

M.M. Sinoo, J. van Hoof, F. van Dijken, H.S.M. Kort (2006) Design of a healthy living environment for older adults with low vision. In: E. de Oliveira Fernandes, M. Gameiro da Silva, J. Rosado Pinto (eds.) HB2006: Proceedings of the 8th International Conference Healthy Buildings, 4-8 juni, Lissabon, Portugal. Volume III, pp 279-282. ISBN 989-95067-1-0

Design of a Healthy Living Environment for Older Adults with Low Vision

M. M. Sinoo¹, J. van Hoof¹, F. van Dijken¹ and H.S.M. Kort¹

¹Hogeschool Utrecht, Chair of Demand Driven Care, Bolognalaan 101, 3584 CJ Utrecht, the Netherlands
E-mail: marianne.sinoo@hu.nl

Summary: Vision is an important sensory function. Eye problems and low vision are very common in the ageing population. Changes in vision function must be taken into account when considering activities of daily living, quality of life and the design of facilities for older persons. The design of the environment will ease the strain on the health care system and reduce the expenses if caretakers are aware of the design of the building. Creating a healthy environment for older persons with low vision involves improvement of lighting, controlling brightness, awareness of the use of colours, the arrangement of spaces and clear acoustics.

Keywords: Low vision, Lighting, Home modification
Category: Architecture for healthy environment

1 Introduction

Nearly 5% of the population in the Netherlands contends with visual impairments. In the USA and the Netherlands respectively, 26 and 36% of the nursing home residents are estimated to have visual impairments [1,2]. As the population aged 65 and over increases, the number of individuals suffering from visual impairments will increase dramatically. In the Netherlands it is expected that the number of older adults with vision impairments will be doubled by 2020 compared to the year 2000 [2]. Visual impairments can be a result of the normal ageing process or diseases, such as diabetes.

Low vision can be improved or enhanced through (i) vision devices e.g. corrective lenses, (ii) assistive technology, and (iii) the design of a supportive and healthy living environment.

In this paper the importance of a healthy living environment for people with low vision and design principles will be addressed.

2 Causes of vision impairment

A major part of blindness and visual impairment in the Western World is caused by four ophthalmologic disorders: age related macula degeneration, cataract, glaucoma and diabetic retinopathy (fig. 1).

Macular degeneration may be of two types; a dry type due to atrophy of the light-sensitive cells in the macula area, and a wet type in which an increasing number of new blood vessels develop underneath the retina. As a result the retina may break down with haemorrhage and destruction. This especially occurs in the area of the macula, and results in a loss of visual acuity and contrast sensitivity [3].

Cataracts are the result of changes of the protein structure of the lens due to progressive thickening and

opacification. For a person with cataract this results in increased sensitivity to glare, loss of contrast and visual acuity and a diminished visual field [4].

Glaucoma can be defined as a progressive optic neuropathy with a particular pattern of optic nerve damage and visual field loss that results from a variety of diseases affecting the eye. A major problem for glaucoma patients is the peripheral field loss. In daily life this results in higher risks for falling and bumping into objects that are outside the field of view [5].

Retinopathy due to diabetes mellitus results in new vessel formation and intra retinal haemorrhage influencing the macula. These changes may cause retinal and visual damage experienced as scattered field loss, decreased visual acuity, increased sensitivity to glare and loss of colour and visual acuity [6].

