The Impact of Presbyopia Correction on Near-Vision Related Quality of Life (N-VRQOL) in Rural Tanzania

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Abstract

Objective: To investigate the impact of presbyopia and its correction in rural Tanzania

Design: Interventional follow up study

Main Outcome Measures: Change in Near Vision Related Quality of Life (N-VRQoL).

Methods: the selection of the village was done at random from among a group of villages of appropriate size (those with approximately 150 people over 50 years old) currently being monitored by Kilimanjaro Centre for Community Ophthalmology (KCCO) for use of outreach. Near vision was tested and corrected to the nearest 1 diopter. All villagers 50 years old and above who require a simple near addition were dispensed free ready-made spectacles. Presbyopia was defined as at least 1 line of improvement on a near visual acuity chart with an addition of a plus lens for people with distance vision equal or better than 6/18. A near vision–related quality of life questionnaire (validated in other studies) was administered to determine the degree of self-rated difficulties with tasks appropriate to life in a rural setting, and how much near vision loss contributed to this difficulty.

Result: 175 participants were enrolled initially and 142 (81.14%) participated to the study. Once in the field an additional 32 (18.39%) non enrolled participants came. They were examined and raised the participant's number of 174 subjects. There were 70 (40.23%) men and 104 (59.77%) women. The age ranged from 50 to 90 years with a mean age of 64.5 years. Eighty-two (113) percent of subjects were presbyopes and the prevalence of presbyopia was significantly higher in literate (can read or write or both). There was no association between presbyopia and baseline N-VRQoL score. Spectacle coverage was 21%.

The follow up rate was 74.8%. Everyone showed significant change in near vision related quality of life. Near point of accommodation was a good predictor of how often spectacles were used and willingness to pay for spectacles.

Conclusions: We think that responses on the near-visual function quality of life tool may have been biased, However, other findings support the concept that presbyopic spectacle are valued and used by people who need them.

Keywords: Presbyopia; Visual Acuity; Participants; Quality of Life

Introduction

After 40 years old in most people, and by age 45 years old in virtually all, a clear, comfortable focus at a near distance becomes more difficult with eyes which see clearly (whether with or without glasses) at a far distance. This normal condition is known as "presbyopia," and it is due both to a lessening of flexibility of the crystalline lens and to a generalized weakening of the ciliary muscle which enable the

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lens to accommodate. Presbyopia, derived from the Greek word "presbys" meaning "old person," and describes the condition where the eye exhibits progressively a diminished ability to focus on near objects with age. This may happen to anyone at some point in life, even those who have never had a vision problem before.

By the time one reaches 60 years old or so, the crystalline lens is virtually incapable of changing its shape. Unless one is nearsighted, it is not possible to focus objects (such as print on a page) clearly at even an arm's length distance. People with presbyopia experience blurred vision, headaches and eye strain, at near points. The diagnosis is derived primarily from the history. The remaining near vision accommodation can be measured with various devices (e.g. the accommodometer) [1].

Presbyopia is believed to have functional consequences primarily for those who use their near vision for near tasks. Hence little attention has been paid to presbyopia in developing countries where literacy rate are low and it is not part of Vision 2020 agenda of WHO [2]. Yet, it may be a considerable source of day- to- day problem for people and have an impact on their quality of life, especially the near-vision related quality of life (N-VRQoL).

Near-vision-related quality of life (N-VRQoL) is the term used to describe the impact of vision impairment on various activities of daily living. Near vision related quality of life (N-VRQoL) describes the impact specifically on performing tasks that require near vision, such as reading or sewing.

In the developing world, research has focused almost exclusively on distance, rather than near, visual acuity. Although there are 2 studies which quantified the impact of presbyopia in quality of life in Africa none of them has measured this outcome after correction of the problem with spectacles.

Material and Methods

This is an interventional study in which the main outcome measure is the near-vision related quality of life. This is measured at baseline, and then we provided presbyopic spectacles and measured near-vision related quality of life improvement again three months later.

All villagers of 50 years old and above who are on the eligible list (created by village leader) were offered reading spectacles if they want them.

