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Patterns of Myopia Progression in European Adults

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Objective: Data regarding the progression of myopia and new-onset myopia in young adults are lacking. This study aims to describe the natural history of myopia development and progression in adults using anonymized electronic medical records from Irish optometric practices.

Design: Longitudinal study.

Subjects: Electronic medical record data were extracted from 40 Irish optometry practices with 18 620 (59.5% female) patients meeting the inclusion criteria.

Methods: Refractive error change was determined among patients with multiple eye examination visits during the period January 1, 2003 to December 31, 2022. Patients aged 18 to 39 years, inclusive, at baseline and attending >1 eye examination with an interval of ≥11 months between visits and that were myopic at the final visit were included in the analysis. Annualized myopia progression in diopter (D)/year was assessed using linear mixed models with age, sex, baseline spherical equivalent refraction, and previous myopic progression as fixed effect covariates. The proportion of patients with unstable myopia (progression worse than −0.25 D/year) was determined.

Main Outcome Measures: Proportion of adults across the age range 18 to 39 years with significant myopic progression.

Results: Significant myopia progression (progression <−0.25 D/year) was noted in 10.7% of all myopes. The proportion of myopes with significant progression was clearly related to age with 19.9% of myopes in the youngest age group experiencing progression compared with 6.8% in the oldest age group. Higher proportions of myopic progression were also observed in high myopes with 1 in 12 high myopes (8.0%) exhibiting persistent fast myopic progression as adults (worse than −0.50 D/year). Of patients with emmetropia or hyperopia at baseline in this clinic-based population, 28.5% and 0.8% became myopic during the follow-up period.

Conclusions: Although myopia has stabilized in most adults (>18 years of age), a sizeable proportion of younger adults and high myopes (of all ages) do progress at a clinically significant rate. Almost 3 times as many adults in youngest age group (18–24 years) experienced myopic progression when compared with the oldest age group (40–44 years). Consideration should therefore be given to exploring the efficacy and benefit of myopia management in this cohort of patients.

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Myopia prevalence has surged dramatically in recent years, and it is estimated that by 2050, myopia will affect 50% of the global population,[1] with some parts of Asia already experiencing rates exceeding 70% among younger generations.[2,3] Of most concern is the increasing number of individuals with high myopia, with reports of high myopia prevalence of >20% in some populations.[4] These trends are particularly concerning due to the complications associated with increasing severity of myopia[5,6] and in particular the increased risk of vision impairment over the course of a myopic individual's life.[7,8]

In response to this increasing myopia prevalence, a number of optical[9–12] and pharmacological[13–15] treatments have become available that can reduce the incidence[16] and progression of myopia[9,10,12–14], which typically develops during childhood and adolescence.[17,18] In recent years, increasing numbers of eye care practitioners are prescribing these treatments to their pediatric patients in order to reduce their future risk of vision impairment.[19,20]

Most myopic progression occurs from the ages of 6 to 16 years[18] with approximately 50% of myopic children stabilizing (annual progression <−0.50 diopter [D]/year) by age 16.[21] This does, however, mean that a significant proportion of myopes experience continued progression as they enter adulthood. Indeed, the Correction of Myopia Evaluation Trial (COMET) found 23% of 18 year olds did not have stable myopia.[22] This finding is supported by our previous work showing 35% of 17 year olds were progressing by −0.25 D/year[18] and a French study which found approximately 10% of myopes aged 14 to 29 progressed by at least −0.50 D within 12 to 26 months.[23] The Drentse Refractive Error and Myopia (DREAM) study also observed myopic progression at this age with a

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median progression of −0.08 D/year in 19 to 21 year old myopes.[24] Alongside the continuing progression of myopia in those with myopia, there are also reports of late onset myopia during adulthood,[25] with 1 Australian cohort reporting an 8-year myopia and high myopia incidence of 14% and 0.7%, respectively, between ages 20 and 28 years.[26] Another study of myopia onset in adults conducted in Argentina estimated approximately 50% of adult office workers had first become myopic from age 19; however, this study relied on the participants remembering when they had first received spectacles so may not be an accurate assessment of myopia onset.[27]

To date, the majority of data regarding onset and progression of myopia in adults derive from studies with limited follow-up, usually over a short time period and often involving specific population cohorts such as optometry or medical students.[25] With an increasing number of myopia control treatments available around the world, it is necessary to accurately describe the progression of myopia in adults in order to allow clinicians to identify older patients that may also benefit from myopia control. Therefore, this study aims to describe the natural history of myopia progression in young adults using anonymized electronic medical records (EMRs) from Irish optometric practices.