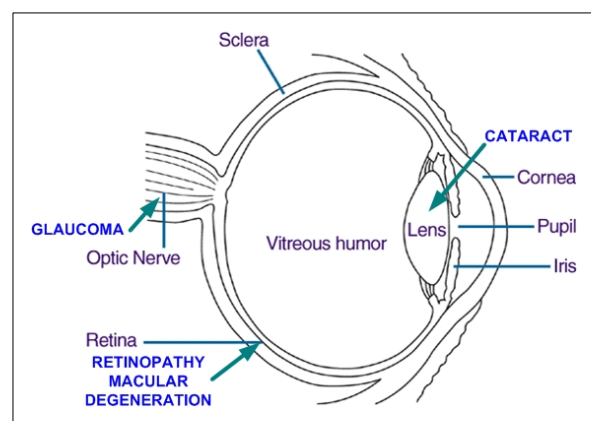


Fig. 1. Localisation of eye diseases

Vision loss can also be due to refractive disorders; conditions in which the eye does not refract or bend incident light into perfect focus into the retina to enable the best possible acuity. A natural progression in the refractive error tends to occur with age. The use of visual aids as glasses and contact lenses may help. With increasing age however, the group that reports vision impairment even when wearing glasses or contact lenses expands [7].

2.1 Basic visual abilities

Vision impairment can result in the loss of basic visual abilities: acuity, contrast sensitivity and visual field. Visual acuity means that we can read or see objects sharp.

Reduction of the visual field is resulting in a decreased ability of detecting objects in the immediate environment.

In order to see an object some contrast must exist between the object and its surroundings. The contrast may be luminance (brightness) contrast or colour contrast.

2.2 Vision impairment and low vision

Ophthalmologic disorders can result in difficulties in perceiving details.

Vision impairment refers to conditions encompassing the continuum from blindness to partial sight. Vision impairment means that a person's eye sight can not be corrected to a normal level [8].

In low vision the visual function is reduced and it is not possible to make improvements by using glasses or contact lenses. A person with low vision is limited in terms of daily activities as reading, writing, watching television and performing hobbies [8].

Blindness refers to the condition of no usable vision with the exception of light perception [8].

3 Low vision and the environment

It is generally recognised that changes in vision become more common as a person ages. The prevalence of impairment increases progressively with age. The visual impairments can interfere with everyday activities as daily household tasks and difficulty in getting around. Vision impairment alters the way in which people perceive and interact with their visual space. Vision impairment can effect several visual functions;

The visual field area declines with age. This means that the portion of space in which objects are simultaneously visible is declining.

Colour discrimination decreases with age. Blue, green and violet colours are most affected by the natural yellowing of the lens. Blue objects tend to be observed as darker than they are.

Dark adaptation is the ability to regain visual sensitivity after being in a dark room for a certain time interval. Adapting to the dark can be limiting for older adults when moving from light to dim environments. Older persons require more light for carrying out the same tasks compared to younger persons [1].

The amount of light that reaches the retina is reduced with increasing age. This is a result of normal ocular changes that result from ageing [9]. A 60 year old person needs three times the amount of light as a 20 year old to complete a visual task comfortably. The challenge is to provide enough light without creating glare [1].

Glare or light that is reflected directly back into the eye causes difficulties to see for older adults. The recovery time from the effects of glare is much longer for older than younger adults [9].

4 Benefits of an improved environment

It is possible to increase quality of life and well-being by improving lighting conditions.

Environmental factors in the home contribute to prevent falls and improve ambulatory ability among older persons. Improved lighting, optimal contrast by use of colours in areas where the older person spends a lot of time, can prevent falls.

Target localisation problems due to visual or higher order impairments could be improved by lighting or use of colours.

4.1 Quality of life

Low vision is associated with decreased functional status and quality of life. This is especially pronounced among patients with macula degeneration. An adjustment of the lighting environment makes it possible to perform daily activities as reading, and preparing food. The self esteem as well as quality of life increases. To prevent adaptation problems it is relevant for the visually impaired to provide unaltered lighting of the highest quality throughout the entire home environment.

It is possible to increase quality of life and well-being by improving lighting conditions in the environment. In a study on the effect of quality of light on quality of life [10] lighting adaptations are made to allow visually impaired people to manage their own daily activity as far as possible. Quality of life improved significantly in the group that received improved lighting conditions in the living room, as well as in tasks carried out on the working surface in the kitchen.

Qualitative assessment as a proper planning of lighting with good contrast conditions and absence of glare as well as quantitative assessment e.g. intensity of light is of great importance for the abilities of the visual impaired to carry out their daily activities [10].

