Impact of Presbyopia on Quality of Life In India (Rural Sitting)

Mr. Satyendra Singh Sachan
Assistant Professor
Rama University, Kanpur

Abstract-
Purpose: *To determine the impact of uncorrected presbyopia on quality of life in rural Kanpur area*
Design: *Cross-sectional study.*
Participants: *Population-based sample of 1709 village and town-dwelling adults aged 40 and older in the Kanpur district in rural U.P.*
Methods: *Subjects underwent distance and near visual acuity testing to determine presbyopia. A near vision–related quality of life questionnaire was administered by trained interviewers to determine the degree of self-rated difficulty with tasks appropriate to life in a rural UP setting, and how much near vision loss contributed to this difficulty.*
Main Outcome Measures: *Near vision–related quality of life.*
Results: Complete data were available for 1564 (92%) of the subjects. The prevalence rate of presbyopia was 62%. The majority of presbyopes (94%) did not have corrective near vision glasses. Compared with nonpresbyopic, being presbyopic increased the odds of reporting some difficulty with near vision tasks by 2-fold (odds ratio [OR], 2.04; 95% confidence interval [CI]: 1.57–2.66), odds of reporting moderate difficulty by 5-fold (OR 5.01; 95% CI: 3.19 –7.89), and odds of reporting high difficulty by >8-fold (OR 8.52; 95% CI 3.13–23.10). The degree of presbyopia was associated with increasing difficulty with daily tasks (P<0.0001).
Conclusions: *This is the first study to demonstrate that uncorrected presbyopia has a significant impact on vision-related quality of life in a rural indian setting. The high prevalence of presbyopia, and increased aging of the population in developing countries, suggests that the World Health Organization's Vision 2020 refraction agenda should place greater emphasis on presbyopia.*

I. INTRODUCTION

Presbyopia is the age-related loss of accommodation,[1] ren- dering the need for optical correction to maintain clear near vision. Presbyopia is believed to have functional conse- quences primarily for those who use their near vision for reading and writing. Hence, little attention has been paid to presbyopia in the developing world where literacy rates are low. This view is evident by the World Health Organization, whose Vision 2020 refraction agenda places little emphasis on presbyopia. However, this nation has no scientific basis; anecdotal evidence suggests a need for good near vision even among those who are in the rural developing world who may need adequate near vision for many of the tasks they carry out in the course of their daily lives.

There is only one study (an educated sample in the United States) that has found an impact of presbyopia on health-related quality of life. The outcome measure used in that study would not be transferable to a rural India setting. In the developing world, research has focused al- most exclusively on distance, rather than near, visual acuity loss. Although there are reports of presbyopia as a prob- lem in the developing world, there is no quantification of the impact. Only one study from Singapore looked at the pro- portion of presbyopes who required the use of near vision in carrying out their daily activities. Hence, little is known about the need for near vision and the impact of presbyopia on quality of life in the developing world.

The current study is the first population-based investiga- tion of presbyopia in rural UP, with the aim of deter- mining the prevalence of presbyopia and the impact of uncorrected presbyopia on vision-targeted quality of life in this setting. In this article, we describe our near vision– related quality of life instrument targeted to adults with presbyopia and assess its association with presbyopia.

II. SUBJECTS AND METHODS

StudyPopulation

The UP Near Vision Impairment Project is a cross-sectionalpopulation-based study of village and town-dwelling adults aged 40 and older in the Kanpur district of rural U.P,North India.

Villages are populated by subsistence farmers and served by the small town of Kanpur, which is home to small shopkeepers and market-sellers. Glasses of some kind are not available in Rural Kanpur. Three villages from the district and 4 sectors of the Kanpur town were randomly selected for

participation. A house-to-house census in the study villages and town sectors was conducted, and an initial sample of 2040 people age 40 and older from these selected areas were identified. Subjects were excluded from the study if their presenting distance visual acuity was worse than 20/200, best-corrected distance visual acuity was 20/80 or worse, or if they had known ocular pathology that would confound near visual acuity testing. Visual acuity of 20/80 or worse was chosen because corrected distance acuity at this level was sufficiently impaired as to preclude assessment of near vision and properly assign loss to presbyopia.

Subjects were administered a near vision–related quality of life questionnaire and underwent vision test.

