Myopia: A Disease??

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Is Myopia a Disease?

- Myopia long considered a disorder of refraction
- Is it that simple?
- Standard of care has always been to prescribe spectacle and/or contact lenses
  - Has that proven to be successful?
  - The rates of myopia worldwide have skyrocketed
  - The downstream consequences of high myopia and myopic progression are important to understand
- Underappreciated
- Profound public health problem
- Tremendous economic impact

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Is Myopia a Disease?

- Myopia is common – 42% of Americans (12-54 yrs)
- Increasing in prevalence
- Systematic Data review and meta-analysis
  - 145 studies
  - 2.1 million participants
- Global prevalence of myopia = 28.3% (2010)
- Projected increase of myopia = 34% (2020)
- Regional differences are important!
  - East Asia = 47% (2010)
  - North America = 34.5%
  - Western Europe = 28.5%

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Unprecedented Increases in Myopia

- China
- Japan
- South Korea
- Singapore
- Taiwan
- In some parts of Asia the incidence of myopia is 80%!

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Eyesight Influences Many Things

- Affects the way we relate to others
- Integrate into society
- Impacts education
- Impacts employment
- Child development
- Mental health
- Functional capacity in elderly
- Greatest burden of uncorrected vision is seen in older individuals, rural areas, and least developed countries

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Serious Myopia Related Problems

- Glaucoma – larger discs, tilted discs, peripapillary atrophy make misinterpretation of data commom
- Retinal detachment
- Cataract
- Myopic macular degeneration
  - Most common cause of blindness in Japan
  - Most common cause of low vision and blindness in China
    - Beijing Eye Study
- Since cpRNFLT is not often helpful the observation of thickness of retinal macular layers is important

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World Health Organization (WHO)

- Myopia experiencing an alarming increase in prevalence
- Estimates for 2050
  - 50% myopic worldwide
    - This represents half the population of the world !!
    - 5 billion people
  - 10% high myopia
- High myopia (HM) is particularly concerning
  - Associated with significant increase in visual impairment (VI)
  - Myopic macular degeneration (MMD)
    - Alarming increase in prevalence
    - Puts 1 billion at risk for blindness leading co-morbidities
- Largest burden
  - East Asia
  - SE Asia
  - South Asia

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Environmental Factors - Multifactorial

- Intense near work
  - Half the studies do not show a relationship!?
- Time outside
  - Prevents or delays or both
  - Does time outside prevent or does time inside stimulate?
- Reading behaviors
  - Especially prolonged or intensive
- Illumination levels
  - Fluorescent lamps / low light levels / low frequency of flicker
- Esophoria – linked to onset and progression

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Environmental Factors - Multifactorial

- Intensity of education studies
- Head tilt while reading
- Parental myopia

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Cram School

- Well documented and remarkable difference between myopia in SE Asia and other countries
- Probable causative role in myopia development is competitive stressful education system
- Cram schools are after school tutoring programs
- Prolonged attendance at cram schools are a major risk factor for onset of myopia in children 7-12 years of age
  - Average time spent in cram schools are >2 hours/day
  - Doesn't account for the time at near spent in classroom during regular school hours or time spent doing homework after school

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The New Kid on the Myopia Block

- Children spend large amounts of time playing games on smart phones, tablets, PCs
- Reading
- Shoolwork is on laptops, PCs, smartboards
- Homework is on laptops, PCs
- Close work dominates culture
- Sedentary postures common

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Pathologic Myopia (PM)

- Major cause of irreversible VI worldwide
- Leading cause of monocular blindness in Japanese >40 years of age (Tanjimi study)
- Primary cause of VI & blindness in China
- European & Latin American populations – 3rd leading cause of blindness
- 2015 International Panel created a new photographic grading system for myopic macular degeneration
  - META-PM Classification System

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META-PM Classification

- Tessellated fundus
- Diffuse chorioretinal atrophy
  - Peri-papillary diffuse choroidal atrophy (PDCA)
  - Macular diffuse chorioretinal atrophy (MDCA)
- Patchy chorioretinal atrophy – atrophy & holes in Bruch's membrane
- Macular atrophy
  - CNV-related Macular atrophy (CNV-MA)
  - Patchy atrophy related macular atrophy (patchy-MA)

