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ORIGINAL ARTICLE

Prevalence predictions for age-related macular degeneration in New Zealand have implications for provision of healthcare services

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Abstract

Aim: To predict the prevalence of age-related macular degeneration (AMD) in New Zealand from 2014 through to 2026.

Method: Prevalence estimates for AMD in New Zealand for 2014 through to 2026 were generated by applying ethnic prevalence rate estimates for any, early and late AMD to New Zealand population projections for European, Māori, Pacific and Asian peoples.

Results: The prevalence of any AMD in New Zealand for the 45–85 year age group is estimated to be 184,400 in 2014 (10.3% of this age group) and increase 12.9% to 208,200 (9.9% of this age group) in 2026. For 2014 and 2026 respectively, early disease is estimated to be 167,500 and increase to 189,200 and late disease is estimated to be 7,600 and increase to 8,600.

Conclusion: The prevalence of AMD is expected to markedly increase from 2014 through 2026. New Zealand has the lowest funding of treatment for AMD in the OECD and a relatively low ophthalmic workforce. As such, there is a need to plan for an increasing demand for intervention strategies and associated ophthalmic services.

Age-related macular degeneration (AMD) is the leading cause of visual loss in individuals older than 50 years in New Zealand, as it is for the developed world as a whole.[1,2] Forty-nine percent of blind registrations in New Zealand are for AMD (Blind Foundation figures).

Early AMD is the presence of soft drusen in the macula.[3] Soft drusen are accumulated extracellular material beneath the retina, seen clinically as small yellow spots. Late AMD takes two forms; geographic atrophy (GA) is loss of demarcated patches of retina, and neovascular AMD (nAMD) is growth of neovascular tissue beneath the retina, with secondary fluid leakage, bleeding and scar formation.

AMD is a disease of over 45 years of age and prevalence increases with age.[2] Late AMD is a feature of older age, with 10% of people over 80 years of age having late AMD.[4] Significant vision loss occurs with late AMD.[3] This has widespread implications: reduced quality of life (QOL), other health issues such as hip fracture, depression and increased mortality and economic costs such as reduced income, treatment costs and increased need for care services.[5]

New Zealand is entering a period of demographic shift to an ageing population.[6] This is due to two main factors.

Firstly, the European population is in transition from higher birthrate to lower fertility and mortality. Ageing of the European population is now moving from the under 65 year age group to the over 65 year age group. The largest increases in the over 65 age group will occur between 2020 and 2040 with ageing of the large birth cohorts of the 1950s and 1960s.[6]

Secondly, the Asian population, which was 9.7% of the total population in 2006, is estimated to be 15.8% by 2026, largely due to migration.[7] The Asian over 65 year age group is projected to increase fivefold from 2006 to 2026 to be 11.2% of the Asian population.

Until a decade ago, AMD was largely untreatable. However, the finding that antioxidant therapy reduces progression to late AMD and anti-vascular endothelial growth factor (VEGF) agents are highly effective in nAMD has radically improved visual outcomes.[8,9]

Progression to late AMD can be slowed with antioxidant therapy and vision loss from nAMD dramatically reduced with anti-VEGF therapy. Antioxidant and anti-VEGF therapy are cost-effective with robust health economic benefits.[3,5] However, optimal anti-VEGF therapy requires 4–6 weekly ongoing intravitreal injections, resulting in a significant financial and logistical burden on healthcare systems.[10]

The ageing of the population implies a rising prevalence of AMD with an associated treatment burden. Thus, best available estimates of prevalence are essential for healthcare planners to design and implement strategies to manage increasing need and to prevent avoidable vision loss.

This study aims to provide prevalence predictions for AMD in New Zealand for 2014 through to 2026.

Methods

New Zealand ethnic population projections—New Zealand ethnic population projections for each year from 2006 to 2026 were provided by Statistics New Zealand.[7] These comprise 11 separate data series of population projections reflecting assumptions of mortality, fertility, ethnic mobility and migration (Table 1).

Series 6 is considered to be the most likely outcome. For this study we used series 1, 6 and 11 (respectively the lowest, mid and highest population projections) for each year 2014 through 2026.

Table 1. Ethnic population projection series reflecting different assumptions sourced from Statistics New Zealand.

