

MYOPIA

The risk of rising myopia in the Netherlands

A fact-based overview on the rising prevalence of myopia and its impact on healthcare, economy, and patient.

A FACT-BASED OVERVIEW

About this document

This report aims to provide a fact-based overview of the current prevalence and impact of myopia on society, patients and the healthcare system. A specific focus has been put on the Netherlands throughout the research conducted for this report.

The report has been based on research conducted by Catalyze Group and commissioned by the Dutch EyeFoundation, in collaboration with CooperVision Specialty EyeCare EMEA. The research was conducted between February and March 2022 where insights from a literature study and desk research were combined with a health-economic analysis on some of the data available. The study's scope covers European countries with a particular focus on the Netherlands.

METHODOLOGY

For the literature search, specific search terms were used (e.g., myopia management, control and prevention) to identify relevant literature studies in two different search engines: PubMed and Google Scholar. The search was restricted to European articles from the last ten years.

This report contains calculations on the impact of myopia on productivity, the number of people visually impaired or blind due to myopia, and projections of these two estimates until 2055. These calculations were conducted based on data from the Centraal Bureau voor Statistiek (CBS) on the population count and projection, and average income and age distribution. Myopia prevalence and projections were based on recent research studies conducted on Dutch populations. Finally, the loss of productivity used for projections in this report was based on research studies and papers which calculated and used this term and described it throughout their methodology sections.

INTRODUCTION

Defining myopia

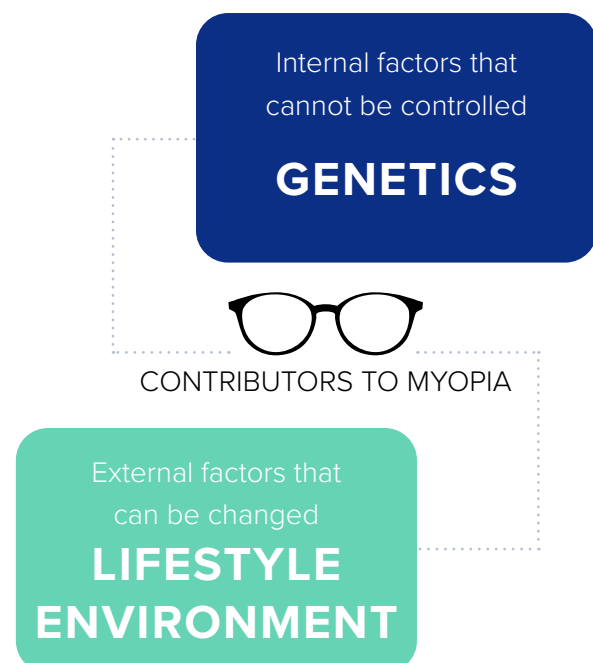
Myopia, or near-sightedness, is a condition currently affecting 30.6% of all European adults¹. In some cases the condition only requires correction but in others can lead to visual impairment and even blindness. The WHO defines myopia as “a condition in which the spherical equivalent objective refractive

error is ≤ -0.50 dioptre (-0.50 D) in either eye”, whilst high myopia starts at ≤ -5.00 D. It should be noted that the definition used by most research studies that were included in this report defined high myopia at ≤ -6.00 D or an axial length over 26 mm.

