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# Age Related Visual Pathologies among Nursing Home Residents: An Evaluation of Light Conditions and Recording in Client Files

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## **Abstract**

**Objective:** Reflection on visual problems in nursing homes.

**Data Sources:** Eye examinations, documented visual problems and illuminance levels.

**Study design:** The optometric examinations and recorded visual problems were combined with illuminance data.

**Data collection:** In seven nursing homes, 259 residents underwent an optometric examination. Their client records were analyzed for information regarding visual functioning. The illuminance data were ranked to set the quality of the lighting conditions.

**Principal findings:** 50% of the referred residents had problems with cataracts, retinal problems (21%), suspected glaucoma (13%), and other pathologies (16%). The information was not current in 56% of the records. The quality of lighting conditions was low or moderate.

**Conclusion:** The finding of poor lighting conditions in nursing homes in combination with a high prevalence of visual problems (with cataract found to be the most common age related pathology), stretches the need of enhanced awareness of eye care by professional caregivers.

## **Keywords**

*eye care, professional care, older adults, quality of light, low vision, ICF*

## **1. Introduction**

The prevalence of visual impairment is high in people aged 50 years and older according to the “global data on visual impairment 2010” published by the World Health Organization (WHO, 2010). The WHO report states that, 65% of visually impaired people and 82% of all blind people are 50 years of age and older. Global data from the WHO (WHO, 2007) also shows that the main causes of visual impairment are uncorrected refractive errors and ophthalmological disorders: age-related macular degeneration,

cataracts, glaucoma, and diabetic retinopathy. Eye pathologies cause a loss of basic visual abilities and visual functioning, such as visual acuity, contrast sensitivity, dark adaptation, and visual field loss (Silverstone, Lang, Rosenthal, & Faye, 2000). The highest estimated prevalence (> 40%) of visual impairment (blindness and low vision) in the Netherlands has been found in the subgroup of residents of nursing homes and residential care facilities (Limburg & Van Keunen, 2009). A study by Wang, Mitchell, Cumming and Smith (2003) suggested a higher incidence of nursing home admissions among visually impaired older adults. The environmental design of nursing homes is an influential factor when considering daily activities and quality of care (Sinoo, Duijnste, & Kort, 2012; Van Hoof, Aarts, Rense, & Schoutens, 2009a; Evans & Rowlands, 2004; Boyce, 2003).