Methods

Data were provided by optometry practice owners in the Republic of Ireland using the Acuitas practice management system (Ocuco Ltd, https://www.ocuco.com/). Anonymized data were extracted from the practices' clinical records remotely by the EMR provider after explicit consent was obtained from the practice owners. The extracted data included all records from the time the practice started using the EMR system up to the date of extraction (May 2023). To anonymize data at extraction, all personally identifying information was removed and a new, randomly generated, practice-specific, unique identifier assigned to each patient by the EMR provider. No key was saved to link unique identifiers back to identifying information. The unique identifier facilitated the tracking of patients attending the same practice over time but could not follow a patient between practices. Date of birth was not used as part of the analysis with age calculated at each visit date used to assess age trends. The data available for each patient included demographic, refractive, visual acuity, binocular vision, contact lens, ocular health, and clinical management. The study was approved by the Research Ethics and Integrity Committee at Technological University Dublin (REC-18-124) and adheres to the tenets of the Declaration of Helsinki. Patient level consent was not required due to the nature of the anonymization of the data.

Refractive error change was determined among patients with multiple eye examination visits during the period from January 1, 2003 to December 31, 2022. Refractive error was measured by subjective refraction without cycloplegia. Myopia was defined according to the International Myopia Institute standards,[17] as a spherical equivalent refraction (SER) of ≤−0.50 D with high myopia defined as ≤−6.00 D. Emmetropia was defined as SER >−0.50 D and ≤+0.75 D and hyperopia was defined as SER >+0.75D.

To assess myopia progression, patients were included in the analysis if they: (1) attended >1 eye examination with an interval of ≥11 months between visits, (2) were aged 18 to 39 years inclusive at the baseline visit, and (3) were myopic at their last recorded visit. Visits for included patients where they were aged <18 or >45 years (e.g., if long follow-up) were excluded. Key word searches using terms such as "orthokeratology" or "MiSight" were performed to identify patients that were prescribed a myopia control treatment, and these were then excluded from the analysis. Annual refractive change was determined by dividing the difference in SER of the right eye between visits by the time in years elapsed between those visits. The proportion of myopic patients experiencing continued myopic progression at different threshold levels of <−0.25 D/year or <−0.50 D/year was also calculated.

To assess patterns of SER change in patients with incident myopia, patients were included in the analysis if they: (1) attended >1 eye examination with an interval of ≥11 months between visits, (2) were aged 18 to 39 years inclusive at the baseline visit (visits with age <18 or >45 years excluded), and (3) were emmetropic or hyperopic at baseline. Those that were myopic at their last visit having been emmetropic or hyperopic at the baseline visit were considered to be incident myopes. Incidence of high myopia was assessed in a similar way with those that had low myopia (SER >−6.00 D and ≤−0.50) at baseline and high myopia at the last visit classified as incident high myopes.

Myopia progression was assessed using linear mixed models (LMMs) with age (assessed on a logarithmic scale and untransformed), current SER, baseline SER, and previous SER progression as fixed effect covariates and random intercept terms for subject. This analysis was performed separately for groups that were myopic and emmetropic at baseline regardless of their final refractive status. Sex- and age-specific centiles for annual myopic progression were derived by fitting weighted cubic splines to age- and sex-specific empirical quantiles of myopia progression for those emmetropic at baseline, myopic at baseline, and highly myopic at baseline.

A Kaplan−Meier Survival analysis was performed to assess the stability of refraction for patients that were myopic, highly myopic, or emmetropic at baseline. The thresholds for a progression event were a cumulative myopic shift of >1.00 D and 2.00 D.

Results

Data from 1 176 167 practice visits by 434 738 patients were extracted from 40 optometry practices across Ireland. Of these recorded patients, 18 620 (59.5% female) were aged between 18 and 39 years at baseline, had a minimum of 2 visits ≥11 months apart and were myopic at the final visit. At the initial visit, 17 033 (91.5%) of these patients were myopic, 1564 (8.4%) were emmetropic, and 23 (0.1%) were hyperopic. Amongst the myopic group, 1125 (6.0%) were high myopes at the initial visit. All visits took place between January 1, 2003 and December 31, 2022 with 73.4% of visits occurring between 2012 and 2022. The median number of visits per patient was 3 (interquartile range [IQR]: 2−5) with a median interval of 2.17 (IQR: 1.56−3.06) years between visits. The median age at baseline was 30 (IQR: 24−36) years, with a relatively uniform distribution across the entire age range in both men and women. At baseline the median SER for myopes was −1.88 (IQR: −1.00 to −3.38) D, for emmetropes was −0.25 (IQR: 0.00 to −0.38) D, for hyperopes was +1.00 (IQR: +1.00

