Omofolasade Kosoko-Lasaki1, 3

Disparities in eyeglass insurance coverage in Canada

3:45 PM–5:30 PM
3971

Commercial Relationships: Laetitia Truong

Purpose: Uncorrected refractive error is the leading cause of visual impairment globally. The WHO estimates that 153 million people worldwide live with uncorrected refracted error. This ocular problem has been shown to have enormous social and economic outcomes in addition to limiting educational opportunities for children and consequently translates to poverty. The purpose of this study was to demonstrate the effectiveness of low-cost First Sight® eyeglasses in reducing the societal burden and improving access to treating refractive error.

Methods: Over the summer of 2014 and 2015, medical students from Creighton University School of Medicine and under the direction of OKL, an ophthalmologist, performed vision screenings in health clinics and schools in Nebraska (USA), Guatemala, Ghana, Cambodia, Peru, and the Dominican Republic. Demographic information was obtained on the subjects such as age, gender, education, occupation, and medical history. The subjects were screened for refractive error using a tumbling E chart for children and adults. Individuals were fitted with First Sight® eyeglasses using a trial lens flipper after the refractive error was determined with a trial lens. The vision with the eye glasses was also confirmed after fitting.

Results: A thousand individuals were examined but only 178 (mean age of 11 and 43 in children and adults respectively) were fitted with distance-prescription glasses supplied by First Sight®. A hundred percent of the participants showed an improvement in their visual acuity. Of those patients, 62% (n=111) were female and 36.6% (n=65) were male. Moreover, of the 356 lenses dispensed, -1 Diopters was the most prevalent corrective lens prescribed. Finally, in Guatemala, the most common condition associated with refractive error was a family history of visual difficulties.

Conclusions: Using low-cost equipment in a global setting to detect refractive error and provide eyeglasses for less than $4.50 a pair, individuals with uncorrected refractive error have benefitted from the devastating effects of uncorrected visual acuity.

Commercial Relationships: Laetiitia Truong; Brett Briggs; Lee Weiner; Nizar Mamdani; Omofolasade Kosoko-Lasaki

Spectacle use in a rural population in the state of Telangana in South India


Purpose: To assess the prevalence and patterns of spectacle use among those aged ≥ 40 years in the south Indian state of Telangana.

Methods: A population-based cross-sectional study was conducted in which 6150 people were enumerated from 123 clusters in the two districts of Telangana state (Adilabad and Mahbubnagar) using a two stage cluster random sampling methodology. A questionnaire was used to collect information on current and previous use of spectacles, type of spectacles and details of the spectacles provider. The vision with the eye glasses was also confirmed after fitting.

Results: Among the 5881 participants examined, 53.6% were women, 62% had no formal education. The prevalence of current spectacle use was 28.9% (95% CI: 27.6 – 30.0). It was higher in 20-39 (55.9%) and 40-64 (59.5%) higher insurance coverage than seniors (33.8%, p<0.05). Canadians residing in the three territories have the highest coverage (76.9%) while those in Quebec have the lowest (39.1%, p<0.05). Compared to immigrants (47.3%), non-immigrants (57.4%, p<0.05) have 10.1 more individuals with insurance per 100 people. Compared to non-whites (49.2%), white Canadians (56.4%, p<0.05) have 7.2 additional individuals with insurance per 100 people. There is no significant difference in insurance coverage between men (55.7%) and women (54.3%, p>0.05). Among Canadians in the 20-64 age group, individuals with middle or high income are 55% (adjusted PR 1.55, p<0.05) more likely to have insurance than those with low income after adjusting for ethnicity and immigrant status. Compared to those with less than secondary school education, individuals with secondary school education are 11% (adjusted PR 1.11, p<0.05) more likely and individuals with university or college education are 21% (adjusted PR 1.21, p<0.05) more likely to have insurance coverage.

