Quality of Life and Near Vision Impairment Due to Functional Presbyopia among Rural Chinese Adults

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Purpose. To evaluate the impact of near-vision impairment on visual functioning and quality of life in a rural adult population in Shenyang, northern China.

Methods. A population-based, cross-sectional study was conducted among persons aged 40+ years, during which functional presbyopia (correctable presenting near vision < 20/50 [N8] at 40 cm) was assessed. Near-vision–related quality of life and spectacle usage questionnaires were administered by trained interviewers to determine the degree of self-rated difficulty with near tasks.

Results. A total of 1008 respondents (91.5% of 1102 eligible persons) were examined, and 776 (78%) of completed the questionnaires (mean age, 57.0 ± 10.2 years; 63.3% women). Near-vision spectacle wearers obtained their spectacles primarily from markets (74.5%) and optical shops (21.7%), and only 1.14% from eye clinics. Among 538 (69.3%) persons with functional presbyopia, self-rated overall (distance and near) vision was worse ($P < 0.001$) and difficulty with activities of daily living greater ($P < 0.001$) than among nonpresbyopes. Odds of reporting any difficulty with daily tasks remained higher (OR = 2.32; $P < 0.001$) for presbyopes after adjustment for age, sex, education and distance vision. Compared to persons without presbyopia, presbyopic persons were more likely to report diminished accomplishment due to vision ($P = 0.01$, adjusted for age, sex, education, and distance vision.)

Conclusions. Difficulties with activities of daily living and resulting social impediments are common due to presbyopia in this setting. Most spectacle wearers with presbyopia in rural China obtain near correction from sources that do not provide comprehensive vision care. (*Invest Ophthalmol Vis Sci.* 2011; 52:4118–4123) DOI:10.1167/iovs.10-6353

Presbyopia is an age–related near-vision impairment, which is common in those aged 40 years and above. The demand for near vision and near-vision correction is increasing with the widespread use of devices such as mobile phones and computers, even in rural areas of the developing world. Uncorrected near-vision impairment caused by presbyopia may have a negative impact on activities of daily living, career options, and self-esteem: 53% of Indians,[1] 58% of Brazilians,[2] and 70% of rural Tanzanians[3] with functional presbyopia reported experiencing difficulty with near tasks. In the Tanzanian study, being presbyopic increased the odds of reporting some difficulty with near-vision tasks by twofold and severe difficulty by more than eightfold. Women were more likely to report difficulty with near tasks than were men.[3] In the Indian study, those who did not use reading spectacles were more likely to report difficulty with near work than were those who wore spectacles.[1]

Recently, population-based studies in Nigeria[4] and Zanzibar[5] have confirmed that presbyopes are more likely to report difficulty with near vision tasks than nonpresbyopes. Rural dwellers in the Zanzibar report were more likely to experience such problems than were those living in urban areas. In the developed world, a Finnish study[6] showed that 6.1% of subjects with near-vision impairment had some difficulty in reading, and 1.5% of those could not read newsprint at all. Besides the burden of uncorrected near-vision impairment associated with presbyopia, it has been suggested that the capacity to offer near-vision correction at primary eye care clinics can encourage more local residents to seek eye care, particularly in rural areas of developing countries.[7]

The present study was undertaken to assess the impact of corrected and uncorrected presbyopia on visual function and several other measures of well-being in rural northern China. We also sought to identify the sources of near-vision correction used by persons in this area, to determine whether the provision of such correction could offer the opportunity to deliver more comprehensive eye care.

Methods

Data collection was performed in rural villages of Yuhong District, Shenyang City, China, from June to July 2009. In this district, 65% of the population are rural dwellers, residing in 103 villages spread out over 952 k^2. The rural populations aged 40 years and older is estimated at approximately 76,000. They speak mandarin and are primarily of Han ethnicity, with a small number of Man and Korean. Individuals aged 40 years and above residing continuously for ≥6 months in randomly selected villages and with distance pinhole visual acuity (VA) ≥20/63 (either eye) were eligible. Approval was obtained from the ethics committees at the London School of Hygiene and Tropical Medicine and the Shenyang He Eye Hospital in China. Written informed consent was given by all participants before the examination, and the study complied with the Declaration of Helsinki throughout. A total of 15 study clusters, each containing 80 persons ≥40 years of age, were randomly selected from 103 villages in the study area, to create an estimated study sample of 1200.