The village is selected at random from among a group of villages of appropriate size (those with approximately 150 people of 50 years old and above) currently being monitored by Kilimanjaro Center Community of Ophthalmology (KCCO) for use of Direct Referral Site (DRS) services. Using one of these villages allows us to take advantage of field visits which are already planned, and thus to save on costs. We included all people of 50 years and older in the village. We excluded all people presenting a far VA lower than 6/18 because this state can prevent proper near vision examination. Refraction was not done because of logistic problem. We excluded all people who have had previous eye surgery as this may affect their perceived ability to use their eyes. We excluded also anyone who refuses to participate to the study.

At baseline, we have got a list of all people in the village over 50 years old from the village leader (expecting about 100 - 150 people). We requested each of these people to come to the nearest central site for examination. At follow up (3 months later) we made home visits to see people about the uses of their spectacles and we asked the degree of satisfaction.

The hypothesis used to estimate sample size is: The proportion of presbyopes with improved quality of life (N-VRQoL) after near-vision spectacles provision will be at least 40% larger than the proportion of those without presbyopia correction.

Using the formula:

$$N = \frac{[Z_\alpha \sqrt{P(1-P)(1/q1+1/q2)} + Z_\beta \sqrt{p1(1-p1)(1/q) + p2(1-p2)(1/q2)}]^2}{(P1-P2)2}$$

q1= proportion of subjects in group 1

q2= proportion of subject in group 2

N= total number of subject

$P = q1P_1 + q2P_2$

Assuming that 80% of those with presbyopia will improve and that up to 40% of non presbyopes may improve (placebo effect of having spectacles). Using the sample size estimation table for dichomatous variable with 95% IC with one sided $\alpha = 0.05$ and $\beta = 0.2$ (designing clinical research 3rd Edition, table 6B1 sample size per group for comparing two proportion p86) we need at least 22 people in each group. We expect that only around 20% of those over age 50 in the village to be non presbyopes, so we need to examine at least 110 villagers to find 22 non presbyopes and 88 presbyopes people. We will increase this to 125 to allow for non-participation. The patients received enough information about this study and consent for enrollment in the study. Confidentiality of patients was respected. Patients diagnosed with another ocular problem which needed specific assistance were referred to Kilimanjaro Christian Medical College eye clinic for proper management. This article is submitted to the Research and Ethics Committee of the Tumaini University and was approved. Data collection was taken place in the village at different central site close to the participant's location. People on the eligible list who do not come were visited at their homes. Data was collected on a standard form (appendix 1) by one ophthalmologist which includes: age, sex, occupation, marital status, current use of specs and where they got them.

Clinical information's include: distance VA in each eye (with Pin-hole if < 6/18), near point measured in centimeter from the temporal arcade to the illiterate near vision N8 chart set at a comfortable distance for the patient, reason for vision < 6/18 (if applicable).

The questionnaire for quality of life (appendix 1, part D) is administered by a trained and experienced assistant included nine specifics N-VRQoL questions (reading, sewing, sorting grain, etc.) scaled from 1 to 5 according to their degree of satisfaction.

At follow up (three months after intervention), the eye examination was repeated and the same questionnaire used at baseline (appendix 2) was administered again. In addition, we asked about use of spectacles (how often), willingness to pay it current one is lost and where to get new ones.

Baseline data: one overall score of near vision related quality of life for each individual is obtained from the questionnaire. Means and standard deviations is tabulated for men and women separately and compared by t-test. A correlation coefficient is used to look for correlation between N-VRQoL and presbyopia.

Follow up data: we used paired t test to show N-VRQoL scores improvement between baselines and follow up score. Statistical software used was Stata 13.1 for data analysis.

Data collection

Baseline

Data collection was taken place in the village at different central site close to the participant's location. People on the eligible list who do not come were visited at their homes. Data was collected on a standard form by one resident in fourth year in master of medicine (ophthalmology) which includes:

- Age, sex, occupation, marital status
- Current use of spectacles and where they got them from
- Clinical information:
- Far VA in each eye (with Pin-hole if <6/18).
- Near VA measured in centimeter from the temporal arcade to the illiterate near vision N8 chart set at a comfortable distance for the patient.
- Power added in order to read N8 at 40 cm (Diopters) which is the cut off point according to WHO definition of presbyopia. Beyond this point the patient is define to have functional presbyopia.