Conclusions: Significant disparities exist in eyeglass insurance coverage in Canada. Individuals with low levels of income, low levels of education, seniors, immigrants, non-whites and residents of Quebec have less coverage. Studies are needed to understand if these disparities contribute to the visual impairment burden in Canada.

Commercial Relationships: Gordon Ngo, None; Graham E. Trope, None; Yvonne M. Buys, None; Yaping Jin, None

Support: CIHR HRA 126901; CIHR SEC 117120
(OR: 2.0; 95% CI: 1.7 – 2.3) and those aged 60 years and older had three times higher odds for use of spectacles (OR: 2.9; 95% CI: 2.5 – 3.4) in 60 – 69 year old age group and OR: 2.9; 95% CI: 2.4 – 3.6 among 70 years and older age group respectively). Women were twice likely to use spectacles compared to men (OR: 2.0; 95% CI: 1.8 – 2.3). When compared to subjects who had no education, those who had school education (OR: 3.4; 95% CI: 2.9 – 4.0) and those who studied under graduate or above had higher odds (OR: 6.4; 95% CI: 4.7 – 8.6) for current use of spectacles. Compared to participants from Mahbubnagar, those living in Adilabad had higher odds for spectacles use (OR: 1.5; 95% CI: 1.3 – 1.7). Bifocals were the most commonly used type of spectacles (56.3%) and private eye clinics (70.3%) were the leading service providers. About two-thirds of those using spectacles paid between 300 to 599 rupees (USD 5 to 10) for their spectacles. The prevalence of past spectacle use was 7.8% (95% CI: 7.1 – 8.5). Scratches on lenses / broken spectacles were the leading reason for the participants to discontinue their spectacles. The Spectacle coverage was 64.6%.

Conclusions: We reported on patterns of spectacle use from two districts in Indian state of Telangana using a large representative sample and a high response rate. About two thirds of those who needed spectacles, were using them, suggestive of good primary eye care coverage in the two districts studied.

Commercial Relationships: Srínivas Marmamula, None; Rajesh Challa, None; Eswara Rao K, None; Rohit C. Khanna, None

Support: CBM Germany and Hyderabad Eye Research Foundation, India

Program Number: 3973 Poster Board Number: B0140
Presentation Time: 3:45 PM–5:30 PM

Prevalence of refractive errors in a large German cohort of children and adolescents

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Purpose: To investigate the prevalence of refractive errors in German children aged 2- 19 years old.

Methods: The Leipzig Research Centre for Civilization Diseases (LIFE) is a population-based, prospective, observational single-center study that investigates the development of children and adolescents in Germany. In a cohort of the study sample, the ocular status of urban preschool children or school children and adolescents was evaluated. Participants underwent a standardized protocol including questionnaires and an optometric examination. The examination included measurement of non-cyclopic refractive errors, of the ocular dimensions of the eye using non-contact optical low-coherence reflectometry (Lenstar 900, Haag Streit, Kômitz, Switzerland) and of the visual acuity. Refractive errors were determined using wavefront-based autorefraction (ZEISS i.Profiler plus, Carl Zeiss Vision GmbH, Aalen, Germany) with the following definitions: myopia < -0.5 diopters (D), hyperopia > +0.5 D, astigmatism < -0.5 D.

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Results: Spherocylindrical errors of the eye (sphere and astigmatism) were calculated from the lower order aberrations (Z2;0, Z2;2, Z2;,-2) for a pupil diameter of 4mm for the right eye of 1200 children, aged 2-19 years (mean: 10 ± 3.9 years). For all children, the prevalence of emmetropia was highest (65%; mean: 0.00D ± 0.26D), while hyperopia and myopia were equally prevalent (hyperopia: 17.4%, mean: +1.37D ± 0.38D; myopia: 17.6%, mean: -1.52D ± 1.18D). The average astigmatic refractive error was -0.97D (SD ±0.68D) and was prevalent in 22.4% of the children. When participants were separated into preschool children (n= 355, mean age: 5 ± 1.2 years, range 2-6 years), school children and adolescents (n= 845, mean age: 12 ± 2.8 years, range 7-19 years), prevalence of emmetropia was still highest (preschool: 65%; school children and adolescents: 65%), while the prevalence of myopia increased in the group of school children and adolescents (21%) compared to preschool children (9%).