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Enumeration and Examination Procedures

Door-to-door visits were conducted by trained enumerators at all households within the sample frame to identify all persons aged 40 years and older. At the time of enumeration, 1102 eligible persons were identified. Sociodemographic information on the eligible 40+ population was recorded by trained interviewers. All eligible subjects were then offered an eye examination, and 1008 (91.5%) persons completed the examination. Presenting distance visual acuity (VA) was measured by two trained ophthalmology assistants using a logMAR E chart as the smallest line with at least four of the five optotypes read correctly at a distance of 4 m in an adequately illuminated room at the local health center of each village. The same procedure was used to record distance pinhole vision in each eye.

Presenting and uncorrected near-vision acuity were measured in those participants whose pinhole-corrected distance visual acuity was ≥20/63 in either eye, with a logMAR near-vision E chart at a distance of 40 cm. The distance of 40 cm from the eyes was maintained with a string attached to the top of the chart at one end, the other end of which was placed against the subject's forehead and held taught. VA was measured and recorded as the smallest line with at least four of the five optotypes read correctly. Testing always included the 20/20 line.

Near-Vision Correction and Definition of Presbyopia

All subjects with uncorrected near VA <20/50 underwent vision measurement with progressively higher plus sphere power in both eyes simultaneously until the best binocular acuity (a minimum of 20/50 [N8]) was obtained. The spherical diopter correction was recorded along with the corresponding best-corrected near-vision acuity. Correction of astigmatism was not undertaken in assessing corrected near vision.

Presbyopia (functional presbyopia) was defined as binocular near vision <N8 (20/50) at 40 cm with habitually worn distance refractive correction, with improvement of near vision by at least one line on a near logMAR E chart with the use of a plus lens.[8,9]

Questionnaires

The instruments used in the study included a 12-item Near Vision–Related Quality of Life questionnaire[3] and two items drawn from the Spectacle Usage section of the WHO Spectacle and Work Productivity Questionnaire.[10] Questionnaires were administered in mandarin Chinese by two trained study personnel in the subject's home or at village health clinics. The spectacle questionnaire asked subjects two questions: (1) Do you have glasses for your vision? (2) Where did you get your glasses? The quality of life questionnaire (Table 1) included one question on overall satisfaction with distance and near vision, eight questions (questions 2–9) about the degree of visual difficulty encountered while engaging in specific activities of daily living, two questions on the impact of vision on social functioning, and one question on vision-related dependence on others.

Statistical Methods

Confidence intervals and P values (significant at the $P < 0.05$ level) were calculated for the parameter estimates (SPSS for Windows ver. 16.0; SPSS Inc., Chicago, IL).

An overall score for each subject based on the eight questions concerning activities of daily living was initially derived by adding the item-specific scores, which ranged from 1 (no difficulty) to 5 (significant difficulty). The summary score was rescaled from 0 to 100, and four difficulty groups were created (1) no difficulty (score, ≥90); (2) some difficulty (score, 70–89); (3) moderate difficulty (score, 50–69); and (4) severe difficulty (score, <50).[3] Next, Rasch analysis (Facets;

Table 1. The Near Vision–Related Quality of Life Questionnaire

		1. Very good	2. Good	3. Moderate	4. Bad	5. Very bad
1	*Overall*, how would you *rate your eyesight* using both eyes—with glasses if you wear them?					
		1. None	**2. Mild**	**3. Moderate**	**4. Severe**	**5. Extreme/cannot do**
2	Because of your eyesight, how much difficulty do you have in *carrying out your usual work*?					
3	How much difficulty do you have in *seeing the level in a container* when pouring?					
4	Because of your eyesight, how much difficulty do you have in *unlocking a door with a key*?					
5	Because of your eyesight, how much difficulty do you have in *looking after your appearance*?					
6	How much difficulty do you have in *seeing close objects* (e.g., making out differences in coins or notes)?					
7	How much difficulty do you have *reading ordinary size print*?					
8	How much difficulty do you have in *seeing objects in your food*?					
9	How much difficulty do you have in *doing activities that require you to see well close up* (e.g., sewing, using hand tools)?					
		1. Never	**2. Rarely**	**3. Sometimes**	**4 Often**	**5. Very often**
10	Because of your eyesight how often do you *need to ask help from others*?					
11	Because of your eyesight how often do you *feel that you accomplish less* than you would like?					
12	Because of your eyesight, how often have you found that you are *ashamed or embarrassed*?					