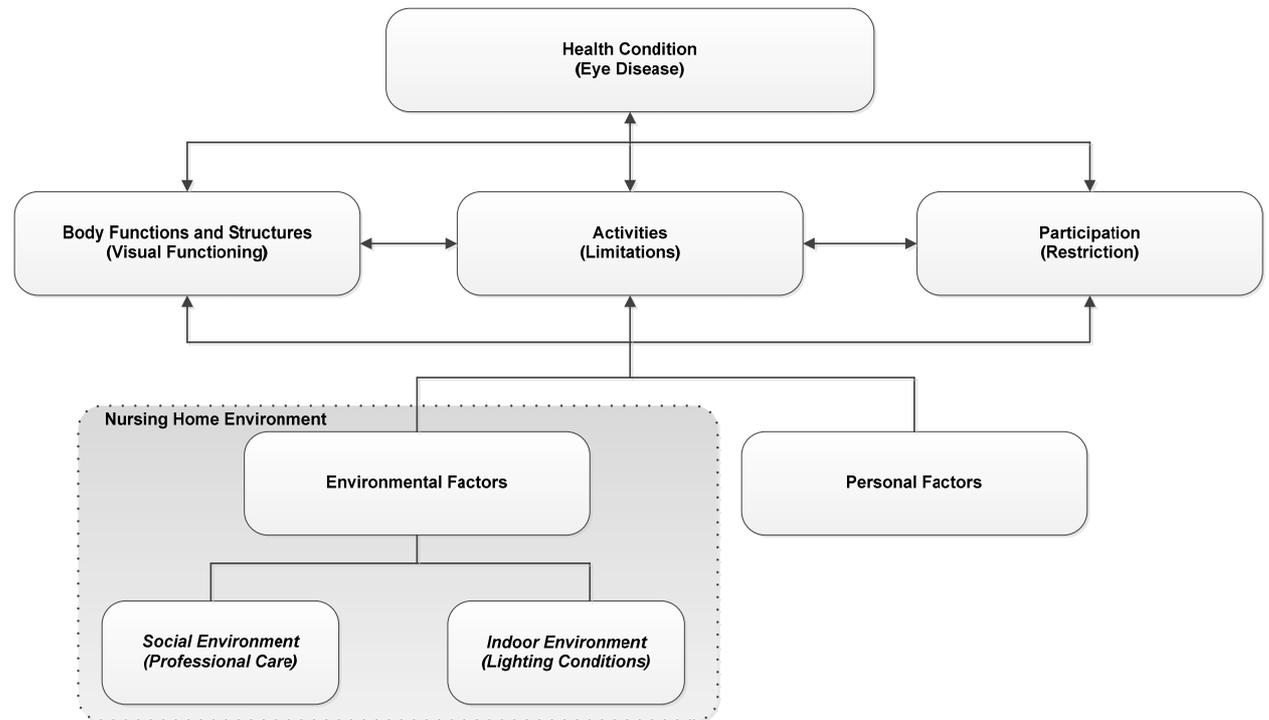
In the Netherlands, a broad range of care professionals is employed in nursing homes, including the nursing care coordinators and caregivers, and medical staff (nursing home physicians) as well as the paramedical and psychosocial staff (Schols, Crebolder, & Van Weel, 2004). A nursing home physician is responsible for both delivering medical care and directing the complex care processes of residents and can be supported by a geriatric nurse practitioner ([www.verenso.nl](http://www.verenso.nl)). Following a multidisciplinary approach, the care requirements of the residents are assessed in close cooperation with the patients and their families. In addition to the regular multidisciplinary team, the nursing home physician can consult external specialists, such as an ophthalmologist, optometrist, low-vision organization, or so-called “flexible eye bus” (described below), in cases of suspected eye problems.

In the Netherlands, two umbrella organizations for low vision care, Bartimeus and Visio, are generally asked to perform optometric examinations in nursing homes. Bartimeus, an organization that aims to improve the quality of life for the blind and visually impaired ([www.bartimeus.nl](http://www.bartimeus.nl)), participated in the eye examinations in this study. In 2008, the “flexible eye bus” was created in the Netherlands by the Rotterdam-Eye Hospital (Van Vliet, Sol, & Lemij, 2011). This bus parks in the neighborhoods of nursing homes or senior housing centers and offers eye screenings on demand. Nurses or family members take residents to this bus. Throughout the Netherlands, optometrists may visit nursing homes, but only on demand of resident, their family or professional caregivers.

### *1.1 Application of the Theoretical Framework*

The role of care professionals and the environment of the nursing home can be described by the framework of the International Classification of Functioning, Disability, and Health (ICF), published by the WHO (2002). The ICF framework originates from the emancipation movement for disabled persons and provides a multi-perspective approach to classifying the functioning and disabilities of individuals with chronic or disabling conditions. This framework is also applicable to older adults with impaired vision. In general, the ICF is used to describe and measure health and disability, and it acknowledges that every person may experience some degree of disability due to a deteriorating health status. The ICF focuses on the impact of health status decrements, and disability is not only described as a medical “dysfunction.” The impact of the environment is also addressed by including contextual factors (WHO, 2002). The ICF lists various related components, including health conditions (disorders

or diseases), bodily function and structures, activities and participation, and environmental and personal factors. Figure 1 shows that the framework of the ICF provides a description of domains that are related to eye diseases. The interaction of these components in an individual with an eye disease is also shown in Figure 1. Personal factors are not considered in this study. This study puts an emphasis on the nursing home environment.



**Figure 1. Interactions between the ICF components for nursing home residents, based on the ICF model (WHO, 2002)**

The factors for persons with eye diseases or disorders in the ICF environmental component can be divided into the social environment (professional caregiver tasks related to visual problems) and the indoor environment (lighting conditions). Therefore, the nursing home environment is an influential factor when considering the daily living activities of residents with visual problems.