30% of Europeans are myopic

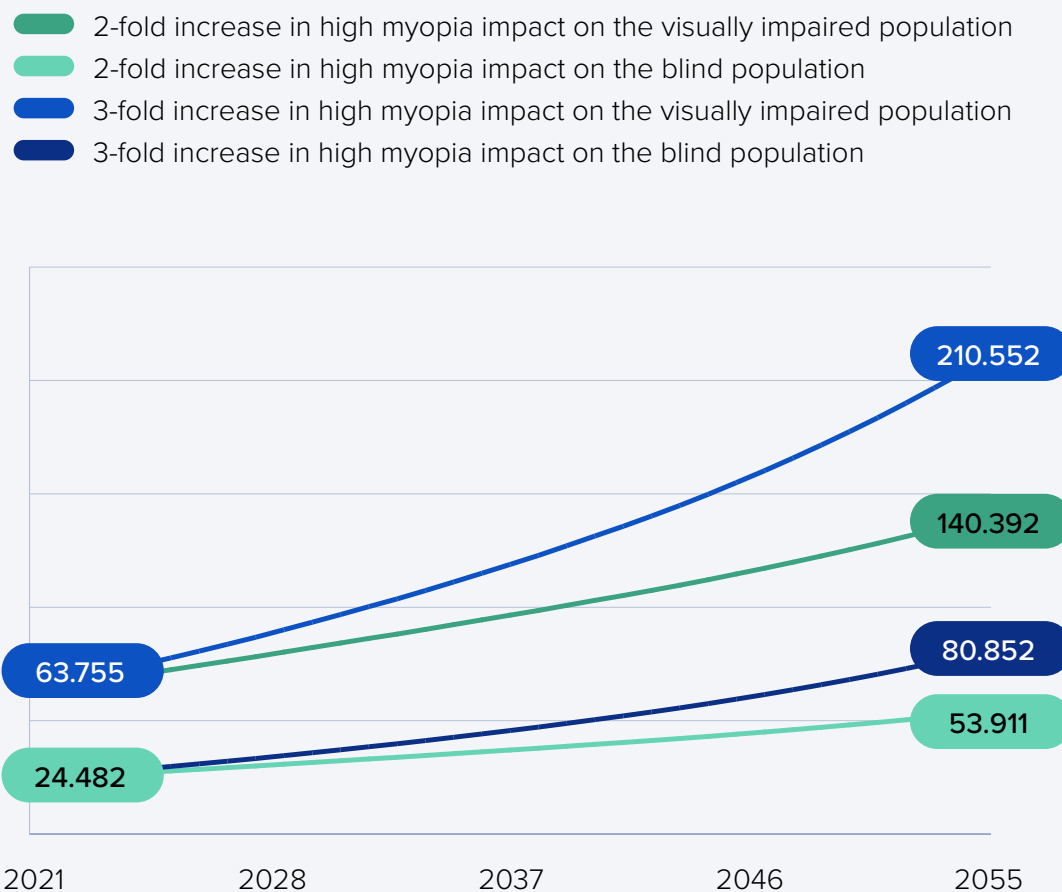


There are both internal and external factors that contribute to the occurrence of myopia. The internal factor is genetics (including heredity of myopia and ethnicity), whilst the external factors are environmental influences and lifestyle. Several genes have been linked to myopia yet there is still little knowledge on reducing the prevalence of genetic myopia². External factors can be influenced and have a demonstrated effect in countering myopia³. For this research study and the establishment of the report, the focus has mostly been put on non-genetic myopia and the potential to lower its prevalence by influencing these external factors.



The prevalence of myopia and its subsequent complications have increased at an alarming pace in the past years. It is expected to increase even further due to global lockdowns as a consequence of the COVID-19 pandemic⁴. In the current circumstances, based on our

calculations, we estimate that at least 140,000 people will likely become visually impaired, and an additional 50,000 people will become blind in the next 30 years in the Netherlands alone.



Graph 1

Estimates and projections of the blind and visually impaired population due to myopia in The Netherlands from 2021 to 2055.

FACTS & FIGURES

Prevalence, causes and projections

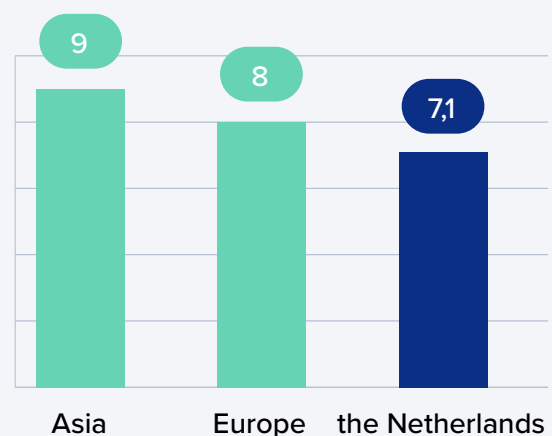
According to estimates of prevalence in the European population¹, there are over four million adults suffering from myopia today in the Netherlands.