Conclusions: The prevalence of myopia and hyperopia is modest in urban children living in Germany. When separated into preschool children or school children and adolescents, the prevalence increases, but is still lower compared to rural Asian children. The global trend towards an increasing prevalence of myopia was not observed in the study group.

Commercial Relationships: None; Mandy Vogel, None; Arne Ohlendorf, Carl Zeiss Vision International GmbH; Siegfried Wahl, Carl Zeiss Vision International GmbH; Peter M. Wiedemann, None; Wieland Kiess, None; Franziska G. Rauscher, None

Program Number: 3975 Poster Board Number: B0142
Presentation Time: 3:45 PM–5:30 PM
Longitudinal changes in refractive error in Korean children
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Purpose: To investigate changes in the spherical equivalent (SE) refractive error and astigmatism in Korean children with longitudinal follow-up and to evaluate the effect of risk factors on changes in refractive error.
Methods: This study is a retrospective case series. In total, 221 patients who first visited the ophthalmology department from 3 to 9 years of age and could be followed for at least 10 years were enrolled. The patients were divided into groups according to the initial degree of SE, initial degree of astigmatism, sex, and ocular alignment. Changes in SE and astigmatism were compared among the groups.
Results: The patients were followed up for a mean of 11.19 ± 1.81 (range, 10–18) years. An overall negative shift in SE and increasing tendency in astigmatism during the follow-up period were noted (p < 0.001). Myopia group was more likely to have a significant negative shift in SE (p < 0.001). The low astigmatism group was more likely to have a significant increase in astigmatism (p < 0.001). Esotropia group showed significantly slower changes in SE and exotropia group was more likely to have a significant increase in astigmatism (p = 0.032, p = 0.022, respectively). There was no sex difference in changes in SE and astigmatism.
Conclusions: Korean children showed a negative shift in SE and increasing tendency in astigmatism during childhood. Changes in SE may be influenced by the initial degree of SE. The initial degree of astigmatism and ocular alignment may influence changes in astigmatism.

Commercial Relationships: None; Young Shin Kim, None; Song-hee Park, None

Program Number: 3976 Poster Board Number: B0143
Presentation Time: 3:45 PM–5:30 PM
National Eye Survey of Trinidad and Tobago: the prevalence and risk factors for refractive error
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Purpose: This study estimated the prevalence of refractive error, and associated risk factors, in people aged 40 years and over in Trinidad and Tobago, a Caribbean nation with a population of 1.3 million.
Methods: A population-based, nationally-representative, cross-sectional survey, using randomized multistage cluster sampling with probability proportionate to size methods, identified 120 clusters each of 35 people. Refractive error was determined by autorefraction (Topcon KR8000-PA). The prevalence of refractive errors amongst participants who were phakic was analysed for the right eye only. Myopia was defined as a spherical equivalent refraction (SE) less than -0.50 dioptres (D), hypermetropia as a SE greater than 0.50 D, astigmatism as a cylinder less than -0.50 D, and anisometropia as a difference in the right and left eye SE greater than 1.00 D.
Results: Of 4200 people enumerated, 2334 (55.6%) attended clinic for a comprehensive optometric assessment. 161 people with previous cataract surgery in the right eye were excluded from the analysis. The mean age was 56.2 years (sd 10.0) and 56.9% were female. The median SE was 0.50 D in the right eye (IQR -0.38 to 1.25, range -23.40 to 14.50) and 0.50 D in the left eye (IQR -0.38 to 1.38, range -19.9 to 15.6), p=0.34. The crude prevalence of myopia was 18.6% (95% CI, 17.0 to 20.2), of hypermetropia was 47.5% (95% CI 45.4 to 49.6), of astigmatism was 37.1% (95% CI 35.4 to 38.7), and of anisometropia was 12.0% (95% CI 10.7 to 13.5). After accounting for sampling design, using response-based weighting, and post-stratification based on age, sex, and municipality, the prevalence of myopia was 19.2% (95% CI 17.5 to 21.0) and of hypermetropia was 45.7% (95% CI 43.4 to 48.1). 37.5% currently owned spectacles for distance correction. In multilevel multivariable analysis risk factors for myopia included age (non linear), increasing years of education and African descent, whilst risk factors for hypermetropia included increasing age and South Asian descent.
Conclusions: Half of older adults in Trinidad and Tobago are hypermetropic and one fifth are myopic, and less than forty percent own spectacles. Uncorrected refractive error is a leading cause of avoidable vision impairment globally. These findings contribute to our understanding of the burden and risk factors for refractive error in the Caribbean region.