VisionTests

We measured presenting distance and near visual acuity. A complete description of the methods is given elsewhere. In brief, distance vision was measured binocularly using a tumbling Early Treatment Diabetic Retinopathy Study chart (Illiterate Early Treatment Diabetic Retinopathy Study chart; Lighthouse, New York, NY) in the prevailing outdoor illumination with the subject's current corrective lens, if any, in situ. The 20/20 line constituted the desired end point for distance vision testing and refraction. Subjects with presenting acuity worse than 20/20 underwent distance refraction using a trial lens set with the addition of spherical lenses until the end point was reached or there was no further improvement with additional lenses. Astigmatism was not corrected due to time constraints.

With the distance refraction in the trial frame, the patient was asked to read our near vision E chart held at eye level and 40 cm from the eyes in ambient outdoor illumination. Pairs of plus lenses were then introduced into the trial frame to facilitate clear vision of the N8 optotype (1 M or 20/50 Snellen acuity), the end point of near vision testing. The positive binocular addition of least magnitude that subjectively improved near visual acuity at 40 cm was recorded as the subject's add and quantified their degree of presbyopia. We defined presbyopes after best spherical distance correction as those who required at least +1.0 diopter of add to improve near vision. Near vision glasses were provided to all individuals who needed them.

FunctionalPresbyopia

The majority of visually impaired subjects did not have glasses for distance and/or near vision. Therefore, those with near vision impairment may include, in addition to presbyopes, hyperopes, even though they may have some accommodation. Conversely, those without near vision impairment may include myopes with adequate near vision despite presbyopia, plus those without pres- byopia. Hence, we defined functional presbyopes as those subjects who needed plus lenses of at least 1.0 diopter to improve near vision in the individual's usual visual state. Figure 1 shows the composite of the functional and objective presbyopia groups. We used functional presbyopia to assess the impact on quality of life. We included those few who stated that they had glasses for near vision, as they did not present them at the time of testing and determination of actual use was uncertain..

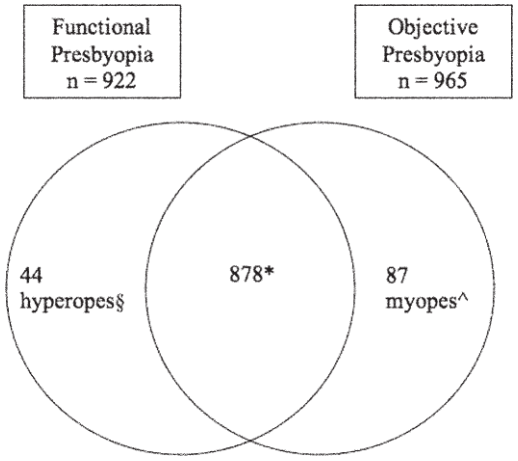

Figure 1. The relationship between objective and functional presbyopia. *Subjects who had objective and functional presbyopia. §Functionally presbyopic but with no presbyopia after distance correction (no objective presbyopia). ^Not functionally presbyopic but with presbyopia after distance correction (objective presbyopia).

Near Vision–Related Quality of Life Questionnaire

A questionnaire was asked of each participant that included the following areas: (1) degree of self-rated satisfaction with distance and near vision (rated on a scale of 1 to 5, with 1 being very satisfied and 5 being very dissatisfied); (2) degree of self-reported difficulty in carrying out daily tasks and how much near vision contributed to this difficulty (rated on a scale of 1 to 5, with 1 being no difficulty and 5 being completely unable to carry out the task); (3) self-rating of satisfaction with general health (rated on a scale of 1 to 5, with 1 being very satisfied and 5 being very dissatisfied); (4) 2 questions on social functioning as follows: how often in the past month the participant had problems with family relationships, and how often in the past month the participant felt looked down upon (rated on a scale from 1 to 5, with 1 being not at all and 5 being all the time); and (5) 1 question on dependency by asking if the respondent required help from others in carrying out tasks due to vision problems (with the choice of a yes or no answer). Items for inclusion were

adapted from published questionnaires.14,15 For the task domain, that were felt to require near vision and that pertained to life in rural UP. The questionnaire was finalized after meetings with a series of focus groups, separately for men and women, in non-study villages to assess the inclusivity of tasks and comprehension of the questionnaire. The focus groups added some tasks to the initial list, but by the last group we had redundancy. These groups had demographic characteristics, socioeconomic status, and work patterns similar to residents in study villages. The questionnaire was then piloted for time of administration. Inter-interviewer reliability was part of the training, and all interviews were conducted in the local language. The tasks included the items shown in Table 1.