Assumptions				
Series	Fertility	Mortality	Migration	Inter-ethnic mobility
1	low	high	low	high
6	medium	medium	medium	medium
11	high	low	high	low

Population projections made in 2010 are for 'European or other (including New Zealander)', 'Māori', 'Asian' and 'Pacific' peoples. 'Other' (Middle Eastern, Latin American and African), which make up about 1% of the population, are not large enough to alter a prevalence estimate. Therefore, we considered 'European or other (including New Zealander)' to be equivalent to 'European', and is referred to as 'European' throughout.

Definitions of age-related macular degeneration—Definitions are those used in the source publication of ethnic prevalences.[2] In essence these are: 'early AMD', which is a minimum of either any soft drusen with pigment abnormalities or large soft drusen (125 micrometres or more in diameter), and 'late AMD', which is either GA or any features consistent with past or present nAMD. 'Any AMD' is the presence of either 'early' or 'late' AMD.

Prevalence rates by ethnicity—We sourced European and Asian prevalence rate estimates from the meta-analysis by Wong et al[2] (Table 2). They estimated ethnic prevalence rates by applying hierarchical Bayesian approaches to pooled data from population-based studies of AMD that met strict quality criteria. Early, late, and any AMD data were pooled separately. Therefore, prevalence rate estimate for any AMD will not be equal to the sum of the prevalence rate estimates of early and

late AMD. Derived prevalence estimates were for an age range of 45–85 years, male and female combined.

We have used a zero prevalence of AMD for Māori and Pacific peoples as there is no published or anecdotal case of AMD in Māori or Pacific people. We conjecture that if the prevalence is higher than zero, it is likely to be very low and therefore inconsequential for this study.

Table 2. Estimated prevalence rates and credible intervals for early, late and any AMD by ethnicity. Sourced from Wong et al. †Bayesian credible interval.

AMD Stage	Prevalence percentage estimate by ethnicity	
	Asian	European
Early AMD	6.81, 95% Crl†(3.14–13.94)	11.19, 95% Crl†(5.63–20.39)
Late AMD	0.37, 95% Crl†(0.17–0.85)	0.50, 95% Crl†(0.26–1.08)
Any AMD	7.38, 95% Crl†(3.40–14.46)	12.33, 95% Crl†(6.46–22.75)

New Zealand prevalence calculations—New Zealand prevalence projections for any, early and late AMD were calculated for each year from 2014 through to 2026 by applying the European and Asian ethnic prevalence rates for 45–85 year olds to the New Zealand European and Asian, aged 45–85 years, male and female combined population projections.

Of note, the 86 years and older age group is not included in the study as the source meta-analysis does not provide a prevalence rate for this age group. This is because of insufficient numbers in many epidemiology studies."

Results

All estimates are using series 6, unless stated otherwise and are rounded to the nearest 100. This is a descriptive study and therefore no statistical tests have been applied.

New Zealand population estimates are in table 3. The 45–85 year age group is estimated to be 1,789,700 persons (39.1% of the population) in 2014 and 2,095,300 (41.1%) in 2026. Of note, the 86 years and older age group (estimated to be 68,400 persons in 2014 and 97,900 in 2026) is not included as AMD prevalence rates are not available.

Table 3. New Zealand population and ethnic subpopulations 2014 and 2026 in the 45–85 year age group (series 6).

Ethnicity	2014 Number of persons (percentage of the population)	2026 Number of persons (percentage of the population)	Percentage change 2014–2026
European	1,405,300 (30.7)	1,542,400 (30.3)	9.8
Asian	150,300 (3.3)	243,800 (4.8)	62.2
Māori	161,200 (3.5)	206,300 (4.0)	28
Pacific	73,000 (1.6)	103,000 (2.0)	41.1
Total	**1,789,800 (39.1)**	**2,095,500 (41.1)**	**17.1**

New Zealand AMD prevalence estimates for the 45–85 year age group for 2014 and 2026 are in Table 4. Prevalence of any AMD in this age group in 2014 is estimated to be 184,300 persons. Early AMD

is estimated to be 167,500 and late AMD 7,600 persons. In 2026 we estimate any, early and late AMD to be 208,200, 189,200 and 8,600 persons respectively.