TABLE 2. Demographic Characteristics of Participants and Nonparticipants in the Study

	(1) All Eligible Participants $N = 1102$	(2) Subjects Completing Vision Screening $n = 1008$	(3) Subjects Completing Vision Screening And Questionnaires $n = 776$	P^*
Age (mean ± SD), y	57.5 ± 10.5	57.4 ± 10.2	57.0 ± 10.2	0.44
Female, *n* %	634 (57.5%)	604 (59.9%)	491 (63.3%)	0.04
Functional presbyopia, %	—	67.3%	69.3%	0.35
Presenting distance vision <6/12, *n* %	—	192 (19.0%)	140 (18.0%)	0.54

* Comparing subject in column (2) with those in column (3).

Winsteps, Inc., Chicago, IL) was performed. Fit statistics were calculated to detect potential discrepancies between the Rasch model and available data, with infit values between −2 and +2 interpreted as demonstrating acceptable compatibility with the model. It was determined that questions 2 to 5 and 7 to 9 independently each met the assumptions of the Rasch model (e.g., the production of equal interval measures that can be added together meaningfully). Thus, question 6 was dropped, and two independent visual function scores (based on questions 2 to 5 and 7 to 9, respectively) were created for each subject and analyzed separately.

The two scores were compared between persons with and without presbyopia as defined above. Associations of age, sex, distance vision, and education with the visual function scores were then investigated by multiple logistic regression. The results for all these analyses were essentially the same between the two scores, and only data for the score based on questions 7 to 9 are presented.

RESULTS

Among 1102 enumerated, eligible subjects, 1008 (91.5%) underwent vision screening. Among these, 776 (78%) subjects completed quality of life and spectacle usage questionnaires and form the basis of all further analyses. The mean age of the participants with complete data was 57.0 ± 10.2 years, 63.3% (491/776) were women, and 56.6% (447) had secondary or higher education. Participants with questionnaire data were more likely to be women ($P = 0.044$) than were all subjects undergoing vision screening, but age distribution, distance vision, and prevalence of presbyopia among the 1102 eligible subjects, 1008 participants in vision screening, and the 776 questionnaire respondents did not differ significantly (Table 2).

Of 538 persons with presbyopia, 327 (60.8%) reported having reading spectacles, of whom 263 (80.4%) provided information on the WHO Spectacle Questionnaire on where their near correction had been obtained. The large majority of respondents had obtained near-vision correction from markets ($n = 198$; 74.5%) or optical shops ($n = 57$; 21.7%). Only three subjects (1.14%) had obtained near-vision glasses from eye clinics and none from village health workers.

When asked on the Near Vision-Related Quality of Life Questionnaire to rate their eyesight overall (considering both near and distance vision), 50.4% (120/238) of the persons without presbyopia indicated that their eyesight was good or very good, compared with only 24.7% (133/538) of persons with presbyopia. Self-rated vision was significantly worse for subjects with presbyopia compared with those without ($P < 0.001$, χ^2 test; Table 3). Over 90% of those with presbyopia reported some level of difficulty with activities of daily living, whereas more than a third of those without presbyopia had no such difficulties.