Commercial Relationships: Shivaa S. Ramsewak; Neville Verlander, None; Frank Deomansingh, None; Amandi Fraser, None; Vedatta Maharaj, None; Subash Sharma, None; Deo Singh, None; Rupert R. Bourne, None; Tansane Braithwaite, None
Support: Ministry of Health of the Republic of Trinidad and Tobago and Fight for Sight UK

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Purpose: To evaluate the effect of parents’ myopia on their children among Korean population using a nationally representative survey.

Methods: The present study used the ophthalmologic examination dataset of the Korean National Health and Nutrition Examination Survey (KNHANES) IV and V, which was performed between 2008 and 2012. A total 3,568 children at age 5 to 18 years and 4,384 parents in 2,192 two-generation families with available ophthalmologic dataset were included. Individuals with any ocular trauma, surgery history or cataract affecting refractive errors were excluded. Generalized estimating equation models were conducted to assess the association and interaction of refractive errors among children and their parents.

Results: The mean spherical equivalent (SE) of fathers, mothers, and children was -1.41±1.92 (-11.64 to +3.31) diopters (D), -1.58±2.05 (-15.38 to +2.56) D, and -1.82±2.22 (-15.43 to +4.88) D, respectively. The prevalence of children’s myopia was significantly higher when children are getting older (adjusted prevalence ratio [PR], 1.3469; 95% confidence interval [CI], 1.3130-1.3817), their fathers have myopia (adjusted PR, 1.5832; 95% CI, 1.1912-2.1042), and their mothers have myopia (adjusted PR, 1.5600; 95% CI, 1.1981-2.0312). No additive or multiplicative interaction was observed between father’s and mother’s myopia in children’s myopia. Regarding high myopia (SE < -6.0 D), the prevalence was higher when children are getting older (adjusted PR, 1.3273; 95% CI, 1.2709-1.3862), their fathers have myopia (adjusted PR, 2.7019; 95% CI, 1.3424-5.4384), and their mothers have myopia (adjusted PR, 4.1722; 95% CI, 2.3951-7.2680). There was no effect of interaction of parents’ high myopia in children’s high myopia.

Conclusions: The present study revealed significant familial concordance of refractive errors among Korean children and their parents. No additive or multiplicative interaction was observed between myopia in father and mother on children’s myopia.

Commercial Relationships: Dong Hui Lim, None; Tae-Young Chung, Jisang Han, None; Seungwan Nam, None; Hyeon Woo Yim, None

Comparison of refractive error measurements in adults obtained by autorefraction and subjective refraction

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Purpose: To determine level of agreement, and factors associated with poor agreement between refractive error measurements obtained by autorefraction at a screening center and subjective refraction obtained in the clinic among older individuals screened in Baltimore.