Table 4. New Zealand prevalence estimates for any, early and late AMD in 45–85 year age group, for ethnic populations combined (European, Asian), European and Asian, and for series 6. Maori and Pacific are not entered as prevalence is zero. Numbers are rounded to the nearest 100

AMD by ethnicity (series 6)	Number of persons		Percentage change: 2014–2026
	2014	2026	
Combined any	184,400	208,200	12.9
European any	173,300	190,200	9.8
Asian any	11,100	18,000	62.2
Combined early	167,400	189,200	12.9
European early	157,200	172,600	9.8
Asian early	10,200	16,600	62.2
Combined late	7,600	8,600	12.9
European late	7,000	7,700	9.8
Asian late	600	900	62.2

Plots of any, early and late AMD prevalence for each year 2014 through to 2026, for combined European and Asian and European and Asian separately, are shown in Figures 1 to 5.

Legend for all figures (graphs)

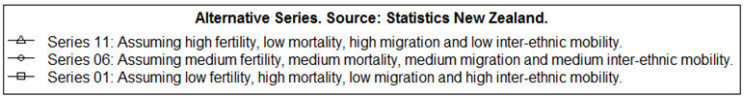

Figure 1. New Zealand prevalence estimates: combined European and Asian any AMD, 45–85 years age, 2014 through to 2026.

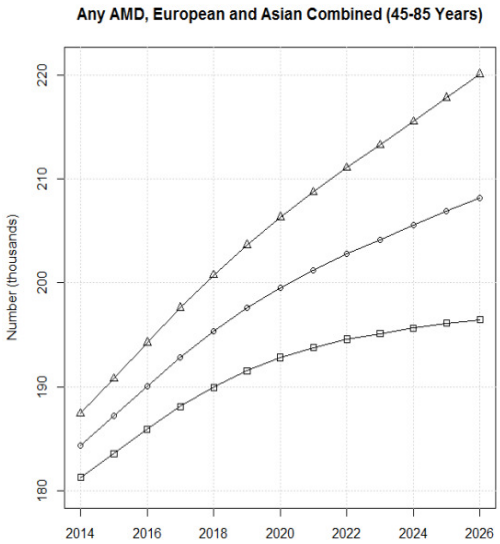

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Figure 2. New Zealand prevalence estimates: combined European and Asian early AMD, 45–85 years age, 2014 through to 2026.

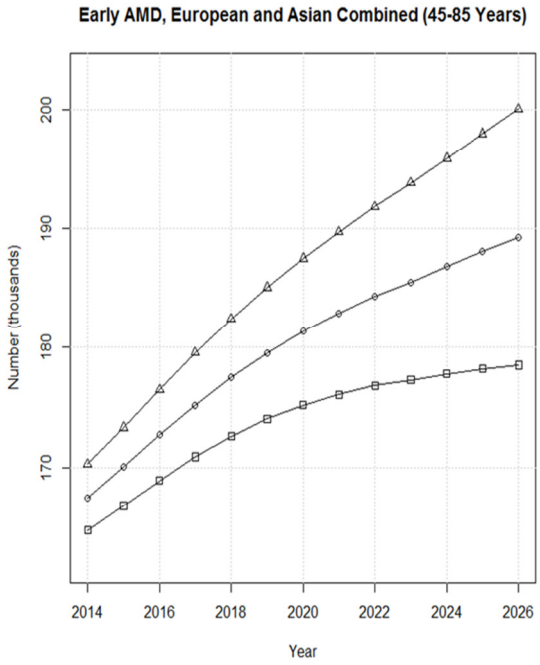

Figure 3. New Zealand prevalence estimates: combined European and Asian late AMD, 45–85 years age, 2014 through to 2026.

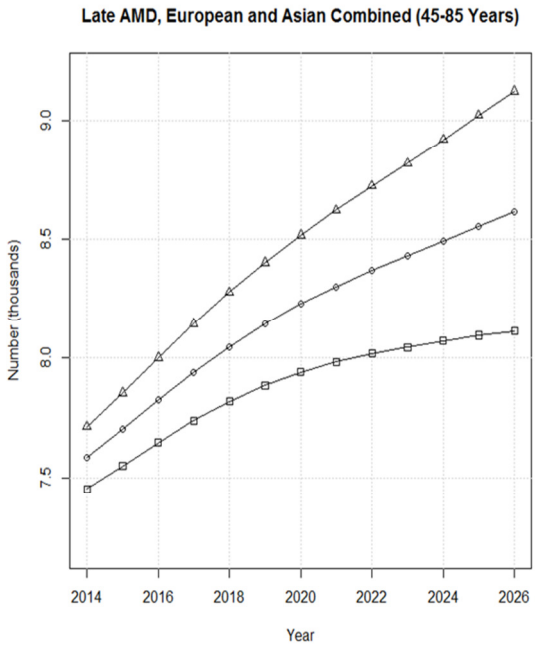

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Figure 4. New Zealand prevalence estimates: European any, early and late AMD, 45–85 years age, 2014 through to 2026.