In nursing homes, all-care professionals are considered to be part of the social environment for persons with visual problems. These professionals should be aware of the indoor environment as well as the potential visual problems of the residents. Moreover, the ICF invites care professionals to communicate regarding the functioning of their clients in a “common language” (WHO, 2002). Potential changes in the indoor environment (building aspects), which can be made for residents with eye problems include improving lighting conditions by controlling the illuminance levels. The majority of older adults require more light than younger people and should therefore be seated in positions with access to appropriate lighting conditions (Sinoo, Van Hoof, & Kort, 2011; Bouma, Weale, & McCreadie, 2006;

Charness & Dijkstra, 1999). This may be near a window or in a properly illuminated place when the resident is performing a task. Furthermore, uniform illumination is advised because adaptation to the dark can be impaired in older adults (Bouma, Weale, & McCreadie, 2006). The benefits of sufficient light levels inside nursing homes are not only “image-forming” (i.e., to improve sight) but they also play a role in regulating important biochemical processes, such as immunologic mechanisms, circadian rhythm, and behavior (Turner, Van Someren, & Mainster, 2010; Riemersma-Van der Lek, Swaab, Twisk, Hol, Witte, Hoogendijk, & Van Someren, 2008).

This study considers the inclusion or lack of the sensory perceptual needs of residents in the client records of nursing homes. The researchers discuss this from the perspective of environmental factors, health conditions (eye disease) and visual functioning set forth in the WHO ICF framework. In addition, a reflection is made on the role of professional caregivers.

The following research questions were formulated:

- 1) What is the quality of the illuminance levels in common rooms and corridors in nursing homes?
- 2) What age-related eye pathologies do optometrists report after eye examinations?
- 3) What is the status of recording of information on visual problems or other eye-related data in client files?

## **2. Methodology**

The total study consists of three parts. In the first study (Sinoo, Van Hoof, & Kort, 2011) lighting conditions were discussed. Illuminance levels and color temperature were assessed in seven nursing home buildings. The main finding was that at least 55% of the illuminance measurements fell below the threshold of 750 lx. In this first study no information about client records was given. The second study (Sinoo, Kort, & Duijnste, 2012) addressed the recording of general eye care information in client records in the seven nursing homes. The findings of this second study showed that a significant proportion of client records showed no recorded information on visual functioning (the use of spectacles; normal vision, low vision or blindness).

In the present study unused data from the second part of the study on age-related eye pathologies among the nursing home residents are combined with the data from the first part of the study on lighting conditions.

Four different nursing home organizations (with seven nursing home buildings) in the central region of the Netherlands participated in both previous studies (Sinoo, Van Hoof, & Kort, 2011; Sinoo, Kort, & Duijnste, 2012). These organizations were motivated to improve the awareness of adequate eye care among their caregivers. In an introduction to all 4 organizations, the boards of the organizations' management and their client councils were asked to participate in the study. Optometrists from Bartimeus performed the eye examinations in the same order and acted independently in this study. A few months after the data collection, Bartimeus offered low vision support to the nursing homes.

Data analysis was carried out using SPSS 20 for Windows (SPSS Inc. Chicago, USA) with a critical

p-value of 0.05. Non-parametric statistics, using the Kruskal-Wallis H-test, were employed to test differences between age groups in the nursing homes.

### *2.1 Selection of Residents and Ethical Considerations*

Among the 4 organizations, 259 out of 686 residents and/or their legal representatives agreed to participate. Families and caregivers decided whether the residents were capable of participating in the eye examination. The selection of residents was based on informed consent and the willingness of the residents and/or their legal representatives to participate voluntarily in a single optometric eye examination. Signatures for consent were collected via paper forms.

The letters asking for informed consent included two choices:

- 1) A consent form for participation
- 2) A form expressing the desire to not participate

A resident began participation in the study if informed consent was received. If the paper was not returned, no action on participation was taken. The non-response was not considered in this study and no further action was taken on this. One reason not to participate was for instance the estimation of the family that participation would be too much a burden for the resident.

### *2.2 Measurements*

#### *2.2.1 Assessment of Visual Impairments*

Single eye examinations were performed, which included refraction, assessment of the anterior and posterior segments of the eyes, bio-microscopy (slit-lamp examination), ophthalmoscopy, and intraocular pressure (IOP) measurements. Additionally, neurologic tests, such as light sensitivity, pupil reaction, visual field assessments (confrontation method), and contrast sensitivity measurements (by a low-contrast vision test), were performed. The eye assessment was summarized in a report that was intended for the ward (care coordinator and nursing home physician). In this report, the optometrist also indicated whether a referral for further examination by an ophthalmologist would be necessary. The optometric examination of age-related pathology lasted for approximately one hour per resident, and an optometric assistant recorded the data.