When the eight visual function questions on the Near Vision–Related Quality of Life questionnaire were grouped separately (questions 2–5 and questions 7–9) and question 6 (Do you have difficulty in differentiating coins and banknotes?) was dropped, infit *z*-scores ranged from −1.15 to 1.15. Values between −2 and +2 generally indicate that assumptions of the Rasch model have been satisfied, producing equal interval measures that can be added together meaningfully. Two sepa-

TABLE 3. Self-Rated Vision and Difficulty with Activities of Daily Living for Persons with and without Presbyopia, as Assessed on the Near Vision–related Quality of Life Questinnaire[3]

Group (Score)	Total	Presbyopia* ($n = 538$) *n* (%)	No Presbyopia ($n = 238$) *n* (%)
Self-rated vision			
Very good	51	13 (2.4)	38 (16.0)
Good	202	120 (22.3)	82 (34.5)
Moderate	429	328 (61.0)	101 (42.4)
Bad or very bad	94	77 (14.3)	17 (7.1)
P^*			<0.001
Difficulty with routine task†			
No difficulty, ≥90	102	29 (5.4)	73 (30.7)
Mild difficulty, 70–89	141	89 (16.5)	52 (21.8)
Moderate difficulty, 50–69	321	245 (45.5)	76 (31.9)
Severe difficulty, <50	212	175 (32.5)	37 (15.5)
P^*			<0.001

Presbyopic correction was worn by 60.8% of persons with presbyopia.

* χ^2 test comparing persons with and without presbyopia.

† Based on questions 7–9 on the questionnaire: difficulty reading ordinary print, seeing objects in food, difficulty with sewing and tools.

TABLE 4. Logistic Regression Model of Potential Predictors of Score Category on the Activities of Daily Living Section, Questions 7–9, of the Near Vision–Related Quality of Life Questionnaire[3]

Variable	Any Difficulty vs. No Difficulty			Severe Difficulty vs. No Difficulty		
Presbyopia	**2.32**	**1.63–3.32**	**<0.001**	**5.52**	**2.84–10.7**	**<0.001**
Presenting distance vision < 6/12	0.561	0.315–1.00	0.05	**0.365**	**0.164–0.810**	**0.013**
Age, y	**1.09**	**1.06–1.13**	**<0.001**	**1.107**	**1.07–1.15**	**<0.001**
Sex, female	**1.702**	**1.05–2.75**	**0.030**	1.40	0.744–2.62	0.299
Secondary education or greater	**0.467**	**0.271–0.80**	**0.006**	**0.371**	**0.188–0.731**	**0.004**

Presbyopic correction was worn by 60.8% of persons with presbyopia. Data in bold are significant at $P < 0.5$.

rate scores on the basis of these two groups of questions were thus calculated for each subject. Results were very similar and only data for the second of these scores are presented.

Scores were significantly worse for subjects with than those without presbyopia ($P < 0.001$, χ^2 test, Table 3).

In logistic regression, models of potential predictors of visual function score category (any difficulty versus no difficulty; severe difficulty versus no difficulty), person with presbyopia had significantly increased odds of reporting both any difficulty (OR = 2.32; 95% CI, 1.623–3.32; $P < 0.001$) and severe difficulty (OR = 5.52; 95% CI 2.84–10.7; $P < 0.001$) with near-vision tasks. Older age was also associated with both any difficulty and severe difficulty ($P < 0.001$ for both), whereas persons with secondary education and greater had reduced odds of either any difficulty ($P = 0.006$) or severe difficulty ($P = 0.004$; Table 4). Female sex was associated with any difficulty with near vision ($P = 0.030$), but not severe difficulty, whereas presenting distance vision <6/12 was protective against severe difficulty with near vision ($P = 0.013$; Table 4).

In the functional dependence and social functioning section of the questionnaire, persons with presbyopia were significantly more likely to report requiring help from others due to their vision ($P = 0.01$), a diminished sense of accomplishment due to vision ($P < 0.001$), and feeling of ashamed or embarrassed because of their vision ($P = 0.008$), than were persons without presbyopia. Only the finding for diminished accomplishment remained significant ($P = 0.01$) after adjustment for age, sex, education, and distance vision (Table 5).