The questionnaire was constructed so that if a subject indicated that performance of a task was made, then the interviewer queried the level of difficulty that the subject had in carrying out that task. For example, one question asked, "How much difficulty do you have threading a needle?" If the respondent did not do the activity, but not because of vision problems, then the score was zero. This was followed by an inquiry about the degree to which the difficulty was specifically due to problems with near vision. In our example,

Table 1.Proportion of Sample Reporting Engaging in, and Difficulty with, Each Task in Near Vision–Related Difficulty Questionnaire

	Engaging in Activity				Reporting Difficulty with Activity			
	Males		*Females*		*Males*		*Females*	
Activity	*N**	*%*	*N**	*%*	*N†*	*%*	*N†*	*%*
Reading	706	66.0	924	35.8	466	60.1	331	62.8
Writing letters	703	55.5	921	25.5	390	37.7	235	51.5
Writing numbers	704	44.3	921	18.0	312	29.2	166	33.7
Cooking food	710	38.3	917	97.2	272	29.3	891	34.4
Winnowing grain	707	2.7	911	82.3	19	31.6	750	38.5
Sorting rice or grain	706	11.0	901	80.7	78	20.5	727	30.5
Threading a needle	700	56.4	909	56.0	395	43.5	509	51.1
Weeding	708	93.8	919	93.1	664	46.8	856	49.2
Harvesting sorghum	704	73.3	918	72.7	516	49.6	667	53.5
Cutting fingernails and toenails	713	98.0	926	96.3	699	11.6	892	17.2
Dressing children	706	43.5	922	56.5	307	2.0	521	8.1
Lighting and adjusting a lamp	711	95.4	921	96.0	678	2.8	884	4.4
Recognizing faces of people standing near	714	96.4	924	99.2	689	3.1	917	3.9

*Total answering the question.
†Total reporting engaging in the activity.

the question was asked, "How much does your near vision con- tribute to difficulty threading a needle?" Again, the possible an- swer ranged along a 5-point scale from no contribution to contrib- utes completely. As has been found with other vision questionnaires,16,17 a very small proportion of the sample an- swered that they were completely unable to do an activity or that vision contributed completely to the difficulty with a task. There- fore, we combined the worst 2 categories with scores of 4 and 5 on each of these scales.

Statistical Analysis

Near Vision–Related Difficulty Score. The criteria for inclusion of tasks in the summary score were that more than 25% of the sample reported doing the task and more than 1% had difficulty with it. On these grounds, 7 of the original tasks were not included when creating the scale.

Item-specific near vision–related difficulty (NVRD) scores were created by multiplying the degree of difficulty and degree of near vision contribution for each activity. Using this strategy, NVRD scores were generated for each task in which a subject was engaged. If the subject reported no difficulty for a given activity, or if the difficulty was not due to near vision, the item-specific NVRD score was recoded to no near vision–related difficulty. An overall NVRD score was derived by adding up the item-specific NVRD scores.

We rescaled the summary score so that it ranged from a low of zero (representing extreme near vision–related difficulty on all items) to 90 (representing no near-vision related difficulty). If the subjects responded that they did not engage in a given activity, then that item was not included in formulating the summary NVRD score.

Pearson correlation coefficients were calculated to determine the degree of convergence between items. Relationships between items were fair, with few coefficients exceeding 0.6. Those with higher correlations were intuitively reasonable, (e.g., difficulty reading and writing, or difficulty reading and threading a needle). Cronbach's alpha coefficient was calculated to assess the internal consistency of the task items. Cronbach's alpha coefficient for item-overall score associations was 0.83, suggesting that it was a reliable measure of the latent construct. The influence of individual items was examined by calculating Cronbach's alpha coefficient excluding one item at a time. No single item weighed heavily on the score (range, 0.78 – 0.83). Rasch analyses of these items sup- ported our hypothesis that the items were measuring one construct, and that the summary score could be used as an indicator of subject ability.[18]

The distribution of the NVRD scores was skewed, with 43% reporting no difficulty on any items. Therefore, 4 difficulty groups were created: (1) no difficulty (score = 90); (2) some difficulty (score, 70 – 89); (3) moderate difficulty (score, 50 – 69); and (4) high difficulty (score <50). We divided the scores so that they translated into meaningful packets of near vision–related difficulty. For example, those in the some difficulty group could have a little difficulty on each activity they did with a lot of it due to near vision, or a lot of difficulty on 3 items with most of it due to near vision. Face validity for our questionnaire and the difficulty groups are shown by the significant relationships with self-report of near

vision problems and dissatisfaction with ability to do near work (Table 2).

