most countries.</p> |

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| 11 | <p>Selroos O, Kupczyk M, Kuna P, Łacwik P, Bousquet J, Brennan D, Palkonen S, Contreras J, FitzGerald M, Hedlin G, Johnston SL, Louis R, Metcalf L, Walker S, Moreno-Galdó A, Papadopoulos NG, Rosado-Pinto J, Powell P, Haahtela T.</p> <p>National and regional asthma programmes in Europe.</p> <p>Eur Respir Rev. 2015 Sep;24(137):474-83.</p> | <p>presents seven national asthma programs to support the European Asthma Research and Innovation Partnership in developing strategies to reduce asthma mortality and morbidity across Europe</p> | Literature review | Review Article | <p>this review shows that clear improvements have been seen in asthma care in countries where asthma programs have been initiated.</p> |
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