4.2 Prevention of falls

Environmental factors in the home contribute to prevent from falls and improve ambulatory ability among older persons.

Improved lighting and optimal contrast by use of colours can prevent falls in areas where older persons spend a lot of time or high risk environments such as bathrooms and staircases [11].

4.3 Target localisation

Many older adults have difficulty with tasks that critically depend on visual search skills.

The ability to rapidly locate objects of interest in the environment is a fundamental aspect of sight. Older adults commonly report problems in locating objects, especially if they are located in unfamiliar environments. They experience a higher incidence of mobility problems, such as falls [12].

In an early study it was found that despite having excellent visual field sensitivity, some older adults have severe difficulty localising targets in a visual search task. For many older adults impairment of higher order visual processing is the major cause of visual search problems. Target localization problems due to visual or higher order impairments could be improved by lighting or use of colours.

4.4 Colour cues

The functional application of colour in the environment of older people is frequently recommended, especially for those with low acuity. Selective colour enhancement can counteract some of the problems created by visual deficits. Older adults can function more effectively and safely within a 'legible' environment.

In a study on the use of colour cues it was found that:

- The use of colour enhanced the overall legibility of the environment.
- 85% of the older adults using colour cues believed this improved their ability to find objects. Some of the poor vision respondents suggested a preference for tactile as well as visual cues.
- Participants were positive about the use of environmental colour cues for people with poor visual acuity.

The data supported the idea that colour influences function through the ability to sharpen the clarity of objects in their surroundings. This enhances the

person's ability to interpret the environment easily and quickly [12].

The effects of colour on performance are clearly not linear [12]. There are mediating influences that seem to override the need to use colour. Especially when learning takes place change of colour is necessary to attract attention. The implication can be that one should provide a variety of colour options that could be changed easily and inexpensively.

4.5 Towards a healthy living environment

Basic strategies for a healthy living environment for older adults with low vision include:

Improve lighting; In the design of the environmental space for the older adult the proper quantity as well as the quality of illumination is of importance. Quantity refers to task performance; a person needs enough light for a task to be done. Quality refers to the distribution of brightness in space; effects as glare, veiling reflections and visual comfort are issues in quality of illumination. Except the task oriented approach in lighting, where light is a source of information, biological effects of light are addressed [14]. A twofold impact of lighting on the individual must be addressed: light as a source of information about the environment and the photo-biological function of light.

Control brightness and illuminance ratios; proper brightness control is an important condition in the environment of the older adult. Increase in light scatter within the eye of the older person can cause visual problems as reduced visibility and a decreased resistance to glare [14]. Glare is influenced by the presence of windows and fixtures. Placement of light sources and the use of matte surfaces are recommended to avoid excessive brightness contrast

The use of clear colours; the incidence of colour defects for aged people with low vision is high. Colour cues can improve the legibility of the environment and people's ability to target objects quickly. Guidelines to improve readability or detection rate are [14]:

1. Optimise differences in lightness between foreground and background colours; avoid using colours of the same lightness.
2. Avoid contrasting light colours; dark colours tend to appear darker to people with colour deficits. Choose contrasting colours from the bottom and upper half of the colour circle.
3. Avoid contrasting hues; people with colour deficits have difficulty distinguishing neighbouring hues. Choose distant rather than adjacent hues.

Conveniently arranged lay-out of spaces; a simple and logical designed environment is beneficial to target localisation

Clear acoustics; differences in reverberation time or floor covering will enhance way finding. The visual impaired can detect a difference between the kitchen with a hard floor covering and the living room with a carpeted floor.

5 Implementation strategies

Modification of the living environment for people with low vision is important to improve quality of life and prevention of fall incidents. Consequently in building engineering the focus may be put on lighting as well as mobility and accessibility.

In addition interventions that focus on increasing awareness of users and professional and family carers should be improved in order to support the use of modifications.