Other Variables

Education was divided into 3 categories: (1) none, (2) some primary (no secondary), and (3) at least some secondary. For the multivariate model, the first 2 categories were combined.

Polytomous logistic regression models were used to assess the association of the task difficulty scale with presbyopia. Initially, univariate analyses were carried out to evaluate the independent association of demographic factors, level of education, general health, and social functioning, with the NVRD score to identify potential confounders. All covariates, except age, were modeled as categorical variables.

To account for any variance in the NVRD score due to distance vision loss, we constructed 4 groups, reflecting types of vision loss: (1) no functional presbyopia or uncorrected distance visual acuity loss (n = 552), (2) uncorrected distance visual acuity loss alone (n = 90), (3) functional presbyopia without distance acuity

Table 2. Relationship of Near Vision–Related Difficulty Groups with Self-Reported Near Vision Satisfaction

		NearVisionSelf-ReportedSatisfaction		
NearVision-RelatedDifficulty Group	N	%ReportingProblemswithNearVision	%NotSatisfiedwithNearVision	%NotSatisfiedwithAbilitytoDoNearWork
Nodifficulty	664	37.5	29.5	34.2
Somedifficulty	595	81.0	68.1	69.9
Moderatedifficulty	230	93.9	89.6	89.1
Highdifficulty	66	95.5	97.0	93.9
Total	1555*	65.0	56.0	58.5
Testfortrend,Pvalue		<0.0001	<0.0001	<0.0001

*Nine respondents with missing values in the near vision self-reported satisfaction questions were excluded from this table.

loss (n = 836), and (4) functional presbyopia with distance acuityloss (n = 86). Distance visual acuity loss was defined as having uncorrected visual acuity worse than 20/40. We checked the model for fit using the method prescribed by Hosmer and Lemeshow.[19]The chi-square analysis was performed to assess the associationbetween the degree of presbyopia and the NVRD groups. Stata(version 7.0; Stata Corp., College Station, TX) was used to carryouttheanalyses.

III. RESULTS

Of the initial sample of 2040 subjects identified, 1709 subjects(84%) participated. The reasons for nonparticipation were beingout of village/town (n = 186; 9.1%), refusal (n = 97; 4.8%), orillness (n = 4; 0.2%), and the balance could not be found between the time of the census and the survey itself (n= 44;2.2%). Nonparticipants belonged to the youngest or oldest age group and

Table 3. Characteristics of the Sample

N=1564	N	%
Age(yrs)		
40–44	368	23.5
45–49	288	18.4
50–54	301	19.2
55–59	164	10.5
60–64	179	11.4
65+	264	17.0
Gender		
Female	874	55.9
Male	690	44.1
Tribe		
Mgogo	698	44.6
Mkaguru	523	33.4
Other	343	22.0
Residency		
Village	783	50.1
Town	781	49.9
Educationlevel		
None	777	49.7
Someprimary	651	41.6
Somesecondary	129	8.3
Missing	7	0.4
Visiongroup		
Nofunctionalpresbyopia,nodistancevisionloss	552	35.3
Nofunctionalpresbyopia,distancevisionloss	90	5.8
Functionalpresbyopia,nodistancevisionloss	836	53.4
Functionalpresbyopia,distancevisionloss	86	5.5

were more likely to be villagers.[12] Among the enrolled, 120 were excluded by our exclusion criteria. A further 25 subjects had incomplete vision testing and/or questionnaire information. Thus, complete data were available for 1564 subjects (92%) who did participate.

The average age of participants was 53.4 years, with a range of 40 to 91 years (Table 3). Slightly more than half the participants were female, and Few had any secondary education. Results of near vision testing have been previously reported.12 Briefly, almost 62% of subjects were presbyopic and the prevalence increased with age, female gender, higher educational level, and town residence.

The proportion of subjects engaging in each activity that was part of the NVRD score varied by gender (Table 1). For each activity, a significant proportion reported difficulty as well, with the lowest being the males, who had reported difficulty dressing children (2%).