DISCUSSION

The negative impact of presbyopia on vision functioning and quality of life has been demonstrated in the developed world.[6,11] Our results and those of a limited number of other studies[1,3] suggest that presbyopia exerts a similar impact in the rural developing world. Although some 70% of China's rural population is engaged principally in farming (statistic for 2000[12]), near tasks may play a prominent role in rural life. Patel and West[13] provide a list of common near tasks for rural Tanzania, several of which are likely to be relevant in rural northern China, including activities associated with farming (sorting rice) and childcare (dressing children). Our finding of a significant impact of presbyopia on self-rated overall eyesight (near and distance) is also consistent with vision-related quality of life having improved significantly with provision of presbyopic spectacles in Tanzania.[14]

We found presbyopia-related limitations in activities of daily living to be associated with broader social impairment such as a diminished sense of accomplishment. This is consistent with reports of restriction in household activities, social interaction, work, and leisure time pursuits among persons with visual impairment.[15] Likewise, our finding (in the univariate analysis) that presbyopic subjects were more likely to feel ashamed and embarrassed by their vision deficit is consistent with reports that vision-specific distress is highly prevalent among vision-impaired adults.[16] Although the specific impact of near-vision disability on social functioning has not been widely examined, it has recently been reported that both distance and near-vision impairment (<N8) are independently associated with poorer

TABLE 5. Impact of Presbyopia on Functional Independence and Social Functioning, Based on Questions in the Near Vision–Related Quality of Life Questionnaire[3]

Domain	No Presbyopia *n* = 236*	Presbyopia *n* = 535†	Unadjusted *P*	Adjusted *P*‡
Functional Dependence				
Require help from others due to vision	14 (5.93)	65 (12.15)	0.011	0.15
Social Functioning				
Report diminished accomplishment due to vision	10 (4.24)	80 (14.95)	<0.0001	0.01
Report feeling ashamed or embarrassed due to vision	6 (2.54)	46 (8.60)	0.008	0.12

Presbyopic correction was worn by 60.8 of persons with presbyopia. Data are the number of subjects (percentage of total group).

* Two subjects were missing data.

† Three subjects were missing data.

‡ Adjusted for age, sex, education, and distance vision.

quality of life on various subscales of the Nursing Home Vision-Targeted Health-Related Quality of Life questionnaire.[17]

In addition to presbyopia, other determinants of self-reported difficulty with near-vision tasks were older age, female sex, and less education. The finding on age is consistent with reports from Tanzania, whereas that on education contradicts the Tanzanian results.[3] A potential explanation of our finding may be that higher education levels have been associated with higher prevalence of myopia in adults.[18] It is possible that uncorrected, mild myopia leads to better visual functioning at near among more educated persons at the same degree of presbyopia. As we did not measure refractive error, we are not able to explore this hypothesis, although our finding that reduced distance vision was protective against poor near-vision function (Table 4) is consistent with this. The possibility cannot be excluded that education mediates improved near-vision function through other pathway. Higher educational attainment has been associated independently with better visual functioning in other population-based studies of Asian adults.[18] Alternatively, those with higher educational attainment may have been better able to afford appropriate correction.

Our results indicate that 75% to 90% of adults with presbyopic correction in rural China obtained them in settings such as markets where they were unlikely to receive vision care. This represents a substantial lost opportunity to screen a population known to have a significant burden of untreated eye disease.[19] Common sources for presbyopic correction differ significantly in neighboring India, where 93% of persons with reading glasses reported having obtained them from an ophthalmologist in a mixed urban–rural population.[1] Although the proportion of presbyopic persons with correction (30% in the Indian study, 51% in our cohort[20]) and urban–rural mix differed between these two populations, it appears likely that there are real differences in the source of presbyopic correction between these settings.

Our Rasch analysis suggests that near-vision function on the Near Vision Quality of Life Form may be measured more accurately, at least in this population, by reducing the number of items from eight to three. In addition to improving the validity of the form, this revision would also present a significant time savings.