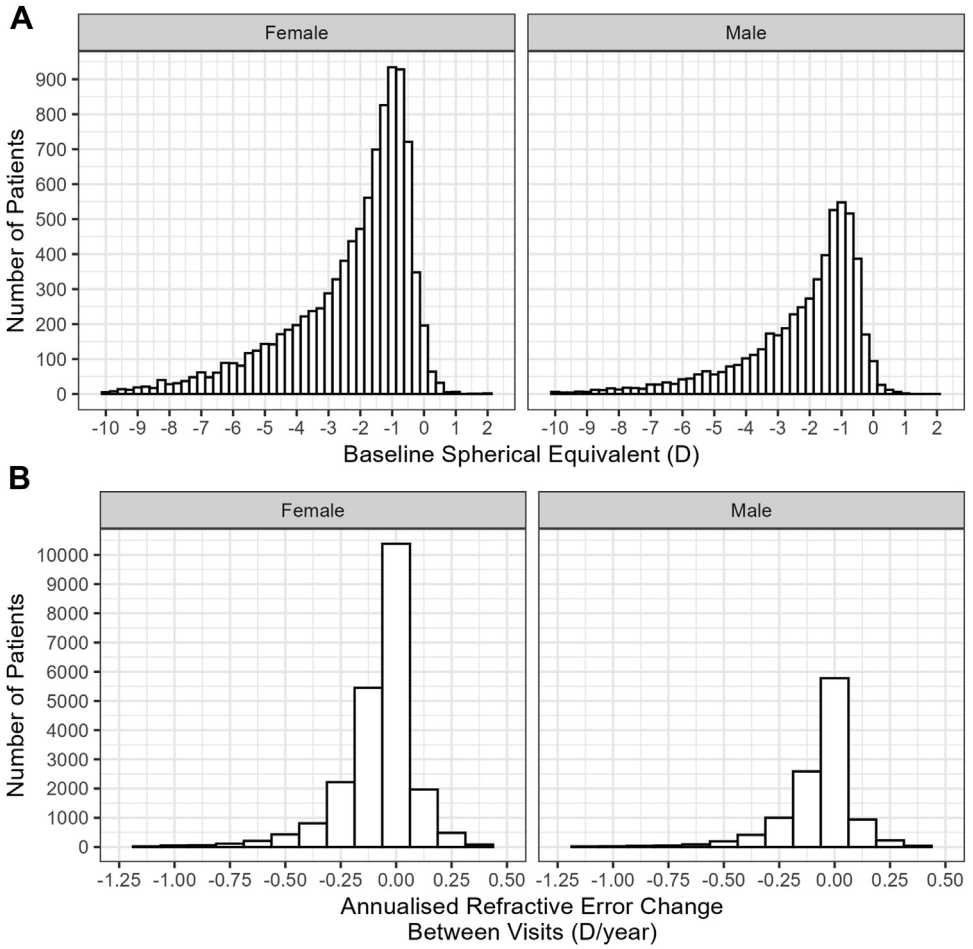

Figure 1. Baseline spherical equivalent refraction (**A**) and annualized refractive error change (**B**) for male and female patients that were myopic at their final visit. D = diopter.

to +1.69) D, and for high myopes was −7.00 (IQR: −6.38 to −8.00) D (Fig 1A).

The overall median annualized SER change was −0.05 (IQR: −0.13 to 0.00) D/year for patients myopic at baseline, −0.06 (IQR: −0.17 to 0.00) D/year for patients highly myopic at baseline, and −0.11 (IQR: −0.20 to −0.06) D/year for patients emmetropic at baseline. These values, however, do not adequately reflect the SER change in various subgroups of the distribution (Fig 1B). For those myopic at baseline, the median SER change in the quartile with the most myopic progression was −0.23 D/year (Table 1) which rose to −0.40 D/year for the decile with the most myopic progression. A similar pattern was observed for those that were emmetropic at baseline, with the median SER change in the highest myopic progression quartile being −0.23 D/year which rose to −0.38 D/year for the highest decile. This was also the case for those highly myopic at baseline, with the highest quartile for myopic progression having a median SER change of −0.27 D/year and the highest decile having median SER change of −0.44 D/year. There was very limited difference in the SER change across the quartiles between the sexes (Table 1).

Among patients that were myopic at baseline, 10.7% exhibited myopic progression worse than −0.25 D/year. For highly myopic patients at baseline, 18.1% exhibited myopic progression worse than −0.25 D/year. Using a higher threshold for progression, 3.0% of myopic patients and 6.9% of highly myopic patients demonstrated SER change worse than −0.50 D/year. The proportion of patients that became myopic but were either emmetropic or hyperopic at baseline was 28.5% for emmetropes and 0.8% for hyperopes. For those that were emmetropic at baseline, the median total change in SER from baseline was −0.50 (IQR: −0.38 to −0.88) D with a median total follow-up time of 4.87 (IQR: 2.78−8.32) years (Table 2). The proportion of patients that were myopic at baseline but became highly myopic was 2.4%.