Social interaction approaches have been shown to be effective to achieve learning and changing for example by using opinion leaders to spread a message in the network or informational visits from respected peers or experts [15].

Many professionals are essential to the people with impaired vision. It is important to consider the multi or interdisciplinary nature of care for the older adult in the nursing home as well as the context of care at home. In this context the older adult, the family caregiver, the disciplines involved in professional caring at home and in the nursing home are target groups.

References

- [1] G. R. Watson, Low vision in the geriatric population; rehabilitation and management. *Journal of American Geriatrics Society*, 49 (2001) 317-330.
- [2] C. Diepeveen, L. Teurlings, P. Verstraten, *Ooit gezien, maar nog niet uitgekeken; werken en omgaan met slechtziende en blinde ouderen*, 2000. Bohn Stafleu Van Loghum. Houten.
- [3] S.D. Schwarz. Age-related maculopathy and age-related macular degeneration. In: B. Silverstone, M.A. Lang, B.P. Rosenthal, E.E. Faye (eds), *The lighthouse handbook on vision impairment and vision rehabilitation, Volume I*, pp. 83-103, 2000. Oxford University Press.
- [4] L.T. Chylack. Age-related cataract. In: B. Silverstone, M.A. Lang, B.P. Rosenthal, E.E. Faye

(eds), *The lighthouse handbook on vision impairment and vision rehabilitation, Volume I*, pp. 33-53, 2000. Oxford University Press.

[5] R. Ritch. Glaucoma. In: B. Silverstone, M.A. Lang, B.P. Rosenthal, E.E. Faye (eds), *The lighthouse handbook on vision impairment and vision rehabilitation, Volume I*, pp. 53-83, 2000. Oxford University Press.

[6] B. Leonard, S.C. Charles. Diabetic retinopathy. In: B. Silverstone, M.A. Lang, B.P. Rosenthal, E.E. Faye (eds), *The lighthouse handbook on vision impairment and vision rehabilitation, Volume I*, pp. 103-129, 2000. Oxford University Press.

[7] S.G. Slade, J.F. Doane, R.N. Baker. Refractive disorders. In: B. Silverstone, M.A. Lang, B.P. Rosenthal, E.E. Faye (eds), *The lighthouse handbook on vision impairment and vision rehabilitation, Volume I*, pp. 197-206, 2000. Oxford University Press.

[8] B. Silverstone, M.A. Lang, B.P. Rosenthal, E.E. Faye (eds), *The lighthouse handbook on vision impairment and vision rehabilitation, Volume I*, pp. XVII, 2000. Oxford University Press.

[9] A.E. Stuck, J.M. Walthert, T. Nikolaus, C.J. Büla, C. Hohmann, J.C. Beck, Risk factors for functional status decline in community living elderly people: a systematic literature review. *Social Science & Medicine*. 48. (1999) 445-469.

[10] G. Brunnström, S. Sörensen, K. Asterstad, J. Sjöstrand, Quality of light and quality of life: the effect of lighting adaptation among people with low vision. *Ophthal. Physiol. Opt.* 24. (2004) 274-280.

[11] B.A. Cooper, The utility of functional colour cues. *Scand J Caring Sci* 13 (1999) 186-192.

[12] C. Owsley, K. Ball, D.M. Keetons, Relationship between visual sensitivity and target localization in older adults. *Vision Res.* 35. (1995) 579-587.

[13] P. C. Hughes, R. M. Neer, Lighting for the elderly: a psychobiological approach to lighting. *Human Factors*. 23. (1981) 65-85.

[14] A. Arditi, J. Brabyn. Signage and Wayfinding. In: B. Silverstone, M.A. Lang, B.P. Rosenthal, E.E. Faye (eds), *The lighthouse handbook on vision impairment and vision rehabilitation, Volume I*, pp. 637-651, 2000. Oxford University Press.

[15] R. Grol, Personal paper: beliefs and evidence in changing clinical practice. *BMJ*. (1997) 418-421.