Methods: All subjects underwent autorefraction using Topcon KR800S as part of community-based screenings in Baltimore MD. Participants with presenting vision worse than 20/40 who could be improved with autorefractive (AR) results were referred to the Wilmer Eye Institute for subjective refraction (SR). AR values obtained at screening were compared with SR values obtained during the follow up visit. Data analysis of sphere, cylinder, axis and spherical equivalent (SE) were performed. Pearson’s correlation coefficient was used to compare agreement between AR and SR. Factors associated with large SE differences (> 0.75 D) were assessed.

Results: As of November 2015, 35 patients presented to the Wilmer Eye Institute for SR. 1 patient underwent refraction in one eye only; 35 right eyes and 34 left eyes were included in the analysis. The mean SE by SR was 0.18D (SD: 3.99, range: -19.13, +4.44), while the mean SE by AR was 0.16D (SD: 4.02, range: -19.56, +4.56). The mean astigmatism error by SR was +0.98D (SD: 0.64, range: +0.13, +3.5). The overall mean difference in SE was 0.06 (SD: 0.61, range: -1.38, +2.38); the difference in SE by each eye is shown in the graphs below. 2/35 (6%) subjects had an absolute difference in right eye SE between SR and AR that was greater than 0.75D, and 6/34 (18%) had an absolute difference in the left eye greater than 0.75D. The main reason for disagreement was nuclear sclerosis or cortical cataract. Pearson’s correlation coefficient for mean SE by AR compared to SR was 0.989 (p<0.001).

Conclusions: We found excellent agreement between subjective refraction and autorefraction carried out in the field. On the basis of these results, the study team is piloting an initiative to dispense glasses to seniors in the community based on autorefractor measurements alone without subsequent subjective refraction in order to improve overall delivery of glasses. To date, less than 35% of those needing glasses have followed up for refraction. With this initiative, we hope to provide glasses to more of those who are in need. Results of this pilot effort will also be presented.
Prevalence of myopia and astigmatism in adults in Germany
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Purpose: To investigate the prevalence of myopia and to analyze the distribution of astigmatism in an adult population in Germany

Methods: The refractive error of both eyes was assessed in 655 adults (123 males, 515 females) with an average age of 41 years (SD: ± 6.2 years, range: 25-72 years) using non-cyclopleged wavefront-based autorefraction (ZEISS i.Profiler plus, Carl Zeiss Vision GmbH, Aalen, Germany) during a routine examination at the Leipzig Research Centre for Civilization Diseases (LIFE). LIFE CHILD is a population-based, prospective, observational single-center study that investigates the development of children and adolescents in Germany. As part of this examination, parents of the participants underwent a standardized protocol including questionnaires and wavefront-based autorefraction measurement. Spherocylindrical errors of the eye (sphere and astigmatism) were calculated from the lower order aberrations (Z2,0;Z2,2;Z2,-2) for a pupil diameter of 3mm for the right eye of the participants. Myopia and astigmatism were defined as an objective measurement ≤ -0.5D, high myopia was defined as a refractive error ≤ -5D.

Results: Myopia was prevalent in 278 of the participants (42.4%), with a mean error of -2.62 (SD ± 2.49D). Analysis of age revealed a similar prevalence between younger adults (20-40 years, prevalence: 21.5%) and older participants (40-60 years, prevalence: 20.9%). High myopic refractive errors were found in 13.3% of the myopes (average: -7.41 ± 3.04D, range: -5D to -21D). The average astigmatic refractive error in the whole study group was -1.36 D (SD ± 0.82D) and astigmatism had a prevalence of 55%. Astigmatism ≥ -1D had the highest prevalence (82.4%), astigmatic refractive errors ≤ -1D were present in 11.2% and of ≤ -2D were found in 6.2% of the participants.

Conclusions: Myopia affected 42% of the study sample and this prevalence is higher compared to already published reports on the prevalence of myopia in adults in Europe and this could be due to the higher number of females that took part in study, as it is known that the prevalence of myopia is higher in females compared to males. High myopic refractive errors were less prevalent compared to other studies. Prevalence of astigmatism was comparable to other study cohorts.