Presbyopes reported almost twice the rates of dependency due to vision, which was age and gender adjusted (P<0.001; Table 4). There were no significant differences between the proportions of presbyopes and nonpresbyopic that reported problems and dissatisfaction with distance vision. Nor were there differences between

	Presbyopia		Nonpresbyopic		
Domain(N=1564)	Males†	Females†	Males†	Females†	Value*
Distancevision					
%Reportingproblems withvision	7.5	13.1	7.7	8.2	0.42
%Notsatisfiedwith Vision	13.3	17.1	12.2	11.9	0.34
Functionaldependence					
%Reportingrequiring helpfromothersdue tovision	61.1	65.1	32.3	40.4	<0.0001
Generalhealth					
%Notsatisfiedwith healthinlastmonth	20.0	29.8	24.0	28.0	0.14
Socialfunctioning					
%Reportingproblems withrelationships	11.0	15.1	8.7	10.7	0.31
%Reporting havingfelt lookeddownupon	32.1	36.6	30.2	37.3	0.41

*Age-genderadjusted.

Table5.Associations of Vision Groups withNear Vision–Related Difficulty Groups

	NearVision-RelatedDifficultyGroup									
	No Difficulty		Some Difficulty		Moderate Difficulty		High Difficulty		Total	
N=1564	n	%	n	%	n	%	n	%	n	%
Nofunctionalpresbyopia andnodistancevisual acuityloss*	339	61.4	173	31.4	34	6.2	6	1.1	552	100
Nofunctionalpresbyopia; distancevisualacuity lossonly*	37	41.1	31	34.4	16	17.8	6	6.7	90	100
Functionalpresbyopiaand nodistancevisual acuityloss*	265	31.7	368	44.0	165	19.7	38	4.5	836	100
Functionalpresbyopiaand distancevisualacuityl oss*	25	29.0	28	32.6	17	19.8	16	18.6	86	100

*Visualacuitylossdefinedaspresentingacuityworsethan20/40.

the 2 groups in general health or social functioning. However, inall domains, females were more likely to report being unsatisfied as compared with males.

The relationship between reported difficulty with tasks (NVRDgroups) and the vision groups is shown in Table 5. Those with nofunctional presbyopia and no distance acuity loss were most likely to report no difficulty (61%),followed by those with no distance increased, subjects were more likely to be in the high difficulty group (*P*<0.0001; Table 7). With +2 diopters or more of add,70% to 80% of people reported some level of difficulty, with 6% to 13% of them reporting high difficulty.

IV. DISCUSSION

acuity loss (41%). Those with both functional presbyopia and distance acuity loss were most likely to be in the high difficulty group (19%; P<0.001). Overall, about 70% of those who had any degree of functional presbyopia reported some level of near vision–related difficulty.

Adjusting for other factors, being presbyopic significantly in- creased the odds of reporting some difficulty with near vision tasks by more than 2-fold, and by 5-fold for moderate difficulty, and more than 8-fold for high difficulty (Table 6). Age, level of education, social functioning, and place of residence were all significantly associated with reporting difficulty with near vision tasks. Although the odds of being female in each group were higher, it was only significant for the group with some difficulty. Distance visual acuity loss was not significantly associated with any of the difficulty groups for near vision tasks.

As the add requirement, or degree, of functional presbyopia This study demonstrates that presbyopia is not only common in rural UP, but it also has a substantial impact on activities of daily life in this setting. This association was strengthened by the finding that with increasing degree of presbyopia, subjects were more likely to fall into the group reporting the most difficulty, suggesting a dose-response relationship.

An association was also found in the United States sample reported by McDonnell et al.2 They compared older with younger emmetropic subjects, using age as a surrogate for presbyopia. However, their study only included subjects who had presented with near acuity of 20/32 or better in the worst eye, which effectively excluded those with severe

Table 6. Polytomous Logistic Regression Model of Near Vision–Related Difficulty Groups

	SomeDifficulty*		Moderate Difficulty*		HighDifficulty*	
Variable	OR	95% CI	OR	95% CI	OR	95% CI
Presbyopia	2.04	1.57–2.66	5.01	3.19–7.89	8.52	3.13–23.10
Distancevisualacuityloss†	0.90	0.54–1.49	2.02	0.97–4.22	2.89	0.77–10.80
Age(per5yrs)	1.14	1.07–1.22	1.12	1.02–1.22	1.30	1.13–1.48
Gender(female vs. male)	1.45	1.12–1.87	1.33	0.92–1.91	1.20	0.65–2.21
Education(somesecondaryvs. none/someprimary)	1.93	1.54–2.43	2.15	1.57–2.93	2.71	1.64–4.46
Socialfunctioning(perunitdecreaseinf unction)	1.50	1.32–1.70	2.13	1.82–2.48	2.75	2.22–3.39
Residence(townvs.village)	1.92	1.48–2.50	2.69	1.82–3.96	2.89	1.46–5.70

CI=confidenceinterval;OR=oddsratio.
*Comparisongroupisthegroupthatreportednodifficulty.
†Visualacuitylossdefinedaspresentingacuityworsethan20/40.