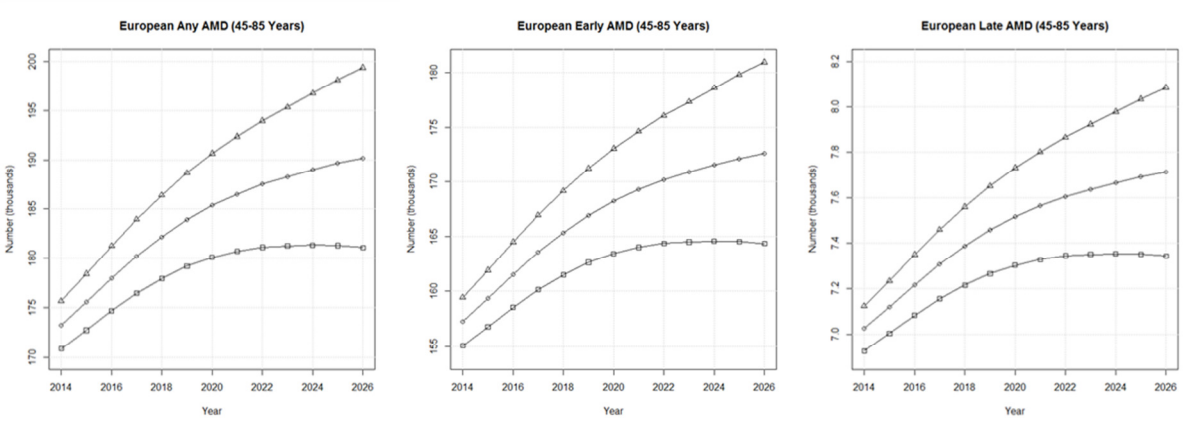
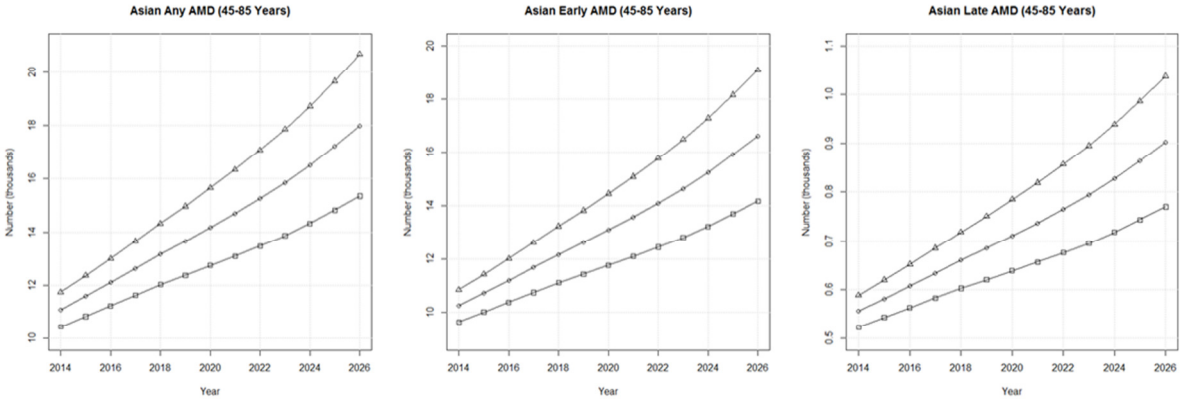


Figure 5. New Zealand prevalence estimates: Asian any, early and late AMD, 45–85 years age, 2014 through to 2026.



Discussion

This study predicts a 12.9% increase in the prevalence of any AMD in New Zealand from 2014 through to 2026 (using series 6 which is the most likely). For series 1 and 11, the prevalence increases from 2014 through to 2026 are estimated to be 17.4% and 8.4% respectively.

For European, any AMD is estimated to increase by 9.8% from 2014 through to 2026. For Asian people, the increase is estimated to be 62.2%.

Significant factors in the rising ethnic prevalences are a shift of the European demographic to an aged population, an increasing Asian demographic due to the combined effect of migration and a shift to an aged population.