Commercial Relationships: Arne Ohlendorf; Heike Lange, None; Mandy Vogel, None; Siegfried Wahl, Carl Zeiss Vision International GmbH; Peter M. Wiedemann, None; Wieland Kiess, None; Franziska G. Rauscher, None

Program Number: 3979 Poster Board Number: B0146
Presentation Time: 3:45 PM–5:30 PM

Posterior corneal shape following gain or loss of keratometric astigmatism
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Purpose: To assess anterior and posterior SimK tomography and apical pachymetry in eyes with known change of corneal astigmatism.

Methods: Subjects were Native American children with an examination that included Retinomax keratometry (Nikon Inc.) and a subsequent examination at least 1.5 years later that included Retinomax keratometry and Pentacam tomography (Oculus GMBH). Right eye keratometry was used to determine change in anterior corneal astigmatism. Pentacam anterior and posterior (a and p) keratometry and apical pachymetry were used to compute a corneal shape descriptor we call the Shell Deviation Ratio (Sd r) derived from the a and p SimK for steeper and flatter (s and f) radii of curvature and corneal thickness (kt). Sdr assumes a and p meridians are aligned. If the cornea is a shell of uniform thickness, ar = pr + kt in all meridians. Typically, the corneal thickens away from the apex (ar > (pr+kt)). The shell deviation (Sd) = ar-(kt+pr). The Sd along the s and f meridians are Sds and Sdf, and Sdr = Sds/Sdf, or Sdr = (ars-(kt+prs))/(arf-(kt+prf)). Sdr incorporates sensitivity to mean corneal curvature, corneal thickness, and rotational thickness asymmetry.

Results: The sample included 390 children age 3 to 15 years (mean ± 6.2) at first exam. The interval from first to second exam averaged 4.9 (range 1.6 to 12.5) years. Keratometric astigmatism exhibited little change (last minus first measurement mean 0.114 D (stdev 0.56 D), range -1.75 to +2.63 D (with-the-rule). Subjects were classified as having decreasing astigmatism based the location of their change scores in the sample distribution (Table 1). Sdr was calculated from the Pentacam data, and averaged 1.216 (stdev 1.732) for children with decreasing astigmatism and 1.148 (stdev 0.197) for children with increasing astigmatism (t=2.635, p=0.009 two-tailed test).

Conclusions: Why some children exhibit increasing astigmatism over time, and others do not, remains unclear. In this sample, there was little net change in the population average value, yet some children had changed in anterior corneal curvature. The Sdr (Shell Deviation Ratio) differed in these two groups. This finding may provide insight into corneal stability associated with relatively thicker and thinner corneas along the steeper and flatter meridians.

| Table 1. Categorization of change in keratometry (second first measurement) based on location of change score in sample distribution. |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Category                        | Location in Sample Distribution | Range                           | n                               |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Decreasing                      | Bottom 25%                      | -0.25 D to -0.20 D             | 182                             |
| Stable                          | 25% to 75%                      | > -0.25 D to +0.40 D            | 108                             |
| Increasing                      | Top 25%                         | > +0.40 D to +2.63 D            | 103                             |
Commercial Relationships: Joseph M. Miller, Michael W. Belin, Oculus (C); Erin M. Harvey, None
Support: NIH/NEI U10-EY13153 and Research to Prevent Blindness