In view of the significant burden of difficulty with activities of daily living and social impairment associated with presbyopia in this and other settings and the fact that 40% of presbyopic persons were without correction in this cohort, there is a need for programs to remediate the problem. The nature of these programs will depend on local barriers to acquisition of presbyopic correction. Patel and West[13] identified lack of knowledge about correcting near vision as a critical factor, whereas financial barriers and lack of demand appeared to be most important in Zanzibar.[14] In our cohort, concerns about poor quality of available correction (33%) and lack of awareness (29%) were the main barriers to the purchase of near-vision glasses.[20] Provision of low-cost, high-quality reading glasses, together with education about their use, during existing outreach programs for cataract screening[14] may be a solution. This effort would also address the lost vision screening opportunities noted above with current sourcing of presbyopic spectacles in nonmedical settings in rural China. Such programs might be sustainable through cost recovery. A willingness to pay modest amounts for reading glasses has been demonstrated in some settings, including Tanzania,[13] Zanzibar,[14] and Timor-Leste.[9] Although compliance with distance glasses may be poor among school-age children,[21] usage and retention of reading glasses among presbyopic adults appears to be quite good: 94% of participants retained their glasses at 1-year follow-up in Zanzibar[14] and 92% in Tanzania.[13] In rural southern China, near-vision glasses were the most common form of correction (owned by 42% of subjects, versus 6% for distance glasses) and also the most likely to be worn regularly (70% of users) in an older population.[22] The efficacy of this simple intervention against presbyopia-related loss of quality of life has been well demonstrated. Persons with spectacle-corrected presbyopia report mean utility values of 0.980, nearly indistinguishable from normal, and only 10% of respondents had presbyopia-associated utility of 0.95 or less.[23]

There were some limitations to the present study. Respondents to the questionnaires were more likely to be women, a potential source of bias. We relied on self-report from subjects and family members about the use of presbyopic spectacles. As this could not be confirmed by other means, we cannot exclude the possibility that attribution of spectacle use was inaccurate in some cases. Our use of the cutoff of 20/50 (N8) to define functional presbyopia, as suggested by the WHO and IAPB (International Agency for the Prevention of Blindness), did not allow us to estimate the prevalence of milder degrees of near-vision disability. Although an earlier version of the questionnaire for visual functioning with identical scoring system used in the present study has been validated with Rasch analysis,[3] we did not independently revalidate the questionnaire.

Our examination without dilation of the pupil may not have identified some subjects with ocular pathology. However, since persons with distance vision <20/63 in one or both eyes were excluded from testing for presbyopia and our definition of presbyopia required bilateral impaired near vision, we believe incorrect attribution of presbyopia on this basis was uncommon. Finally, we did not perform distance refraction on our subjects and are thus unable to assess the impact of refractive error on presbyopia, potentially an important factor due to the high local prevalence of adult myopia.[24]

Despite these limitations, these data provide previously unavailable information on the significant impact of presbyopia on visual functioning and quality of life in rural Asia and may provide the impetus for additional programs to redress this highly prevalent problem.

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References

1. Nirmalan PK, Krishnaiah S, Shamanna BR, Rao GN, Thomas R. A population based assessment of presbyopia in the state of Andhra Pradesh, south India: the Andhra Pradesh Eye Disease Study. *Invest Ophthalmol Vis Sci.* 2006;47(6):2324–2328.
2. Duarte WR, Barros AJD, Dias-da-Costa JS, Cattan JM. Prevalence of near-vision deficiency and related factors: a population-based study in Brazil (in Portuguese). *Cad Saude Publica*. 2003;19:551–559.
3. Patel I, Munoz B, Burke AG, et al. Impact of presbyopia on quality of life in a rural African setting. *Ophthalmology.* 2006;113(5):728–734.
4. Chiroma R. *Prevalence of Presbyopia and the Impact of Uncorrected Presbyopia on the Quality of Life in Rural Gwagwalada, Abuja Nigeria*. MSc Dissertation. Presented in Department of Health and Functional Capacity, National Public Health Institute, Hensinki, Finland. Community Eye Health dissertation, 2008.
5. Laveira H. *Prevalence of Presbyopia and Feasibility of Community Distribution of Near Spectacles in Adults in Zanzibar, East Africa*. Presented in International Centre for Eyecare Education, Kensington NSW, Australia. MSc Dissertation. Community Eye Health dissertation, 2007.
6. Laitinen A, Koskinen S, Harkanen T, Reunanen A, Laatikainen L, Aromaa A. A nationwide population-based survey on visual acuity,

near vision, and self reported visual function in the adult population in Finland. *Ophthalmology.* 2005;112(12):2227–2237.