There was a clear age-related effect (Fig 2), with the proportion of patients experiencing myopic progression progressively declining with age. This pattern was most apparent in the worse than 0.25 D/year progression

Table 1. Median Annualized SER Change in Each Quartile of SER Change for Male and Female Patients

Sex	Quartile 1 Median SER Change (D/Yr)	Quartile 2 Median SER Change (D/Yr)	Quartile 3 Median SER Change (D/Yr)	Quartile 4 Median SER Change (D/Yr)
High myopia at baseline				
Female	+0.11	0.00	−0.07	−0.27
Male	+0.11	0.00	−0.07	−0.27
Myopia at baseline				
Female	+0.09	0.00	−0.07	−0.23
Male	+0.08	0.00	−0.07	−0.23
Emmetropia at baseline				
Female	+0.10	0.00	−0.07	−0.22
Male	+0.09	0.00	−0.08	−0.25

D/Yr = diopters per year; SER = spherical equivalent refraction.

category and was displayed by all refractive subgroups (emmetropes, myopes, and high myopes). For myopes in the 18 to 24 age group, 19.9% progressed >0.25 D/year and 6.2% >0.50 D/year. In the 40 to 44 age group, the proportions were 6.8% and 1.7%, respectively. Amongst the fastest progressors, a similar trend was apparent in emmetropes and myopes. Fast progression amongst high myopes was far less age dependent, with no significant decline in the proportion of fast progressors until 35 years of age.

For patients that were myopic at baseline, LMMs showed that younger age (estimate: −0.15 D/year for log [age in years], $P < 0.01$), more myopic baseline SER (estimate: −0.01 D/year, $P < 0.01$) and more myopic previous progression (estimate: −0.06 D/year, $P < 0.01$) were predictive of faster myopic progression. For patients that were emmetropic at baseline, LMMs showed that younger age (estimate: −0.11 D/year for log [age], $P < 0.01$) and more myopic current SER (estimate −0.08 D/year, $P < 0.01$) were predictive of faster myopic progression.

Spherical equivalent refraction progression centiles were created for female and male patients that were emmetropic, myopic, and highly myopic at baseline (Fig 3). The SER progression centiles were broadly similar for both female and male patients. Young adults at the 75th centile and above for progression demonstrated continued myopic progression up to age 44 with younger ages consistently worse than the −0.25 D/year level. For both baseline myopes and emmetropes, those at the 90th centile had myopic progression worse than −0.25 D/year at age 44. For baseline high myopes, those at the 95th centile still demonstrated progression above −0.50 D/year at age 40.

Kaplan–Meier survival analysis was used to determine what proportion of patients reached a cumulative myopic progression of 1.00 D or 2.00 D over time for both baseline myopes and emmetropes. In general, younger patients were quickest to reach these levels of myopic progression with 10% of baseline myopes reaching 1.00 D of cumulative progression in 3 years (Fig 4A) while 5% of baseline emmetropes reached this level (Fig 4C) in approximately

Table 2. Baseline SER, Annualized SER Change, and Final SER for Young Adults Observed to Be Either Myopic, Emmetropic, or Highly Myopic at Baseline and Were Myopic at the Final Visit

Sex	Number	Median Baseline SER (D) [IQR]	Median SER Change (D/Yr) [IQR]	Median Final SER (D) [IQR]	Median Total SER Change from Baseline (D) [IQR]	Median Total Follow-Up Time (Yrs) [IQR]
High myopia at baseline						
Female	722	−7.00 [−6.38 to −8.00]	−0.06 [0.00 to −0.16]	−7.50 [−6.75 to −8.50]	−0.25 [−0.75 to 0.00]	4.43 [2.51–7.60]
Male	314	−7.00 [−6.50 to −8.00]	−0.05 [0.00 to −0.14]	−7.50 [−6.75 to −8.50]	−0.25 [−0.71 to 0.00]	3.60 [2.62–7.99]
Myopia at baseline						
Female	10 086	−1.88 [−1.00 to −3.50]	−0.04 [0.00 to −0.12]	−2.25 [−1.27 to −3.88]	−0.25 [−0.50 to 0.00]	4.39 [2.45–7.68]
Male	5605	−1.75 [−1.00 to −3.13]	−0.04 [0.00 to −0.11]	−2.13 [−1.25 to −3.63]	−0.17 [−0.50 to 0.00]	4.27 [2.44–7.31]
Emmetropia at baseline						
Female	979	−0.25 [0.00 to −0.38]	−0.11 [−0.06 to −0.19]	−0.63 [−0.50 to −1.00]	−0.50 [−0.38 to −0.88]	5.21 [2.93–8.54]
Male	475	−0.25 [0.00 to −0.38]	−0.11 [−0.06 to −0.21]	−0.75 [−0.50 to −0.88]	−0.50 [−0.38 to −0.88]	4.57 [2.65–7.84]

D = diopter; D/Yr = diopters per year; IQR = interquartile range; SER = spherical equivalent refraction.