Program Number: 3981 Poster Board Number: B0148
Presentation Time: 3:45 PM–5:30 PM
Total, corneal and ocular residual astigmatism: Distribution in a German population and age-dependency – The Gutenberg Health Study
Alexander K. Schuster¹, Norbert Pfeiffer¹, Andreas Schulz², René Hoehn¹, Katharina A. Ponto¹, 4, Maria Blettner¹, Philipp S. Wild², 3, Alireza Mirshahi¹, 4, 6
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Purpose: Worldwide, the most frequent cause of visual impairment is uncorrected refractive error. This study focused on the distribution of total, corneal and ocular residual astigmatism in a German population and evaluated associated factors for each of the three types of astigmatisms.
Methods: A population-based cross-sectional study was performed in a German population as part of the Gutenberg Health Study. A comprehensive ophthalmological examination including refraction, tonometry, Scheimpflug imaging of the anterior cornea (Pachycam, Oculus, Wetzlar, Germany) was performed. In addition to the magnitude and type (with-the-rule, against-the-rule, oblique) of total and corneal astigmatism we calculated the vector components (J₀, J₄) of both astigmatisms and computed ocular residual astigmatism. Associations of the vector components were analyzed with Spearman Rank-correlations. We performed multiple quantile regression analysis to evaluate associated factors on total, corneal and ocular residual astigmatisms.
Results: 13558 subjects (49% female) with a mean age of 54.0 +/- 9.0 years (range 35 to 74 years) were included in this study. The distribution of total astigmatism showed a two-peak distribution having high astigmatism in with-the-rule and against-the-rule position. Corneal astigmatism especially had high astigmatism at with-the-rule position, while ocular residual had a peak at against-the-rule position. Associated factors were keratometry, age and sex for the different astigmatisms (p<0.001). Total astigmatism increased with age and women showed less astigmatism, while corneal astigmatism was lower in older subjects and in men.
Conclusions: In a large German cohort we found a shift from with-the-rule astigmatism to against-the-rule astigmatism for total astigmatism with age. With-the-rule astigmatism was primarily associated by corneal astigmatism while high amount of against-the-rule astigmatism was due to ocular residual astigmatism.
Commercial Relationships: Alexander K. Schuster, None; Norbert Pfeiffer, None; Andreas Schulz, None; René Hoehn, None; Katharina A. Ponto, None; Maria Blettner, None; Philipp S. Wild, None; Alireza Mirshahi, None

Program Number: 3982 Poster Board Number: B0149
Presentation Time: 3:45 PM–5:30 PM
Longitudinal changes of Astigmatism in School-aged Children
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Purpose: Marked difference was reported in the prevalence of astigmatism and mean cylinder changes with age in different studies. The purpose of this study was to assess the longitudinal changes of astigmatism in school-aged children.
Methods: A total of 4,740 school children were enumerated, including 2,042 Grade 1 primary school children (aged 7 cohort) and 2,698 Grade 1 junior high school children (aged 13 cohort) at baseline in a refractive error longitudinal study conducted in Guangzhou China. Children were re-examined annually over a 3-year period in age 7 cohort and 2 years for age 13 cohort. Refraction data were obtained using an autorefractor (Topcon KR8800) without cycloplegia. Progression of astigmatism was defined as cylinder power increase>0.50 diopter. Incident case of astigmatism was defined as newly developed cases with cylinder power>1.25D and a cylinder increase>0.50D at any follow-up visit. Analyses were performed on the right eye only.
Results: The average change of cylinder power was 0.01±0.37D (paired t test, P>0.05) among the age 7 cohort and 0.02±0.32D (paired t test, P>0.05) among the age 13 cohort. Progression of astigmatism was identified in 12.9% of the age 7 cohort and 11.7% in age 13 cohort, while similar number of students were observed significant cylinder power decrease 0.50D, 12.5% among age 7 and 8.9% among age 13 cohort. The cumulative incidence of astigmatism was 0.74% in the age 7 and 2.52% in age 13 cohort. Children with greater baseline cylinder and absolute sphere power were associated with higher incidence of astigmatism. Astigmatism was predominantly ‘with the rule’.
Conclusions: Cylinder power and astigmatism do not change with time in children at least in 2-3 years time.
Commercial Relationships: Lili Wang, Xinxing Guo, None; Xiaohu Ding, None; Mingguang He, None
Support: National Natural Science Foundation of China (81125007) and Fundamental Research Funds of the State Key Laboratory

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error data were also collected using a Topcon TRK-1P autorefractor and expressed as Mean Spherical Error (MSE). The United Nations Geographical sub-regions classification was used to categorise data by continent (Africa; Americas; Asia; Europe; Oceania) and further categorised into one of twenty-two sub-continents. ANOVA analyses and post-hoc testing were used to investigate differences between both continents and sub-continents.