In the Netherlands, this type of research on standard care delivered by Bartimeus does not require review by the Medical Research Involving Human Subjects Act (<http://www.ccmo-online.nl>). Nevertheless, data were collected and treated according to The Dutch Data Protection Act (<http://www.dutchdpa.nl>).

#### *2.2.2 Measurement of Illuminance Levels*

As described in Sinoo, Van Hoof and Kort (2011), measurement of the illuminance levels was performed using a Konica Minolta cl-200-A Chroma meter (by Konica Minolta Sensing Americas Inc.) to assess the lighting conditions in the seven nursing homes. The measurements (E [lx]) were performed in locations where the residents spent most of their time during the day (common rooms and corridors).

All light measurements were performed during the day between 10:00 AM and 3:00 PM from October

2009 to March 2010. The measurements included the contribution of daylight and reflected the light situation as encountered at the moment of observation. The light sensor was held in a vertical position, mimicking the central gaze line ( $E_v$ ), at a height of 1.6 m. The light sensor was laid in a horizontal orientation at table level, a height of 0.9 m, and at chair level of 0.6 m ( $E_h$ ). These heights represent older adults (male and female) standing upright as they walk around common rooms and corridors (1.6 m), perform tasks while seated at a table (0.9 m), or hold items in their laps (0.6 m), respectively. This resulted in two types of measurements in common rooms:

- 1)  $E_v$ , representing residents walking around or standing upright in common rooms
- 2)  $E_h$ , representing residents performing a task either at table level (0.9) or chair level (0.6). These are not separated in the data analysis.

In corridors, one measurement ( $E_v$ ) was used, representing people walking around or standing upright.

### 2.3 Data Analysis

#### 2.3.1 Information in Client Records

As described in Sinoo, Kort and Duijnste (2012), the screening of the client records was performed by the researcher a few days before the optometric examinations took place. During the optometric examination of the resident, the optometric assistant completed, if needed, the information found by the researcher. The researcher visited the administration rooms of the nursing homes to analyze the client records, and during the optometric examination the client record of the resident was taken with him. Client records were kept in folders for each client in three of the four nursing home organizations. One nursing home used electronic client records. In all nursing homes, the researcher was free to enter the offices in which records were kept. Screening of the client records was conducted using fixed categories: the diagnoses of eye diseases, past treatments, use of spectacles or any information connected to visual problems and use of eye medications. Furthermore the information was categorized as current or past visual function information, such as:

- 1) For past information: eye surgeries or eye problems in the past
- 2) For current information: the use of spectacles and current eye medications, eye diseases or visual field losses

Past information is seen as information prior to the admittance to the nursing home.

#### 2.3.2 Quality of Lighting Conditions

As described by Sinoo, Van Hoof, and Kort (2011), the observed illumination levels were compared with the average acceptable threshold values of 750 lx (common rooms) and 200 lx (corridors). These threshold values were based on The Dutch Society for Illumination guidelines (Stoer, 2006) and the values stated by Van Hoof and Schoutens (2007) and De Lepeleire, Bouwen, De Coninck and Buntinx (2007). The latter authors recommend adjusting the threshold levels of the originally stated 500 lx for offices to 750 lx or even to 1000 lx for older adults.

Categorization of the buildings according to lighting conditions was performed by ranking the measured illumination levels into “Good”, “Moderate” or “Low” quality. If < 10% of all measurements

in the common spaces and corridors were below the threshold level of 750 lx, the building was considered to have good quality lighting conditions. If 11% to 66% of all measurements in the common spaces and corridors were below the threshold level of 750 lx, the building was considered to have moderate lighting conditions. If  $> 66\%$  of the measurements in the common spaces ( $E_v$ ,  $E_h$ ) and corridors ( $E_h$ ) were below the threshold level of 750 lx, the building was considered to have low quality lighting conditions.