Widespread myopia is a relatively new phenomenon. Since the 1960s the prevalence of high myopia has been multiplied by five¹. Many studies on the rise of the condition cite modern lifestyles as major negative factor, as they include significantly less time spent outdoors with natural (sun)light and a continuously increasing exposure to “near work”⁵. Near work is defined as work performed in short viewing distance, such as looking at a computer screen, smartphone or book for lengthy periods of time⁵. These assumptions have been confirmed by researchers from the Dutch Generation R study, which found that an increased time spent on phones⁶ and computer screens⁷ is linked to rising numbers of myopia cases.

Myopia can have serious consequences that go beyond the discomfort of wearing contact lenses or spectacles. A recent review based on 39 studies across the world confirms that pathological myopia is a major source of visual impairment and blindness⁸. In the Netherlands, 25% of high myopia cases were found to degenerate into visual impairment, and in an additional 10% of cases even into blindness (according to WHO criteria)⁹. The complications arising from myopia have a major impact on

several aspects of a person’s life, including the ability to work, level of autonomy, mobility and independence, and limiting social life and sports.

In the current circumstances, the number of visually impaired people in Europe is estimated to triple by 2055¹⁰. A survey conducted in 2015 and 2019 among Eye Care Professionals (ECPs) uncovered that Dutch ECPs scored lower than almost every other Western nation in terms of concern for the increase in the prevalence of myopia¹¹. This underlines the need to better educate and engage all stakeholders. In addition, Dutch ECPs also promote myopia correction at an older age than their European counterpart¹¹.



Graph 2

Level of concern amongst practitioners over the increasing prevalence of myopia on a 10-point scale

The reasons behind these differences compared to other European countries is not clear. This is problematic as demonstrated by the DREAM study on a large Dutch cohort, which discovered that all participants suffering from myopia higher than -3.00D before the age of 10, developed high myopia as adults¹². Another study in the Netherlands found that 1.2% of children were myopic at the age of six, and that these children would almost certainly go on to develop high myopia¹³. This underlines the clinical importance of managing myopia as early as possible¹⁴.

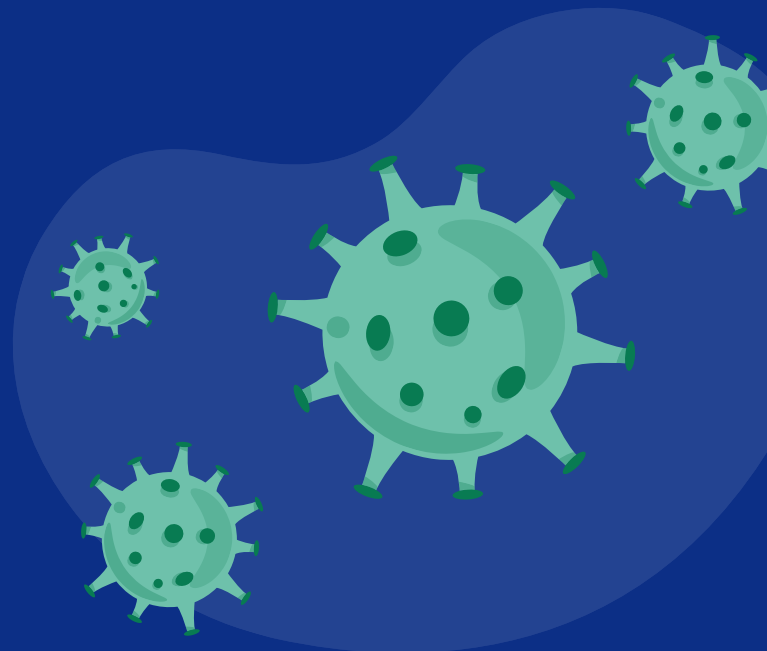
COVID-19 PANDEMIC

The COVID-19 pandemic and lockdowns that followed across the world have radically changed lifestyles, reducing the time spent outdoors and strongly increasing exposure to near work. This has likely had an impact on the development of myopia. Children particularly, increased their screen-time and reduced outdoor time, according to studies from China and Canada⁴. This effect is especially worrying as children are at risk to develop myopia at a much earlier age.