Early age-related macular degeneration—This study estimates a prevalence of early AMD in the whole 45–85 year group of 167,482 persons in 2014 and to increase by 13% to 189,197 in 2026. The meta-analysis of pooled population studies used for this study showed early AMD to have a much higher prevalence in European populations (11.2%) than in Asian populations (6.8%).[2]

The risk of progression to late AMD increases with age and early AMD severity[4]. Altering modifiable risk factors such as smoking, heavy alcohol consumption, systemic hypertension, exercise, obesity and high dietary fat intake may substantially lower the risk of developing early AMD or of early AMD progressing to late AMD.[11,12]

Strategies to reduce the rate of progression of early AMD can have a significant impact on the prevalence of late AMD. A diet rich in carotenoids, omega-3 fatty acids and fish products is associated with a decreased risk of progression of early to late AMD.[13–15] The Age-Related Eye Disease Study (AREDS) 1 and 2 showed antioxidant therapy to reduce progression to late AMD by 25%.[8,16] A follow-on study showed the effect persists for at least 10 years.[17]

AREDS antioxidant medications are readily available over-the-counter and, at approximately $NZ400 per patient per annum, are cost-effective.[18] Efforts to promote antioxidant therapy are important as otherwise uptake and compliance has been shown to be poor.[19]

Late age-related macular degeneration—The prevalence of late AMD in the whole 45–85 year age group is estimated to be 7583 persons in 2014 and increase 13.6% to 8614 in 2026.

Although nAMD represents only 10–20% of late AMD, untreated it has a devastating visual prognosis with loss of 1–3 lines LogMAR visual acuity at 3 months and 3–4 lines by 1 year.[20]

Anti-VEGF treatment is highly effective and the standard of care for nAMD.[21]Vision loss is prevented in over 95% of study eyes and vision significantly improved in 40%. Even very short delays in starting treatment of nAMD can result in significant preventable vision loss.[22,23] Regular treatment is required for years and possibly for life to maintain vision gain.[24,25] U.S. Medicare data on anti-VEGF therapy demonstrates a 40% reduction of vision loss, 46% reduction of blindness and 19% reduction of admission to long-term care.[26] Education on nAMD symptom awareness and vision self-monitoring may lead to earlier diagnosis of nAMD, timely access to treatment and thereby better vision outcomes.[23,26]

Screening—Early AMD has little impact on vision and patients are usually asymptomatic.[27] As such, there is a need for measures to identify patients with early AMD for timely dietary modification and antioxidant therapy.

Screening of over 45 year olds for early AMD, such as by optometry eye examinations or retinal photography, is debated and warrants ongoing consideration.[4,28–31] Screening arguably meets WHO screening guidelines[32,33] but suffers from the issue of a potentially very large screening population.

To reduce the screening population, screening might be confined to only target European, Asian and other at-risk ethnicities and may be further refined by selecting an older age threshold than 45 years.

Health economics of interventions for age-related macular degeneration—AMD has a major impact on quality of life (QOL). Mild AMD has a self-reported 17% QOL decrease (similar to moderate cardiac angina); moderate AMD a 40% QOL decrease (similar to severe cardiac angina); and very severe AMD a 63% QOL decrease (similar to severe stroke with incontinence requiring constant nursing care).[34]

Bilateral nAMD patients with a major decrease in QOL and increased need of daily living report 45% worse vision-related functioning, 13% worse overall well-being, 30% more anxiety, and 42% more depression than controls.[35] Consequently, health care utilisation costs are more than seven times

higher for nAMD patients than healthy individuals.[36] The burden of illness related to nAMD has a significant adverse impact on the economy.

Robust health economic benefits are gained from measures to reduce vision loss from late AMD such as lifestyle and diet modification, antioxidant therapy and anti-VEGF therapy.[5] Severe vision loss from late AMD has declined by around 50% since anti-VEGF treatment was introduced in 2005.[37]

In New Zealand, blind registration for AMD has declined by nearly one-third from 2005 to 2010 (Blind Foundation figures). Health economic analysis confers anti-VEGF therapy a 16–28% value gain.[5] Even treatment of a worse-seeing eye gives significant QOL improvements.[38] Direct non-ophthalmic, non-medical and indirect costs of nAMD exceed the direct ophthalmic treatment costs by several hundred percent.[5]