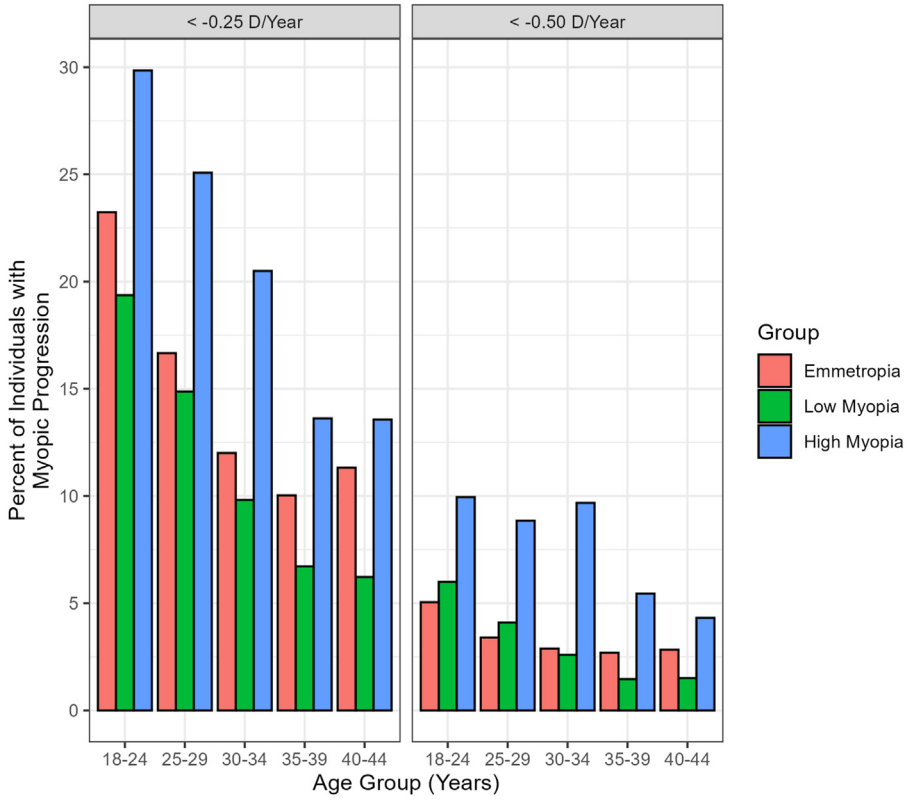

Figure 2. Percentages of patients that demonstrated a myopic shift at various ages, grouped by refractive status at baseline: emmetropia (but became myopic) (>−0.50 D and ≤+0.75 D), low myopia (≤−0.50 D and >−6.00 D), and high myopia (≤−6.00 D). D = diopter.

the same time interval (3.2 years). In the patients that were highly myopic at baseline, a much higher proportion of patients reached 1.00 D of cumulative progression, with approximately 20% reaching this level in a similar time period of 3 years (Fig 4B). At a higher threshold of cumulative myopic progression of 2.00 D, very few

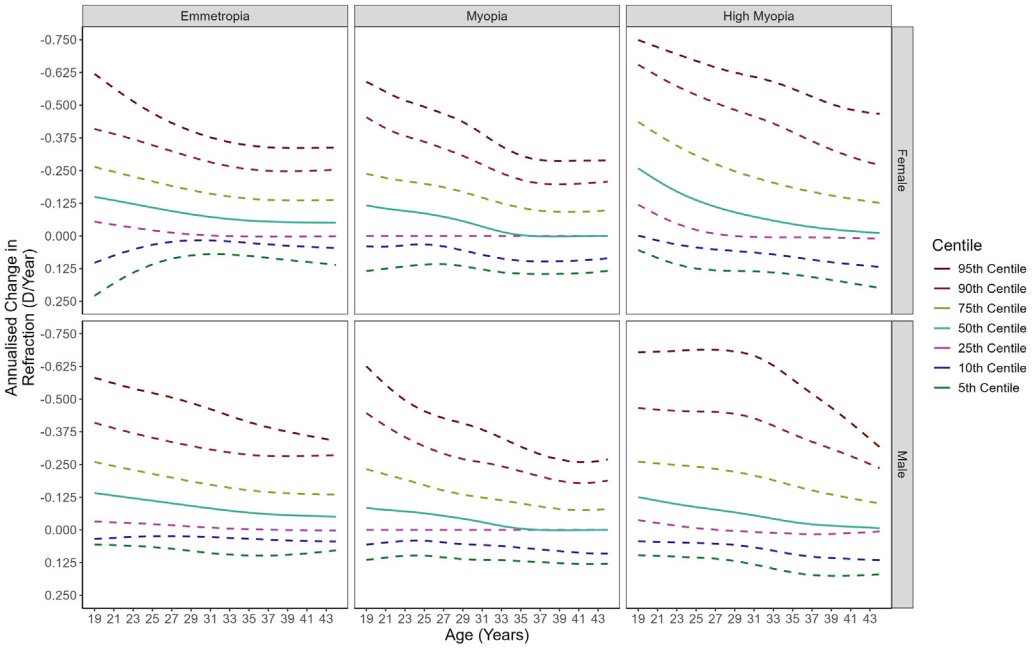

Figure 3. Annualized spherical equivalent refraction progression centiles for young adults that are myopic (≤−0.50 D), highly myopic (≤−6.00 D), and emmetropic (>−0.50 D and ≤+0.75 D) at baseline and had myopia at their last recorded visit. Solid line represents the median (50th) centile. D = diopter.