Several studies have been conducted, particularly in Asian countries, to assess the potential impact of lockdowns on myopia progression in children. The measures taken into account in these studies included home confinement, the inability to play outdoors, home education with digital devices and an overall increased digital screen time. The studies showed that the percentage of myopic students had increased during the years of lockdown¹⁵. The number of online classes per day and screen exposure time were negatively

correlated with spherical equivalent whilst the average time of outdoor activity was positively correlated with spherical equivalent¹⁶⁻¹⁷.

Up to this day, it is still yet unknown what the true impact of the COVID-19 pandemic has been on myopia progression. Initial studies indeed show a higher prevalence of myopia. It will become clear over the next few years what the true impact of the lockdowns has been and whether an increased prevalence of myopia is indeed one of the consequences.



CURRENT SOLUTIONS

Countering myopia through prevention, cure and care

Reducing myopia prevalence can be achieved through three main strategies: preventing, caring, and curing.



1. PREVENTION

There is strong evidence suggesting that myopia could be prevented by spending more time outdoors and reducing near work⁵. A 2012 meta-analysis showed that for each additional hour spent outdoors per week, the chance of developing myopia in children and adolescent populations was reduced by 2%¹⁸. This effect is due to the increase in retinal dopamine secretion triggered by sunlight¹⁹. A growing exposure to near work provokes and worsens myopia as it leads to peripheral hyperopia, stimulating elongation of the eye.



2. CARE

Beyond prevention, myopia can be managed in different ways. These include spectacles and contact lenses, prescription medication, and surgical procedures.

Spectacles and contact lenses

Specific spectacles and contact lenses for myopia management have a demonstrated effect in slowing the progression of myopia, with varying efficiency. Spectacles are very commonly prescribed, thanks to their ease of use²⁰. Different types of contact lenses can also be used. For example Ortho-K lenses provide correction for the whole day, without the need to be worn, by reshaping the cornea during the night²¹. Some types of soft contact lenses have also been showed to significantly slow eye growth⁵.

Prescription medication

Atropine, a pharmacological solution, has shown great results in reducing the progression of myopia in Dutch and European participants, slowing the progression of myopia by 75% when compared to pre-atropine treatment progression in participants²². It appears, however, that high-dose atropine is not often prescribed within the Netherlands²³.

Surgical procedures

Ultimately, once myopia progresses past a certain stage, some patients will turn to surgical procedures such as LASIK, PRK or SMILE, which can (partly) correct myopia but only in a specific patient profile²⁴.

Unfortunately a lack of education sometimes still prevails and leads to sub-optimal decisions on how to manage myopia. For example, a typical misconception floated by some practitioners is that under correcting myopia with spectacles is an effective method of control, even though studies have demonstrated the opposite effect²⁵. Meanwhile, contact lenses have a track record for causing infections, although this can easily be prevented by educating users on proper hygiene, informed consent and maintenance²⁶.



3. CURE

Although there is a wide range of different types of treatments that can manage myopia and its symptoms, there are currently no treatments that can stop the axial length of the eye from growing and hence cure the condition.

Most clinical trials and solutions in development are focussed on finding solutions that slow down or prevent myopia, rather than finding a cure²⁷. This may be due to the complex physiological nature of myopia, where the axial length of the eye elongates as children grow until early adulthood.

Research studies widely agree that prevention remains the best lever of action to stop the spread of myopia and reduce its impact on healthcare systems, the economy, and patients. Overall, there is still a strong lack of awareness from patients and their parents or guardians, policy makers and ECPs on management and prevention of myopia and subsequent complications.