7. Tahhan N, Fricke TR, Naduvilath T, et al. Uncorrected refractive error in the northern and eastern provinces of Sri Lanka. *Clin Exp Optom.* 2009;92(2):119–125.
8. Burke AG, Patel I, Munoz B, et al. Population-based study of presbyopia in rural Tanzania. *Ophthalmology.* 2006;113(5):723–727.
9. Ramke J, du Toit R, Palagyi A, Brian G, Naduvilath T. Correction of refractive error and presbyopia in Timor-Leste. *Br J Ophthalmol.* 2007;91:860–866.
10. WHO. *Spectacle and Work Productivity Questionnaire*. Available at http://www.vision2020.org/documents/Committee%20documents/Refractive%20Error/REPComStrategy.doc. Accessed July 2, 2010.
11. McDonnell PJ, Lee P, Spritzer K, et al. Associations of presbyopia with vision-targeted health-related quality of life. *Arch Ophthalmol.* 2003;121:1577–1581.
12. McGuire W, Fleisher B, Sheldon I. Off-farm employment opportunities and educational attainment in rural China. *China's Agricultural Trade: Issues and Prospects.* 2010:224. Available at ageconsearch.umn.edu/bitstream/55029/2/McGuire%20Chapter%2011.pdf. Accessed on July 2, 2010.
13. Patel I, West SK. Presbyopia: prevalence, impact, and interventions. *Community Eye Health J.* 2007;20:40–41.
14. Laviers HR, Omar F, Jecha H, Kassim G, Gilbert C. Presbyopic spectacle coverage, willingness to pay for near correction, and the impact of correcting uncorrected presbyopia in adults in Zanzibar, East Africa. *Invest Ophthalmol Vis Sci.* 2010;51:1234–1241.
15. Alma MA, van der Mei SF, Melis-Dankers BJ, van Tilburg TG, Groothoff JW, Suurmeijer TP. Participation of the elderly after vision loss. *Disabil Rehabil.* 2011;33:63–72.
16. Rees G, Tee HW, Marella M, Fenwick E, Dirani M, Lamoureux EL. Vision-specific distress and depressive symptoms in people with vision impairment. *Invest Ophthalmol Vis Sci.* 2010;51:2891–2896.
17. Lamoureux EL, Fenwick E, Moore K, Klaic M, Borschmann K, Hill K. Impact of the severity of distance and near-vision impairment on depression and vision-specific quality of life in older people living in residential care. *Invest Ophthalmol Vis Sci.* 2009;50:4103–4109.
18. Lamoureux EL, Saw SM, Thumboo J, et al. The impact of corrected and uncorrected refractive error on visual functioning: the Singapore Malay Eye Study. *Invest Ophthalmol Vis Sci.* 2009;50:2614–2620.
19. Zhao J, Ellwein LB, Cui H, et al. Prevalence of vision impairment in older adults in rural China: the China Nine-Province Survey. *Ophthalmology.* 2010;117:409–416.
20. Lu Q, He W, Murthy GVS, et al. Presbyopia and near vision impairment in rural Northern China. *Invest Ophthalmol Vis Sci.* 2011;52:2300–2305.
21. Castanon Holguin AM, Congdon N, Patel N, et al. Factors associated with spectacle-wear compliance in school-aged Mexican children. *Invest Ophthalmol Vis Sci.* 2006;47:925–928.
22. Congdon NG, Rao SK, Zhao X, Wang W, Choi K, Lam DS. Visual function and postoperative care after cataract surgery in rural China: Study of Cataract Outcomes and Up-Take of Services (SCOUTS) in the Caring is Hip Project, Report 2. *Arch Ophthalmol.* 2007;125:1546–1552.
23. Luo BP, Brown GC, Luo SC, Brown MM. The quality of life associated with presbyopia. *Am J Ophthalmol.* 2008;145:618–622.
24. Liang YB, Wong TY, Sun LP, et al. Refractive errors in a rural Chinese adult population: The Handan Eye Study. *Ophthalmology.* 2009;116:2119–2127.