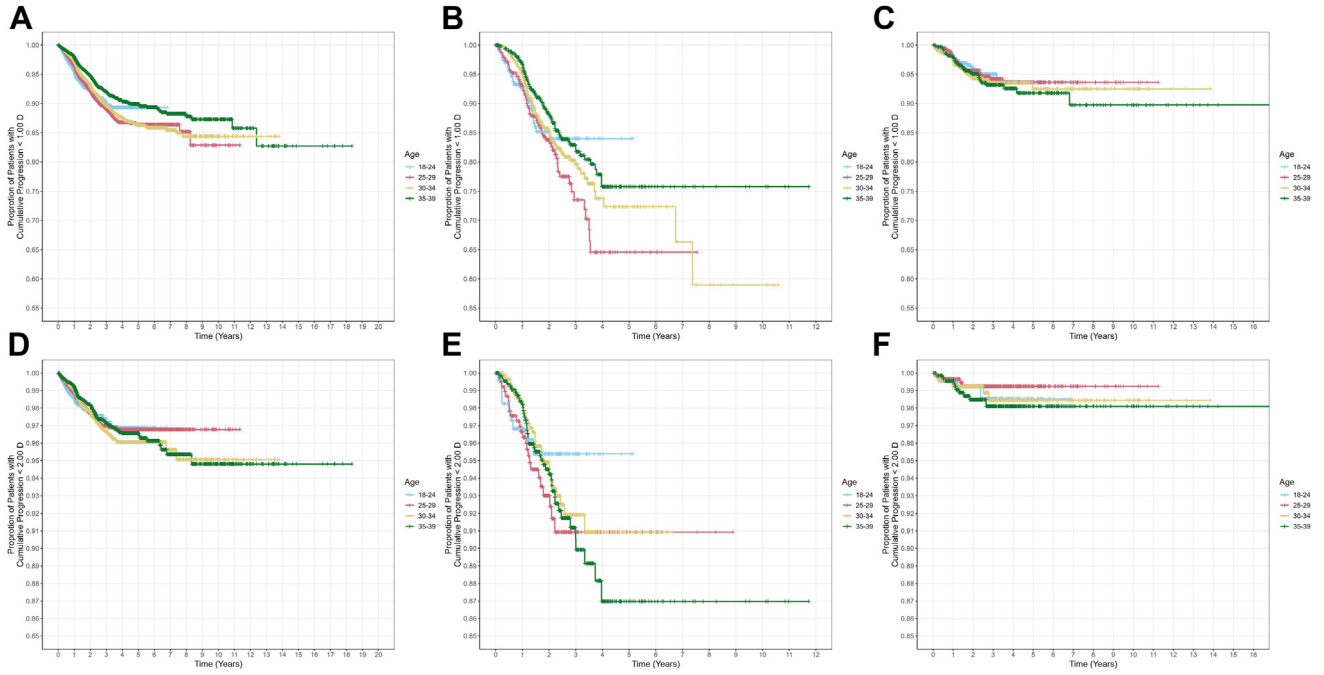

Figure 4. Kaplan–Meier survival analysis demonstrating the proportion of patients that reached a cumulative myopic progression of 1.00 D or 2.00 D over time. The top panel shows the proportion of patients reaching 1.00 D of myopic progression for (**A**) patients myopic (≤−0.50 D) at baseline, (**B**) highly myopic (≤−6.00 D) at baseline, and (**C**) emmetropic (>−0.50 D and ≤+0.75 D) at baseline and myopic at their final visit. The bottom panel shows the proportion of patients reaching 2.00 D of myopic progression for (**D**) patients myopic (≤−0.50 D) at baseline, (**E**) highly myopic (≤−6.00 D) at baseline, and (**F**) emmetropic (>−0.50 D and <+0.50 D) at baseline and myopic at their final visit. D = diopter.

baseline myopes (3% over 3 years) or emmetropes (<1% over 3 years) reached this level of progression (Fig 4D, F). A sizeable proportion (approximately 8%) of high myopes, however, did reach this higher level of progression in 3 years (Fig 4E).