Long-term anti-VEGF therapy places substantial financial burden on a healthcare system.[10,39] In the United States ranibizumab accounted for nearly 10% of the drug budget in 2010.[9] Bevacizumab, with a similar efficacy to ranibizumab but a large price differential (approximately $NZ100 and $NZ2250 per treatment respectively), has superior cost-effectiveness.[39] Economics is the major driver of a widening call to use bevacizumab as the primary anti-VEGF agent.[10]

Provision of age-related macular degeneration healthcare in New Zealand—An ageing population with a consequent rising AMD prevalence will progressively increase demand for ophthalmic healthcare services. Increasing numbers of anti-VEGF treatments and related clinic visits risk over-burden of ophthalmic services.[40]

Compared to other developed countries, New Zealand has a low per capita number of ophthalmologists, currently approximately 1 per 38,000 people.[41] A recent survey of the just over 120 ophthalmologists on the New Zealand medical register found 60% currently engage in treating nAMD patients with anti-VEGF therapy (Goh Y.W., Worsley D.R. Survey of AMD treatment practices by NZ ophthalmologists. 2014). Eighty-eight percent perceive provision of treatment for nAMD to be a significant current burden in the public system. This echoes the experience in other countries.[42]

New Zealand has the lowest public funding of anti-VEGF drugs of all Organization for Economic Co-operation and Development (OECD) countries.[43] Public funded access to anti-VEGF treatment varies nationwide, being determined autonomously by each district health board. Each sets its own funding level and treatment criteria. Thereby, in all but one of the 20 district health boards, access to anti-VEGF therapy is restricted. Bevacizumab is the only routinely available agent. Furthermore, there is no funding of antioxidant therapy or education on lifestyle modification, nAMD symptom awareness and vision self-monitoring.

Only 53% of New Zealand ophthalmologists perceive access to treatment of nAMD in the public sector to be adequate (Goh Y.W., Worsley D.R. Survey of AMD treatment practices by NZ ophthalmologists. 2014).

The only other major ophthalmic condition with widely restricted treatment access is cataract surgery with national criteria set by an ophthalmologist advisory board and based on strong health economics.

Many patients have no option but to pay for anti-VEGF therapy in the private sector. Within a two year period, 46% of ophthalmologists treating AMD report that patients without access to public care have declined starting, or have discontinued, anti-VEGF therapy because of cost. Furthermore, 61% report patients not responding to bevacizumab declining to change to other, more expensive, anti-VEGFs because of cost (Goh Y.W., Worsley D.R. Survey of AMD treatment practices by NZ ophthalmologists. 2014).

Limitations of the study—Our projections are subject to the assumptions outlined in Table 1. These give a degree of uncertainty which may increase as projections are made into the future. These assumptions may result in future prevalence being under- or over-estimated.

The divergence over time of series 1 and 11 gives some idea of the range of prevalence that may occur. The ethnic prevalence rates we used are taken from a meta-analysis of a number of large population studies and therefore are not specific to New Zealand.

Several factors may lead to an underestimation of prevalence.

- The source publication for ethnic prevalences didn't include those over 85 years age in prevalence estimates, as the numbers in this age group were insufficient in most of the pooled studies, yet this age group is likely to have the highest prevalence.[44] In population studies, those with late AMD are more likely to either not participate or dropout for a number of reasons including older age, transportation difficulties and comorbidities.[45] Furthermore, the dropout rate in the pooled population studies is high at approximately 20%, which gives further potential for inaccuracy. The New Zealand over 85 year age group comprises an estimated 68,400 persons in 2014 and 97,900 in 2026, of which the combined European and Asian comprise 66,100 and 84,200 respectively.

  The Blue Mountains Eye Study (BMES) is one of very few studies to calculate a prevalence rate for the over 85 year age group, although based on examining only 135 subjects[46]. The BMES found a prevalence rate in the over 85 year age group of 38.9% for any AMD, 28% for early AMD and 18.5% for late AMD. These rates indicate New Zealand over 85–year age group prevalences in 2014 of 25,700 any AMD, 18,500 early AMD and 12,200 late AMD and in 2026 of 32,800 any AMD, 23,600 early AMD and 15,600 late AMD.

- The Māori and Pacific 45–85 year age group makes up 13.1% of the whole 45–85 year age group in 2014 and 14.8% in 2026. In this study Māori and Pacific peoples are given a zero prevalence of AMD as, to our knowledge, there is no published or anecdotal case. Our approach differs from that of a previous report on vision loss from AMD in New Zealand[47] which arbitrarily assigned a prevalence for Māori. They assumed the Māori prevalence of AMD will be low but under-reported due to a low utilisation of health services.