THE IMPACT OF MYOPIA

Quantifying and qualifying the consequences of myopia

The impact of the increased prevalence of myopia is threefold. First, it creates pressure on the healthcare system. Studies, for example, show that ophthalmologists experience an overload of patients, which leads to increased wait times for prescription. Second, myopia and its complications have a direct impact on the economy by decreasing productivity. In third place, myopia, and especially high myopia, reduces quality of life and has a profound psychological impact on patients. Moreover, myopia and its complications seem to disproportionately affect people coming from underprivileged socio-economic backgrounds²⁸.

1. HEALTHCARE IMPACT

The healthcare impact of myopia can be split into an impact on primary and impact on secondary healthcare. Primary healthcare is related to diagnosis and management of myopia through visits to specialised practitioners in the primary setting. A subsequent secondary impact on the healthcare system, when myopia progresses, will be admissions to hospitals for surgeries treating the complications of myopia in the secondary setting.

In primary care settings, ECPs are increasingly demanded in the Netherlands, with data showing that the wait time for an ophthalmologist has moved up from five weeks in 2015 to over seven weeks in 2019²⁹. This results in a delay in prescription and therefore in a subsequent delay in timely myopia management and a lack of a prompt diagnosis, particularly for patients with more serious conditions. Although additional data was not found, it is likely that other ECPs, such as optometrists and orthoptists also experience increased wait times. The COVID-19 pandemic

and global lockdowns that followed might have had an additional impact on wait times, yet these events have occurred too recently to understand their true potential impact. It is possible that research studies which will be conducted over the next few years reveal new trends on the wait times and prescription delays in this field.

As myopia progresses, the axial length of the eye grows. This potentially leads to an array of complications including myopic macular degeneration (MMD), retinal detachments, glaucoma and cataract¹⁰. These complications can result in impairment of vision, and even blindness. Whilst some procedures can alleviate the burden of the disease, in many cases the damage is irreversible. Unfortunately, this is not a niche phenomenon; a study on a Dutch population found that 25% of all participants had some form of MMD³⁰.

This impact of myopia on the healthcare system can be felt in hospitals, with many complications resulting in a large number of

surgeries or treatment. In Western nations like Australia, cataract surgeries have been firmly linked to high myopia³¹. In the Netherlands the number of surgeries performed for retinal detachments associated with myopia increased by 44% between 2009 and 2016³². This increase was significant even after controlling for participants who had previously undergone cataract surgery, which is a risk factor for retinal detachment.