Discussion

A number of important findings can be taken from the analysis of this large cohort. Overall, the level of myopic progression and onset in this age group is low but not insignificant, with 10% of adult myopes progressing ≥1 D over 3 years of follow-up and 2.4% developing high myopia. The effect of age on myopic progression was obvious in both the raw data analysis (Fig 2) and in the centile analysis (Fig 3), which showed a continuous downward trend in progression with age across all centiles. This trend of reducing progression with age has been reported in several longitudinal studies of young adult myopic progression.[28,29] A notable exception was observed amongst fast progressing, high myopes, where progression did not significantly decline until after 35 years. Recent work reanalyzing 3 different longitudinal datasets of adult refractive error estimated a similar pattern of reducing myopic progression with increasing age.[30] This work similarly found worse myopic progression in those with worse baseline myopia in 2 of the 3 datasets, with those highly myopic at baseline estimated to have a potential cumulative myopic progression over 30 years of up to −2.88 D.[30,31]

Interestingly, investigation of factors associated with myopia progression using LMMs found that previous myopic progression was predictive of future myopic progression among the baseline myopes and may therefore be useful in identifying patients most likely to progress. Further analysis is needed to fully determine the relationship between past myopic progression and future myopic progression in this dataset. The predictive value of previous myopic progression has been assessed in pediatric groups with conflicting results.[32,33] In this analysis, although previous myopic progression was predictive of future myopic progression, age was the greatest contributor to the model.

A more myopic baseline SER was also associated with higher rates of myopic progression. In particular, those with high myopia at baseline displayed high progression rates, with a concerning number, approximately 1 in 10, exhibiting progression of ≥−0.50 D/year across multiple age brackets (Fig 2). This is supported by the results of the survival analysis where, compared with low and moderate myopes, high myopes were approximately twice as likely to progress at the 1.00 D threshold (10% vs. 20%) and the 2.00 D threshold (8% vs. 3%) during the follow-up. Given the nonlinear association between increasing level of myopia and the risk of vision impairment,[34] even just a few years of progression at this rate could have serious long term consequences for these already high risk patients. The most common cause for worsening myopic SER is due to an

increase in axial length,[17] but changes in corneal or lenticular power can also cause a myopic shift in refractive error. Based on previous studies, it is likely that the progression observed in these more highly myopic patients is due to axial elongation from continued eye growth, but our study cannot provide definitive evidence on this. Growth related axial elongation may be more likely in younger patients where continued growth might be expected[35,36] but the continued myopic progression as patients enter their third decade may also be due to advancement of pathological changes occurring such as scleral thinning[37] and posterior staphyloma formation[38] caused by the high levels of myopia. In addition, after the age of 40, lens related changes are more likely to affect refraction, hence the chosen cutoff below 40 years in this study.[39] Alongside the myopic shift that occurred in most patients, some patients in the lower centiles (Fig 3) experienced a hyperopic shift. This finding was also observed some patients in the DREAM study.[24] This is likely due to the onset of presbyopia in the older age groups and may also represent a limitation in the accuracy of refraction at the very low levels ($<+0.125$ D/year) of hyperopic progression seen in these groups.

A significant proportion (28.5%) of the emmetropic patients attending the optometry clinics in this dataset became myopic over the course of the study. However, only a very small proportion ($<1\%$) of the hyperopic patients developed myopia, most of whom had baseline refractions near to the threshold for emmetropia. This finding has previously been observed in United States navy recruits, with only 5% of young men with refractions above +0.50 D becoming myopic compared with 40% of those with refractions below +0.50 D.[40] This implies that hyperopia is protective against becoming myopic in young adults, as it is in children.[41] The definition used for emmetropia (SER >-0.50 D and $\leq+0.75$ D) in this analysis was chosen to match the definition of premyopia recommended by the International Myopia Institute[17] as to date there is no consensus definition for emmetropia.[42] The significant proportion of emmetropic adults that became myopic in this analysis of a clinical population may suggest that the concept of premyopia exists in adults as well as in children; however, it is unclear if this finding could be applied to the entire adult population.

In the context of myopia incidence, it is interesting to observe that 28.5% of emmetropes under optometric care became myopic. Recent work that has sought to explain the variance of myopia prevalence in the United States between the National Health and Nutrition Examination Survey (NHANES) carried out in 1971 to 1972 and a follow-up in 1999 to 2004[43] estimated that 17.1% of the observed difference in myopia prevalence was likely due to adult-onset myopia.[44] This figure is close to albeit lower than that found in this study. This difference may be due to a clinical population being less representative of the total population. Despite this difference, these results may imply that adult-onset myopia represents a small but significant cohort of the total myopic population, albeit most incident myopes had a low final refraction ($\geq75\%$ had final SER -1.00 D or better). Nevertheless, the potentially avoidable loss of uncorrected visual acuity in adult-onset myopia represents a substantial health care and economic burden and should be considered in any predictions of future myopia prevalence or public health planning regarding myopia.