**Results:** Mean OD MSE±standard deviation (D) by continent was, in ranked ascending order: Asia -0.75±2.57, Africa -0.59±2.82, Europe -0.29±2.84, Oceania -0.27±1.86, and the Americas -0.20±1.92. There were no significant inter-eye MSE differences (p>0.05).

Analysis of sub-continents showed mean MSE (D) for Eastern Asia (-1.83±2.41) was significantly more myopic than both Southern Asia (+0.03±1.84) and Western Asia (+0.08±2.15) (p<0.05 for both). Mean MSE for Northern Africa (-1.45±4.43) was significantly more myopic compared to Middle Africa (+0.05±1.11) and Western Africa (-0.08±1.69) (p<0.05 for both). Large differences between mean MSE were also noted between other sub-continents; North America and Caribbean (mean difference 1.07D), Northern and Western Europe (mean difference 0.91D), and between Australia & New Zealand and Micronesia (mean difference 0.80D), but such differences failed to reach statistical significance (p>0.05).

**Conclusions:** Significant variation in population means of refractive error within continents highlights the importance of undertaking data analysis by sub-continent. Further work is required to understand the factors underlying such variations in global refractive error distribution.

**Commercial Relationships:** Manbir Nagra, None; Penny J. D’Ath, None; Stefano Ceccon, None; W D. Thomson, None; Penny J. D’Ath, None

**Program Number:** 3984 Poster Board Number: B0151
**Presentation Time:** 3:45 PM–5:30 PM
**Refractive Error & Academic Achievement**
Lesley Doyle, Sara McCullough, Kathryn Saunders. School of Biomedical Sciences, Ulster University, Coleraine, United Kingdom.
**Purpose:** To investigate associations between refractive error and academic achievement in Northern Irish teenagers.
**Methods:** Self-reported academic achievement and refractive error were evaluated in a subgroup (n=169) of participants from the NICER study. General Certificates of Secondary Education (GCSEs) are national standardised examinations taken at 16yrs. Results for Math and English were graded as HIGH (A*-B) or LOW (C-Undergraded). Refractive error (most ametropic meridian (≥-0.50D), mild hyperopia (≥0.50D to <+1.00D), moderate to high hyperopia (≥+1.00D to <+2.00D) and astigmatism (cylinder ≥0.75D)) were 18%, 59%, 17%, 6% and 19%, respectively. Mean dominant ocular axial length was 23.4mm [range 21.1–27.0] and corneal radius was 7.8mm [range 7.2–8.4], resulting in AL/CR of 3.0 [range 2.7–3.5]. There was a slight correlation between both AL and CR with average time near work (r=0.153, p=0.029 and r=0.165, p=0.019, respectively). Mean outdoor activity was 3.8 [range 0.8–8.7] hours/day, indoor activity 2.5 [range 0.0–6.0] hours/day and near-work hours/day outside the school day was 5.8 [range 0.7–11.8]. Emmetropes spent more time outdoors than myopes and hypermetropes [50 minutes/day and 20 minutes/day; F(22.6, 689.6)=11.3, p=0.04]. There was no difference between groups on time spent on indoor activities or near-work hours.

**Conclusions:** Myopia is less frequent whereas hypermetropia is more common in adolescents, especially boys. Outdoor time spent appears to be protective against myopia.

**Commercial Relationships:** Jon V. B. Gjelle, None; Lene A. Hagen, None; Solveig Arnegard, None; Stuart J. Gilson, None; Rigmor C. Baraas, None

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