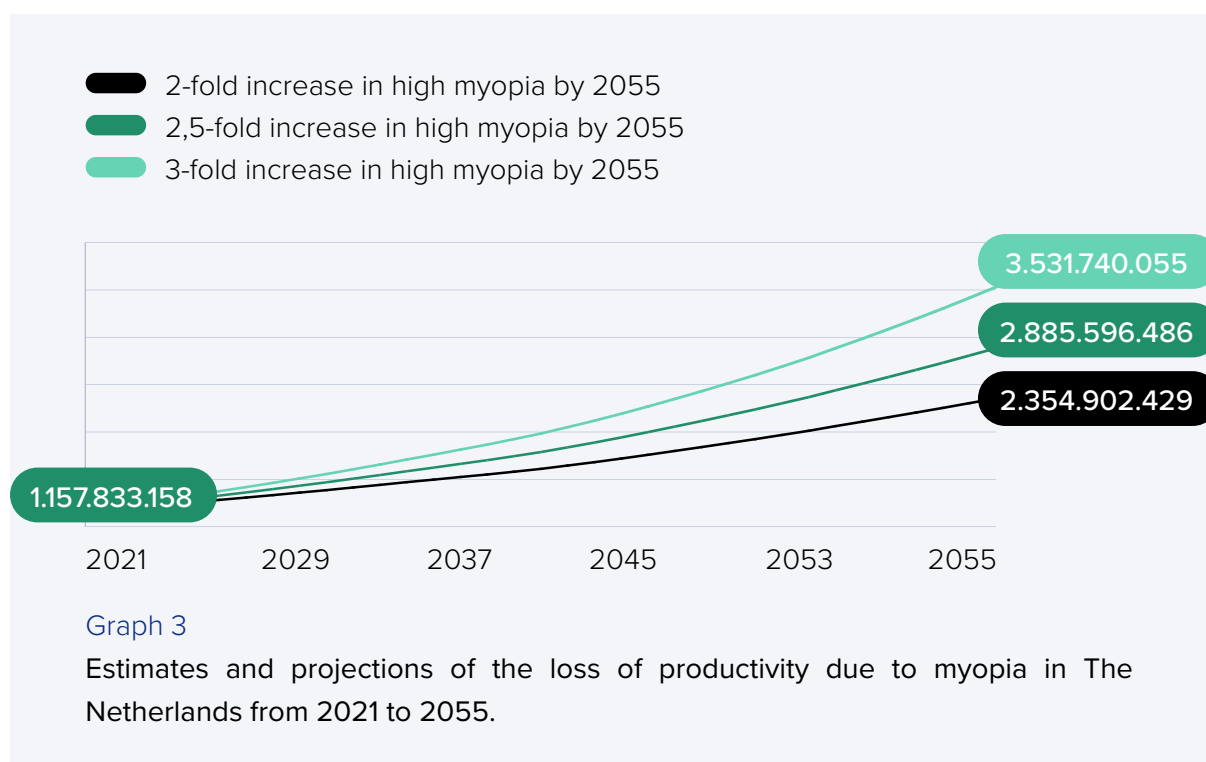
2. ECONOMIC IMPACT

Myopia causes several types of costs. Some of these costs can directly be assigned to the healthcare system (e.g. spectacles, prescription medication and surgeries), whilst others are attributed to the loss of productivity or autonomy for individuals suffering from visual impairment due to myopia.

In the Netherlands, the healthcare costs for myopia management are partly paid by the

government and insurance companies through the 'basic insurance package' as determined by the government, and partly paid as out-of-pocket payments by individuals. The first cost a person suffering from myopia will encounter is the cost of correction. A patient will be prescribed spectacles or contact lenses which they will then purchase, usually from an optician. Our calculation showed that Dutch patients spent around 400 million euros in 2020 on managing their myopia, for example through spectacles and contact lenses. This number is based on the total amount spent on corrections and the prevalence of myopia amongst different types of refractive errors³³.

As myopia can lead to visual impairment and blindness, affected patients will lose much of their productivity, for example by losing the ability to work or to participate in traffic. A 2010 study determined that visually impaired individuals had 30% lower wages than the average earner³⁴. According to our



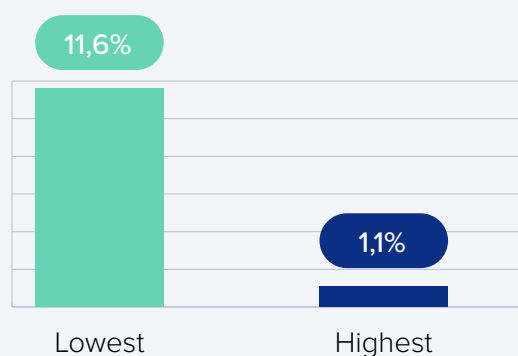
calculations, visual impairment and blindness caused by myopia are costing over one billion euros of lost productivity every year to the Dutch economy. Given the current increase in prevalence of myopia and high myopia in Europe, this number could range from 2.3 to 3.5 billion euros by 2055.

3. PATIENT & SOCIETAL IMPACT

Myopia has a lifelong impact on socio-economic opportunities. Although this condition affects all layers of society, it seems to have a disproportionate impact on those living in lower socioeconomic conditions²⁸. These findings were partly corroborated by a similar study conducted on schoolchildren in Ireland, which identified a higher risk of myopia in non-Caucasian participants with a similar lifestyle³⁵.