- There are some potential errors in the population statistics compiled by Statistics New Zealand. These include error introduced due to double counting (because an individual may identify with more than ethnic group) and rounding in ethnic population projections.

Conclusion

AMD is prevalent in the elderly. Due to an ageing population demographic, AMD prevalence in New Zealand is expected to substantially increase from 2014 through to 2026. AMD is currently the leading cause of significant permanent vision loss in New Zealand and the impact of late AMD on QOL, burden of disease and the economic impact is marked. Treatment of AMD has a high health economic benefit that easily justifies public funding of interventions proven to reduce AMD disease progression and prevent vision loss.

This study highlights a need for New Zealand healthcare planners to review current strategies and funding of interventions that minimise vision loss from AMD. Additionally, there is a need to plan for a rising demand for AMD interventions and related ophthalmic services.

Competing interests: Nil.

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SUMMARIES

The burden of disease and injury attributable to alcohol in New Zealanders under 80 years of age: marked disparities by ethnicity and sex

Jennie Connor, Robyn Kydd, Kevin Shield, Jürgen Rehm

This study summarises major effects of current drinking patterns on health of the NZ population, although there are additional health and social harms not included in the study. Men are more affected than women, and Maori are more affected than non-Maori. These differences are largely due to higher rates of injury in these groups, due to more frequent intoxication. The leading cause of alcohol-related death in women is breast cancer, and alcohol also increases the risk of other common cancers. Improvements in health, and reduction in disparities, will require reduction in consumption across the population using types of regulation known to be effective for doing this.

Motor neurone disease in the greater Wellington region: an observational study

Viswas Dayal, Ian Rosemergy, Janet Turnbull

Motor neurone disease (MND) is a degenerative condition affecting the nervous system and leads to progressive disability due to weakness involving the limbs, muscles involved in swallowing and speech, and breathing. MND in the Wellington region was found to be prevalent at a rate of 8.5 per 100,000 people over a 12 month period. The average age of onset of MND was 66.2 years, and the median survival time for these patients was 29 months (2.4 years). The disease most commonly manifested as a combination of limb and bulbar (swallowing and speech) muscle weakness, and less commonly as weakness of respiratory (breathing) muscles. The Wellington region provides comprehensive healthcare services to these patients with input from medical specialists, dietitians, speech language therapists, and palliative care providers.

Does Pūkawakawa (the regional-rural programme at the University of Auckland) influence workforce choice?

Christina Matthews, Warwick Bagg, Jill Yielder, Vernon Mogol, Phillippa Poole

University of Auckland medical students spending a year in Northland greatly value the experience. In the early years after graduation they are likely to work in regional and rural areas of New Zealand. In addition, these graduates show an intention to work in general practice. Together these outcomes may help to address workforce shortages and misdistribution in New Zealand. Funding of regional and rural medical student learning opportunities ought to be a high priority.

Prevalence predictions for age-related macular degeneration in New Zealand have implications for provision of healthcare services

David Worsley, Andrew Worsley

Age-related macular degeneration (AMD) is a very common eye condition and is associated with ageing. AMD causes approximately 50% of blindness in New Zealand. As New Zealand has a rapidly ageing population, the prevalence of AMD can be expected to also increase markedly in the next two decades. In this study we predict the prevalence of AMD in New Zealand from 2014 through to 2026. The prevalence of any AMD in New Zealand for the 45–85 year age group is estimated to be 184,400 in 2014 (10.3% of this age group) and increase 12.9% to 208,200 (9.9% of this age group) in 2026. For 2014 and 2026 respectively, early disease is estimated to be 167,500 and increase to 189,200 and late disease is estimated to be 7,600 and increase to 8,600. AMD prevalence predictions for the very elderly (over 85 year age group) could not be included in this study, but may add approximately 15% to these figures.

The expected increase in prevalence of AMD is likely to be a major healthcare burden for which New Zealand is not well prepared. By international standards New Zealand has a low level of investment in AMD healthcare; the lowest public funding of anti-VEGF treatment in the OECD, no specific funding for prevention strategies and a relatively small ophthalmic workforce and public infrastructure. As such, there is an urgent need to plan for an increasing demand for AMD treatment, prevention strategies and associated ophthalmic services. The alternative is risking a major increase in preventable blindness.