- Reason for vision <6/18 (if applicable).

The questionnaire for quality of life is administered by a trained and experienced assistant in Kiswahili and included: Nine specifics N-VRQoL questions (reading, sewing, sorting grain, etc.) scaled from 1 to 5 according to there degree of satisfaction.

Follow up

- At follow up (three months after the prescription), the eye examination was repeated and the same questionnaire as was used at baseline (appendix 2) were administered again.
- In addition, we asked about use of spectacles (how often), willingness to pay if current one is lost and where to get new ones.

Data analysis

Baseline data

One overall score of near vision related quality of life for each individual is obtained from the questionnaire. Means and standard deviations is tabulated for men and women separately and compared by t-test. A correlation coefficient is used to look for correlation between N-VRQoL and presbyopia.

Follow up data

We used paired t test to show N-VRQoL scores improvement between baselines and follow up score.

Statistical program was Stata.

Result

Baseline finding

175 participants were enumerated initially and 142 (81.14%) participated in the study. Once in the field an additional 32 (18.39%) non enumerated participants came. They were examined and giving a total of participation of 174 subjects. They were 70 (40.23%) men and 104 (59.77%) women. The age ranged from 50 to 90 years with a mean age of 64.5 years.

Item	Male mean score (% of 70 males who answered questions)	Female mean score (% of 104 females who answered questions)	All mean score (% of 174 who answered question)
Cooking	1.9 (n = 23; 32.8%)	2.16 (n = 100; 96.1%)	2.11 (n = 123; 70.6%)
Stone	2.84 (n = 25; 35.7%)	3.19 (n = 99; 95.2%)	3.12 (n = 124; 72.9%)
Reading	3.23 (n = 65; 92.8%)	3.40 (n = 67; 64.4%)	3.32 (n = 132; 75.9%)
Sewing	3.12 (n = 64; 91.4%)	3.37 (n = 104; 100%)	3.28 (n = 168; 96.5%)
Finger nail	1.96 (n = 69; 98.5%)	2.40 (n = 101; 97.1%)	2.22 (n = 170; 97.7%)
Phone	2.28 (n = 36; 51.4%)	2.53 (n = 32; 30.7%)	2.40 (n = 68; 39%)
Thorn	3.15 (n = 65; 92.8%)	3.61 (n = 104; 100%)	3.44 (n = 169; 97.1%)
Lighting lamp	1.17 (n = 69; 98.5%)	1.21 (n = 102; 98%)	1.20 (n = 171; 98.2%)
Diff btw 2000/5000	1.37 (n = 70; 100%)	1.18 (n = 103; 99%)	1.26(n = 173; 99.4%)
Overall mean score for those who answered	2.33 (SD = 0.66)	2.56 (SD = 0.52)	2.48

Table 1: *Baseline visual function score (mean) for each near task by sex (number and % to whom question was applicable for each).*

P = 0.004 for difference in overall between males and female.

The mean score is higher (meaning a worse visual function) in women compare to men overall and for every individual task except for recognizing the 2000 and 5000 Tsh notes.

Spectacles ownership					
Variable	**Yes**	**No**	**Total**	**OR (95%IC)**	**P-value**
Gender					
Male	24 (42%)	33 (58%)	57 (100%)	2.36 [1.14, 4.89]	0.019
Female	20 (23.5%)	65 (76.5%)	85 (100%)		
Total	44 (31%)	98 (69%)	142 (100%)		
Age (means and SD)	63.25 (9.82)	64.92 (9.92)	64.46 (9.9)		0.84
Married					
Yes	34 (76.9%)	52 (23.1%)	86 (100%)	3.01 [1.34, 6.75]	
No	10 (17.9%)	46 (82.1%)	56 (100%)		0.006
Total	44 (31%)	98 (69%)	142 (100%)		
Literacy					
Yes	43 (41.7%)	60 (58.3%)	103 (100%)		< 0.001
No	1 (2.7%)	38 (97.3%)	39 (100%)	27.23 [3.6, 206.1]	
Total	44 (31%)	98 (69%)	142 (100%)		

Table 2: Characteristic of spectacles ownership for enumerated participants.