Moreover, children living in relatively poor socio-economic conditions are less likely to seek correction or comply with the correction they have been prescribed³⁶. This is concerning as early myopia management

is recommended to slow myopia progression, which reduces the risks associated with high myopia. In addition, uncorrected myopia in children may have a negative impact on academic performance and psychological wellbeing³⁶. A 2020 survey in the Netherlands indicated that visual impairment is ten times more prevalent in populations with the lowest level of education compared to those with the highest level of education³⁷. No explanatory factors were listed with the survey. The relation between lower socioeconomic status and visual impairment has been demonstrated by several studies in developed countries³⁸. It is possible that people with a lower level of education are less aware of the complications associated with eye conditions, less likely to seek treatment, and less likely to pay for additional health insurance coverage. Visual impairment might also deter individuals from following higher levels of education due to their limitations. The figure below exemplifies the uneven burden of myopia in Dutch society.



Graph 4

Visual impairment prevalence (%) by level of education in the Netherlands (Low/High).

The impact of myopia on a person's quality of life is multifaceted and individuals suffering from myopia need to cope with those negative consequences on a daily basis. These encompass social, financial, emotional and physical aspects of life.

For example, interactions in social settings are more difficult as it can be challenging to see and recognise faces. On an emotional and physical level, myopia could hinder an individual's independence and autonomy by limiting social activities and reducing their self-confidence.

Day-to-day activities such as driving a car or playing sports might become more challenging or even impossible. Financially, myopia can hinder an individual's ability to conduct the work they were performing, in addition to the lifelong cost of myopia management. The accumulation of those factors seems to have a strong negative psychological impact, with individuals suffering from myopia reporting higher levels of anxiety and depression than average non-myopic people, as reported by several studies on the topic³⁹⁻⁴⁰.



THE FUTURE OF MYOPIA

Preserving the vision of future generations

There are several steps that can be taken to manage myopia and the expected rise in cases in the future.

New and innovative solutions are emerging

New solutions that manage or slow down myopia are arising. Innovations particularly happen in the field of contact lenses and spectacles, and atropine dosages with many clinical studies focussing in this area. Other areas of innovation that are less advanced include studies on genetics and intra-ocular pressure⁴¹.

In 2020 a peripheral defocus design for contact lenses showed excellent results in slowing down myopia in children⁴². Beyond individual correction, myopia management may shift towards combining multiple solutions to further reduce aggravation of the disease.

Adequate prescriptions of current solutions

Solutions can only make an impact if they are adequately prescribed. As described earlier, Dutch practitioners are still reluctant to prescribe correction for myopia at a younger age and are displaying lower levels of concern towards the rise of myopia compared to their European counterparts¹¹.

Introduction of measures to promote activities that reduce the risk of myopia

With the rising prevalence of myopia in the Netherlands, particularly among the younger population, there is a need to introduce a stronger emphasis on myopia reduction. This can for example be implemented by reforming school programmes and introducing more outdoor activities throughout the day. In addition, it could be valuable to create awareness among parents on the risks associated with myopia and how they could help prevent them¹⁴.

ECPs are well positioned to play a key role in prevention and early diagnosis of myopia

Lastly, ECPs are in a great position to educate children and parents, prescribe corrections early on and advocate for better solutions for their patients.

In the past years organisations such as the World Council of Optometry have responded to the rise of myopia and the potential role that ECPs could play, such as through the Resolution created for the standard of care for myopia management by optometrists, which includes mitigation, measurement and proper management of myopia as well as public education⁴³.

On that point, the government could also step in by improving subsidies on myopia management solutions and incentivising patients to select more effective solutions. Particular attention should be paid to geographic areas where families have a

lower socio-economic background, as this seems to be a compounding factor for myopia prevalence and its subsequent complications.