In recent years, the use of myopia control treatments has increased substantially in pediatric patients.[19,20] To date, no randomized controlled trials of myopia control treatments have been undertaken in adult patients. This is justified as the majority of myopia onset and progression occurs in childhood.[18] However, our study shows some adults can show substantial myopia progression and, given that it seems likely that the mechanism of myopia progression and the myopia control treatment will not vary between a child and a young adult,[45] it may be reasonable to consider using myopia control treatments in adult patients. Consideration should also be given to conducting trials of myopia control treatments in adult myopes displaying continued myopic progression. It is difficult to determine, however, if the potential side effects[46–49] and costs of these treatments are warranted in this age cohort given the generally slow rate of myopia progression. This present study certainly suggests that practitioners might consider offering myopia control to young adults with worse baseline myopia (particularly if they have high myopia), who are younger and who are documented to have progression rates that would place them in the higher centiles for progression. In many cases, this may involve continuing treatment for those that have already been using myopia control during the adolescent years. For those with lower baseline myopia and slower progression, the benefits of myopia control are not likely to outweigh the costs and drawbacks as the estimated progression, and thus accrued benefit, for these patients is relatively small. With the lower levels of progression seen in most patients in this age cohort, observation with standard refractive correction may be an appropriate first-line management strategy, depending on the patient's concerns and preferences. Clinicians should be aware, however, of the possibility of significant myopic progression in younger adults and consider whether any form of myopia management may be appropriate in such patients.

There are several limitations to this work which should be acknowledged. Firstly, many of the refraction data assessed in this work are noncycloplegic, which may result in an overestimation of myopic SER. However, the need for the use of cycloplegia in this age group is neither well established, nor standard clinical practice.[50–52] The group most likely to be affected by the lack of cycloplegia are hyperopes, with myopes typically less affected.[50,51] The potential for over estimation of myopia due to the lack of cycloplegia is also less likely to be an issue when assessing change in a patient's SER over time rather than measurement at a single time point. A further limitation is

the potential selection bias inherent in using clinical data. For a variety of reasons, some people will not attend eye care services; this potential attendance bias means the studied population may not be fully representative of the general population. This is less likely for myopia, which is a highly symptomatic condition and because access to eye care is free under public insurance/health schemes in Ireland. As young adult emmetropes/low hyperopes are unlikely to be symptomatic, they may not attend an eye care professional and this sample may be less representative of the broader emmetropic/hyperopic population. Despite this limitation, our data are still likely to be more representative of the general population than previous studies of young adult myopic progression and onset which have generally involved small cohorts of university students,[25] a group much more likely to be overrepresented with myopes.[53,54]

Although the refraction of most adult patients aged 18 to 44 years is stable, 7% to 20% of myopes and high myopes have significant myopia progression (<−0.25 D/year) and 2% to 7% have fast myopia progression (<−0.50 D/year) during adulthood. Younger, more myopic adults and those with a recent history of myopia progression are at higher risk of experiencing such progression and could be considered for myopia control interventions. Furthermore, a sizeable proportion of emmetropic patients become myopic during adulthood. These findings point to the need to evaluate the efficacy and benefits of active myopia management in adults, ideally through well conducted randomized controlled trials, to guide appropriate clinical care for adults that demonstrate clinically significant myopia progression.

Data Availability

The data from this study are available on request. The TU Dublin Research and Ethics Committee has placed restrictions on disseminating this data. Data access requests can be sent to researchethics@tudublin.i.e. quoting ethics approval REC-18-124.

Footnotes and Disclosures

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Disclosure(s):

All authors have completed and submitted the ICMJE disclosures form.

The author(s) have made the following disclosure(s):

M.M.: Consultant − Thea.

G.L.: Grants − Ocumetra.

D.I.F.: Grants − 2024- present Co-PI Health Research Board (HRB) Achieving a clear vision for myopia care in Ireland with secondary data; Consultant − Thea, Johnson & Johnson, Vyluma, Dopavision, Coopervision; Honoraria − Coopervision, Vyluma; Travel expenses − Coopervision, Vyluma; Patents pending − myopia treatment monitoring, myopia progression monitoring; Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid − Chair for two International Myopia Institute white paper committees; Shares − Shareholder as founder of Ocumetra Ltd.; Others − Vyluma, Topcon.

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HUMAN SUBJECTS: Human subjects were included in this study. This study was approved by the TU Dublin Research Ethics and Integrity Committee and adheres to the tenets of the Declaration of Helsinki (REC-18-124). Patient level consent was not required due to the nature of the anonymization of the data.

No animal subjects were used in this study.

Author Contributions:

Conception and design: Moore, Lingham, Flitcroft, Loughman

Data collection: Moore, Lingham, Flitcroft, Loughman

Analysis and interpretation: Moore, Lingham, Flitcroft, Loughman

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Overall responsibility: Moore, Lingham, Flitcroft, Loughman

Abbreviations and Acronyms:
D = diopter; **EMR** = electronic medical record; **IQR** = interquartile range; **LMM** = linear mixed model; **SER** = spherical equivalent refraction.

Keywords:
Adult myopia, Electronic medical records, European myopic progression, Myopia, Myopic progression.

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