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META-PM Classification

- Lacquer cracks (LC)
- Myopic choroidal neovascularization (CNV)
- Macular traction maculopathy
- Dome-shaped macula

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Choroidal Thickness (CT) in PM

- Normals – choroid thickness is thickest subfoveal
- Pathology – thickest at superior, temporal, inferior, subfoveal
- Choroidal thickness (CT) is markedly thinner in HM
  - Starts nasal to FAZ and moves towards macula
- CT significantly thinner in eyes with more severe myopic maculopathy
  - 50% less CT
  - 1st sign of pathology
- Progression from no pathology-to tessellated-to diffuse atrophy is due to progressive thinning of choroid

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Papillary RNFLT in High Myopia

- OCT-derived macular ganglion cell complex measurements and cpRNFL loss were strongest predictors for VF progression
- cpRNFLT is lower in older eyes
  - Mean rate of loss 0.52u/yr
  - In older subgroups (40-50, and 50-59 yrs) the degree of cpRNFL loss becomes greater & the differences widened with higher degrees of myopia!
  - Needs to be accounted for in evaluation of OCT images
  - Remains unclear if in high myopia the progressive loss of cpRNFL loss represents glaucoma suspect or even preperimetric or perimetric low tension glaucoma

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Common Sense Action Plan

- Prevent myopia
- Correct myopia
- Control myopia after it occurs
- Manage pathologic complications of high myopia
- Better understand the economic value of intervention
  - Not cost
  - Productivity data and downstream effects should drive policymakers
  - Naidoo Ophthal March 2019 - sentinel work on economics of correcting myopia

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Common Sense Action Plan

- Naidoo et al
  - Combined data for spectacle correction with myopia data
  - Applied disability weights
  - Applied employment rates
  - Labor force participation
  - GDP per capita
  - Stratified for various levels of myopia
  - Calculated results in USD ($)
  - Data collection from 2015

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Common Sense Action Plan

- Naidoo et al
- Annual global productivity loss from uncorrected refractive error
  - $202 Billion USD
- Cost of $20 Billion USD to build infrastructure, train personnel, and deliver care needed to correct all vision impairment (VI) from uncorrected refractive error
  - 5 year implementation plan

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Myopia Treatments & Control

- Spectacle and contact correction
- Under-correction of myopia
  - Ineffective at slowing progression or
  - Actually accelerate progression
  - Note: recent study documents that significant under-correction yields less progression than full correction
    - ie not correcting refractive error at all!
- Atropine – at various dosages convincingly controls progression of myopia and axial elongation
  - Abrupt discontinuation maximizes rebound phenomenon
  - Greater loos of treatment effect with higher dosages

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Myopia Treatments & Control

- Atropine effect not caused by cycloplegic effects
  - Acts of inner retina magnifying the retinal response to myopic defocus
  - Inhibits chorioretinal thinning in response to hyperopic defocus while not suppressing thickening in myopic defocus
- Orthokeratology
  - Better control effects in children with large pupils
  - Average control is 50%
  - Greater effects on higher myopic refractive error or with greater corneal shape change
  - Atropine added to orthokeratology may increase control effect

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Myopia Treatments & Control

- Multifocal or bifocal contact lenses
  - Average progression control is 40%
  - All published studies used distance centered multifocal contacts
    - Would other designs work better?
    - What are the effects of different add powers?
    - Is there an additive effect of atropine with CL?

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Studies & Resources

- Managemyopia.org
- Myopia task force
- Treehouse Eyes
- The Myopia Meeting
- Vision by Design meeting
- Global Specialty Lens Symposium
- TsaiDC Myopia Investigation study (Taipei) Invest Ophth Vis Sci 2016
- KuPW Association of Near Vision Activities and Incident Myopia in Children Nationwide 4 year f/u study Ophthal 2019 126 214-220

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Studies & Resources

- Min-WooLee LongitudunalChanges in Peripapillary RNFLT in High Myopia Ophthal 2019 126 522-528
- Naidoo Potential Loss of Productivity Resulting from Global Burden of Myopia Ophthal 2019 126, 338-346
- Fang OCT Based Diagnostic Criteria for Different Stages of Myopic Maculopathy Ophthal 126 1018-1032

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Thank you

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