MYOPIA IN ASIA: THE CASE OF CHINA

In Asia, where myopia and high myopia prevalence are reaching critical levels, strong measures are introduced to curb the rise of myopia. Whilst the European population seems to be faring better for the time being, researchers argue that European countries could learn from the preventative measures used by Asian countries, who are many years ahead in implementing preventative measures²⁵.

CHINA

The Chinese government aims to reduce the prevalence of myopia of six-year-old children to 3%, underlying the importance of early myopia management. According to a study on Chinese schoolchildren, that objective would mean more than halving the current prevalence of 6.1% for six-years-old⁴⁴. To achieve this, a comprehensive plan was set out targeting parents, schools and the healthcare system. The emphasis is placed on prevention, early diagnosis and treatment, and raising awareness⁴⁵⁻⁴⁶.

Prevention is promoted through increased parental awareness of lifestyle risk factors, such as time spent on screens and outdoors, whilst schools have been instructed to incorporate more outdoor activities and eye exercises in their educational programmes.

In parallel, earlier and more frequent vision screenings will be conducted in schools. This measure is accompanied by new guidelines and education on the treatment of myopia.

As of 2020, at least 70% of urban Chinese adults are suffering from myopia⁴⁷, against only 30% in Europe. However, with 45% of younger Europeans suffering from myopia, the prevalence in younger generations is much higher than the average of the rest of the European adult population⁴⁸. In addition, a strong and consistent uptrend in prevalence can be witnessed throughout the past years. Taking immediate and effective measures in the Netherlands could be a way to prevent myopia from becoming the issue that it is today in Asian countries such as China.

CONCLUSIONS

Summary and next steps

Myopia, or near-sightedness, has shown an incredible increase in cases in the past years, both in Europe as well as the rest of the world. Although genetic in some cases, myopia is in many cases caused or worsened by environmental factors. The COVID-19 pandemic has accelerated the rise in myopia cases even more. This is due to a change in lifestyles which included significantly less time spent outdoors with natural sunlight and an increasing exposure to computer screens, tablets, and mobile phones. According to the DREAM study, which was led before the pandemic, approximately 9% of all myopic children under the age of ten will go on to develop high myopia¹².

The prevalence of high myopia is predicted to increase by 2 to 3-fold in Europe by 2055¹⁰. Given population projections and the current rates of visual impairment and blindness due to myopia, the Netherlands is poised to have between 140,000 and 210,000 visually impaired people and between 53,000 and 78,000 blind people due to myopia in 2055 (Graph 1).

Although milder forms of myopia can relatively easily be managed through contact lenses or spectacles, the more serious forms of myopia can have severe consequences and a great impact on the healthcare system, economy,

and the patient. The impact on the healthcare system can be felt both in a primary care setting, through increased wait times at ECPs, and in a secondary care setting in hospitals through surgeries and hospital treatments. With respect to economic impact, visual impairment and blindness is currently estimated to result in a loss of productivity of over one billion euros a year within the Netherlands. By 2055, this number is expected to have increased from 2.3 to 3.5 billion (Graph 3). From a patient's perspective, the impact of myopia on a person's life can be severe, including limitations to social life, financial situations and a lack of autonomy and independence.

As previously described, effective solutions (optical & pharmacological interventions for myopia management) currently exist to prevent and slow down the progression of myopia. An example is the 2012 meta-analysis which showed that each additional hour a week spent outdoors leads to a reduction of 2% in the chance of developing myopia in children and adolescents¹⁸. The main hurdle to implement these relatively simple preventative measures, is the lack of awareness of both the dangers of myopia and its counters from most Dutch stakeholders in the field, including public health authorities, ECPs, parents and patients.

Current treatments for myopia are effective and great solutions for individuals suffering from the condition. However, with the expected rise of myopia cases, treatments that manage myopia are potentially not sufficient. Besides, a lack of awareness results in an incorrect use of the current available treatments. Curative therapies and (the relatively simple) preventative measures might be needed to slow down the rising numbers of myopia cases on a global level. The potential acceleration of myopia cases due to global lockdowns might provide a good momentum to explore the best ways to prevent and cure this condition in the future.



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