A presbyope is defined in a functional way simply by a participant who cannot read the N8 chart at a comfortable distance when his/her distance visual acuity is equal or better to 6/18. With this definition; 81.9% subjects were presbyopes and the prevalence of presbyopia was significantly higher in literate (can read, write or both); OR = 27.23 [3.6, 206.1]; p < 0.001. The prevalence of presbyopia increases with age in people from 50 to 59 years then decrease from 60 up to 90 years, so that the mean age of non presbyopes is actually higher than that of presbyopes.

Presbyopia				
Variable	**Yes**	**No**	**Total**	**P-value**
Sex				
M	44 (84.62%)	8 (15.38%)	52 (100%)	
F	69 (80.23%)	17 (19.77%)	86 (100%)	0.52
Total	113 (81.88%)	25 (18.12%)	138 (100%)	
Age				
Observation	113	25	138	
Mean (SD)	60.9 (8.6)	69.1 (9.3)	62.4 (9.2)	1.00
Literacy				
Yes	96 (88.07%)	13 (11.93%)	109 (100%)	
No	17 (58.62%)	12 (41.38 %)	29 (100%)	0.004
Total	113 (81.88%)	25 (18.12%)	138 (100%)	
Near point				
Observation	113	25	138	
Means	49 (SD=7.3)	32.7 (SD = 4.9)	46 (SD = 9.4)	< 0.001
Visual function pre-intervention				
Observation	113	25	138	
Means (SD)	2.4 (0.6)	2.5 (0.5)	2.4 (0.6)	0.20

Table 3: Associations with presbyopia.

There is a large difference between presbyopic near point (49 cm) compared to non presbyopic (32.2 cm) as expected; p < 001. However, the mean score on visual function for all presbyopes is not significantly different from the score of non presbyopes.

Spectacle coverage was calculated for those who come with their own spectacles for near vision (even if under corrected) divide by the number of presbyopes. Spectacle coverage was 21% (24/113).

Follow up finding

For logistic reasons we could only follow up people who were given spectacles. Therefore, we only followed up a subgroup of those who were presbyopes. We did not follow up anyone who was not presbyopes as we had expected to do (see sample size calculation) because of logistic difficulties.

	Successful follow up, n = 80	Unsuccessful follow up, n = 27	p-value
Sex			
M	24 (30%)	16 (59.26%)	
F	56 (70%)	11 (40.74%)	0.007
Age (mean- SD)	61.8 (8.5)	57.6 (6.3)	0.010
Enumerated			
Yes	68 (85%)	10 (37.04%)	0.014
No	12 (15%)	17 (62.96%)	
VF score baseline	2.4 (0.5)	2.4 (0.6)	0.511
Literacy			
Yes	64 (72.73%)	24 (27.27%)	0.296
No	16 (84.21%)	3 (15.79%)	
General satisfaction			
No trouble	1 (100%)	0 (0%)	
Little trouble	52 (72.22%)	20 (27.78%)	0.615
Severe trouble	27 (79.41%)	7 (20.59%)	

Table 4: Characteristic of participants we found for follow up.

We attempted to follow up all 107 participants who were given spectacles and we found 80 (74.8%) of them. Among 80 people we found for follow up interview, 62 (77.5%) were found at their house and 18 (22.50) found elsewhere. The proportion of non-enumerated participants that we could not successfully follow up is high (63%) than those enumerated (37%). They were 70% of women followed up successfully compared to only 30% of men.