Table 7. Distribution of Near Vision–Related Difficulty Groups by Add Required

	AddRequired									
	0		*1*		*2*		*3*		*≥3*	
DifficultyGroup	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Nodifficulty	377	58.7	156	33.8	105	30.4	20	23.5	6	19.4
Somedifficulty	204	31.8	204	44.5	148	42.8	36	42.4	11	35.5
Moderatedifficulty	49	7.6	83	18.0	72	20.7	21	24.7	10	32.2
Highdifficulty	12	1.9	17	3.7	21	6.1	8	9.4	4	12.9
Total	642	100	460	100	346	100	85	100	31	100

Chi-squaretestfortrend=136.2;*P*<0.0001.

presbyopia. Hence, although an association of presbyopia with reduced quality of life was found, it was likely an underestimate. We cannot directly compare our findings with the United States study because of different methods of testing and different instruments being used for assessing outcomes. The National Eye Institute Visual Function Questionnaire instrument20 used by McDonnell et al2 included items not relevant for a developing country's rural setting.

Our questionnaire showed good internal consistency, and we demonstrated good face validity. Thus, for a developing country's rural setting, we feel our near vision–related difficulty questionnaire measured relevant tasks and captured the impact of presbyopia in this setting.

Other variables were also associated with difficulty in the near vision tasks. Increasing age and being female were associated with higher odds of reporting difficulty, independent of presbyopia. As females and older persons have more presbyopia and more severe presbyopia, this association could reflect residual confounding. Other psychometric analyses of vision-specific quality of life questionnaires have found similar relationships with demographic vari- ables.21 Distance vision loss alone was not significantly associated with reporting difficulty, suggesting our ques-tionnaire was able to specifically elicit near vision–related difficulty.

We chose to study presbyopia in the villages and town because they represent points along the economic development spectrum and may reflect differences in perceptions of the impact of presbyopia. In fact, those in town were more likely to be represented in the higher difficulty groups, independent of presbyopia, distant visual acuity loss, and education. This finding suggests that there may be differences in the impact of presbyopia on town residents, or in perceptions of difficulty between town and village people. This is a new finding, and we have only observations as to why the differences may exist. Town residents do have access to electricity, permitting near activities in the evening under lower light conditions. Thus, they may be reporting experiences that village residents do not encounter, because they typically do not carry out activities at night. The lamps in the villages are very low ember or oil lamps used for mobility. In addition, village residents may be less likely to have prolonged, high-concentration near vision tasks, such as bookkeeping, so perhaps some of the reporting reflects duration and intensity of the task.

Glasses coverage was very low in this population. How- ever, not everyone with presbyopia would necessarily benefit from near vision correction, as evidenced by the numbers who required add but were in the no difficulty group. About 70% reported some degree of difficulty and presume- ably would benefit from near vision correction. In 2002, there were about 5.5 million people older than 40 years of age in UP. Our prevalence figures suggest about 3 million functional presbyopes in this population, with ap- proximately 2.1 million pairs of glasses required to meet the needs of those who described loss of quality of life as a result of their presbyopia.

In summary, this is the first population-based study to document the impact on near vision–related quality of life with presbyopia in a rural UP setting. This is quite pertinent as developing countries are undergoing the demo- graphic transition to an aging population, leading to an increase in the number of people with presbyopia who will spend greater proportions of their lives being presbyopic. Furthermore, as additional transactions are done requiring reading materials, adults without good reading vision will be at an economic disadvantage. Finally, any attempts at promoting adult literacy in the developing world hinge on adults having better near vision to succeed. Addressing the near vision needs of developing world populations represents a simple means to improve the quality of life of the burgeoning presbyopic generations to come. Our findings provide evidence for greater emphasis on near vision in the World Health Organization's Vision 2020 refraction agenda.

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