VF pre-post	Male			Female		
	Baseline Mean/SD	F/ up Mean/SD	p-value	Baseline Mean/SD	F/ up Mean/SD	p-value
Cooking	1	1		2 (1)	1.3 (0.7)	0.00
Stone	2.6 (0.5)	1.3 (0.8)	002	3.3 (0.8)	1.3 (0.8)	0.00
Reading	2.9 (1)	1.1 (3)	0.00	3.5 (0.7)	1.2 (0.5)	0.00
Sewing	3 (1)	1.4 (1)	0.00	3.4 (0.7)	1.5 (1)	0.00
Finger nail	1.8 (1)	1.3 (0.9)	0.02	2.4 (1)	1.2 (0.6)	0.00
Phone	2.3 (1)	1.2 (0.8)	0.00	2.7 (1)	1.3 (0.8)	0.00
Thorn	3 (0.2)	1.5 (0.2)	0.00	3.6 (0.7)	1.7 (1)	0.00
Lighting lamp	1.3 (0.6)	1	0.00	1 (0.4)	1 (1)	0.05
Diff btw 2000/5000	1.2 (0.6)	1 (0.2)	0.16	1.1 (0.3)	1 (1.1)	0.09
Overall mean VF (for those answering both pre and post)	2.1 (0.5)	1.2 (0.4)	0.00	2.5 (0.5)	1.3 (0.4)	0.00

Table 5: Near VRQoL score improvement at follow up between men and women.

Change in vision function is the difference between vision function score at baseline and vision function score at follow up. Women showed larger changes in vision function than men for most tasks, although this was not always statistically significant. When overall change was compared, however, women had significant more improvement in the post intervention stage than men did.

Discussion

Baseline

This study was designed to determine whether correction of presbyopia by simple reading spectacles in a representative group of villagers over 50 years old would result in an improvement of their near visual acuity. In order to guarantee that we saw a representative group among which we decided to examine the entire group of villagers over 50 years old. We asked village's leaders to enumerate this group before we went to the village. They listed 175 people from whom we examined 142 (81%).

Once in the field an additional 32 non enumerated people came and were included in the study. The characteristics of enumerated and non-enumerated people were compared and showed a statistical difference only on spectacle ownership. The non-enumerated did not differ in any other way than the enumerated; they were not more likely to have poor far visual acuity, be presbyopes, have a different near VA, be literate, be given spectacles, be more dissatisfied with their vision, or have a different baseline vision function score.

The mean visual function score was significantly higher in women showing that women experience more difficulty compare to men. It is difficult to know how to interpret this in view of the potential bias in our baseline vision function scores and it is also possible that the visual function test is just more sensitive to pick up problems in tasks that are mostly done by women. However, a similar finding was reported by Patel., *et al.* in Tanzania (2006) and Sherwin., *et al.* in Kenya (2008) [2,3].

Female has 2.4 fold less chance to own spectacles than male which puts them at a disadvantage. Being literate is associated with owning spectacles by 27 fold. This finding may be related to the strong possibility that people who can read have higher education levels, more awareness of where to get spectacles and more income [4].

We found a high prevalence of presbyopia (82%) and we tested indoors with natural illumination from a window with N8 illiterate E-chart at a comfortable distance chosen by the participants. Similar high prevalence is found (82%) in Ghana [5]; (85%) in Kenya [3]; (89%) in Zanzibar [6] and 79% in Timor- Leste [7] but the parameter used to define presbyopia was not well defined in Ghana study. The lower prevalence, 61.7%, found in one Tanzania study [2] may be due to testing outdoors giving a good depth of focus. The lower prevalence (55%) in a South India population based on assessment of presbyopia [8] and that in Nigeria of 33% [9] included younger populations, 30 years and over for the former and 18 years and older for the latter.

The prevalence of presbyopia is not higher among women than men in our study. This is similar to presbyopia studies done in Zanzibar and Nakuru Kenya [3,6], but is in contrast to a study in Dodoma where women had more presbyopia than men [2]. There was an age dependant increase of presbyopia in the age group ranging from 50 to 59 years old then presbyopia decreased from 60 up to 90 years old. This may probably be related to nuclear lens sclerosis giving a myopic shift due to an advanced aging process. Nirmalan., *et al.* in India and Sherwin., *et al.* in Kenya have found similar result and the same explanation was given [3,8].

Spectacle coverage of 21% was found in our study. Laviers., *et al.* [6], Sherwin., *et al.* [3] and Nirmalan., *et al.* [8] documented similar findings of 26.2%, 6.3% and 30% respectively. Economic and demographic differences limit comparison of our finding with that of India. According to WHO recommendation spectacle coverage less than 33% indicate that provision should be a high priority [10].

The near point of accommodation for presbyopes is around 49 cm compared to non presbyopes at 32.2cm meaning that presbyopes have to hold things far away from them in order to see clearly and may have some times to ask help from others; thus they experienced some difficulties in activities related to near.

A major concern in this study is that no statistical difference was found between presbyopes and non presbyopes in visual function scores. Also, there was no association seen between near point and visual function score as would be expected. This finding might be

a result of bias in the baseline measurement of visual function. Participants may have noticed that spectacles will be given free and therefore many people might claimed difficulties with near visual tasks in order be given spectacles for free. Or perhaps the visual function questions do not really discriminate well between those who need presbyopic correction and those who do not. Also, the impact of the visual function seem to be not equal and put some of the participants in disadvantage. For instance, our examination was done indoor while some of the participants are doing their activities outdoor.

Follow up

The follow up rate overall in our study was 74.8%. A much higher rate of unsuccessful follow up was observed among non-enumerated. This was probably because non-enumerated may have come from outside the study area in order to get spectacles freely. However, follow up is always difficult in the field; Laviers., *et al.* [6] at Zanzibar documented 74.2% follow up in a house to house survey and attributed it to moving away or death among the subjects.

In our study only one person (1.3%) had lost his spectacle and 4 (5%) had them in bad condition. In Zanzibar study, 12 individuals (6.4%) no longer had their spectacles [3]. This indicates that spectacles for near vision were valued. Although only 33.75% are willing to pay 6.000Tsh to replace the spectacles in case the current ones are lost or damaged, the significant association between willingness to pay and near point indicates that those who need spectacles the most are most willing to pay. Willingness to pay is higher among men, although not statistically significant (p-value = 0.13). In Zanzibar study it is found that people were willing to pay a mean of only 3.14 USD for spectacles and being male was significantly associated with willingness to pay [6].

In our findings the most common activities individuals use spectacles for are reading (Bible, phone message, and writing). In rural setting people believe that spectacles are mainly for reading small print, for instance at church. In our study we explained to participants that spectacles can be used in any situation where near task requirement is needed. However, it is still noted that only 62% had used the spectacles in the previous day. Thus, presbyopes spectacles are not used on a daily basis by all. We also found that those who used spectacles most were those with the greatest near point indicating that need (measured by near point) does determine usage.

It is interesting that 88% of the presbyopes seen at follow up don't know where to get another pair of spectacles if their own become broken or lost. This suggests that a local shop selling spectacles is needed. The study in Dodoma [2] found that it is very difficult to obtain reading spectacles for persons in rural villages and small towns there. In southern India, Nirmalan., *et al.* [8] showed that a major proportion of people with presbyopia who had spectacles (93 per cent) had obtained their spectacle prescriptions from ophthalmologists, who work primarily in big cities.

A paired t-test was used to test for improvement in visual function score at follow up and it showed a significant improvement between baseline and follow up. However, again, it is difficult to know how to interpret this in view of the potential bias in the baseline findings. Follow up scores may also have been a biased by respondents wanted to demonstrate gratitude and please the interviewer. In Zanzibar study [6] the same high level of satisfaction was found. West., *et al.* [11] in Tanzania study in 2007 suggested that assessment and correction of presbyopia require modest expertise and can be undertaken independently of fixed optical services. Several foundations have demonstrated a sustainable model to distribute high-quality, low-cost reading spectacles in rural areas. These organizations train women to start their own small business to prescribe and dispense presbyopic spectacles at low prices. Such an approach can be an independent but integrated part of a comprehensive eye health solution, as it may be the first point of contact for those with other eye problems and could identify those in need of further eye care services [12-23].

Conclusion

In spite of limitations, this presbyopic follow up study has provided some important information. It shows that people in rural setting experience presbyopia, even when they are not literate. Although it is less clear exactly how much quantitative change may occur in their near related visual quality of life when we provide presbyopic spectacles (because of likely bias in the baseline measure) to them, there is evidence that it is improved. Frequency of use of spectacles was associated with near point. People appear to value the spectacles but don't know where to get them.

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