### 3. Results

The results are described in the following order: first, the lighting conditions in the participating nursing homes are described, followed by the characteristics of the participating residents, their reported referrals by the optometrist, and the information found in their client records.

#### 3.1 Lighting Conditions in the Nursing Homes

The ranking of the lighting conditions in the seven nursing homes is presented in Table 1. The ranking is based on the percentage of measurements below the threshold in common rooms ( $E_v$  and  $E_h$ ) and corridors ( $E_v$ ).

**Table 1. Ranking of the quality of lighting conditions in the seven nursing homes, based on the study by Sinoo, Van Hoof, & Kort (2011)**

Nursing home building	Number of common rooms measured (N = 59)	$E_v$ in the eye-gaze direction, common spaces				$E_h$ in the eye-gaze direction, common spaces				$E_v$ in corridors				Ranking
		$E_{min}$ [lx]	$E_{max}$ [lx]	N < 750 lx	% Below threshold	$E_{min}$ [lx]	$E_{max}$ [lx]	N < 750 lx	% Below threshold	$E_{min}$ [lx]	$E_{max}$ [lx]	N < 200 lx	% Below threshold	
1	2	110	850	13/14	93%	290	460	5/5	100%	20	250	9/12	75%	Low
2	10	30	2750	88/94	94%	60	2500	28/32	88%	6	240	13/14	93%	Low
3	8	90	3060	59/90	66%	200	1880	28/41	68%	9	260	16/21	76%	Low
4	16	20	1590	170/179	95%	20	3670	40/50	80%	13	250	87/89	98%	Low
5	6	40	1230	77/81	95%	50	3330	40/43	93%	38	2450	47/61	77%	Low
6	12	150	3700	78/120	65%	170	3200	21/38	55%	14	1120	15/45	33%	Moderate
7	5	70	1770	41/54	76%	100	3660	19/26	73%	18	740	19/21	91%	Low
Total	59			632				235				263		

Illuminance levels in common spaces (minimum and maximum levels) compared to a threshold level of 750 lx (frequency of measurements below the threshold with respect to the total number of measurements) and illuminance levels in corridors compared to a threshold level of 200 lx.

$E_v$  = vertical illuminance,  $E_h$  = horizontal illuminance, lx = lux (unit of illuminance)

$E_{min}$  = Minimum illuminance value,  $E_{max}$  = Maximum illuminance value

The residents of all buildings (with or without eye pathologies) lived in an environment with low or

moderate quality lighting conditions.

Only nursing home 6 was ranked as having “moderate quality” lighting conditions. Less than 66%, albeit 65% ( $E_v$ ) and 55% ( $E_h$ ), of the measurements in the common spaces and 33% of the measurements in the corridors ( $E_v$ ) of nursing home 6 were below the threshold.

### 3.2 Demographics of the Participating Residents

The mean age of the 259 participating residents in the four organizations was 81.3 years ( $\pm 10.5$ ). No significant difference in the ages of residents was found between the four participating nursing homes organizations ( $\chi^2 = 1.324$ ,  $df = 3$ ,  $p = 0.723$ ).

Of the 259 participating residents, 163 (63%) lived in psychogeriatric wards and 96 (37%) lived in rehabilitation or somatic wards. This is a ratio of approximately 2:1. According to the current knowledge of the Dutch nursing home population, the ratio of residents residing in psychogeriatric and somatic wards is 1:1 (Ten Draak, 2010). According to the WHO criteria for vision impairment, 74% of the assessed residents had “normal vision” and 26% were assessed as having “low vision or blindness” (Sinoo, Kort, & Duijnste, 2012).

### 3.3 Reason for Reported Referrals (R RR) to the Ophthalmologist after Optometric Examination

In Table 2, the reasons for the reported referrals (R RR) by the optometrist are presented along with the quality of the lighting conditions from Table 1 and the presence of visual functioning information in the client records.

**Table 2. Information in client records, quality of lighting conditions, and Reasons for Reported Referral (R RR) after optometric examination**

	Nursing Home Building							Total N	No info about visual functioning in client record	Info about visual functioning in client record
	1	2	3	4	5	6	7			
	Lighting conditions									
R RR*	Low	Low	Low	Low	Low	Mod	Low			
Cataract	5	16	15	9	3	6	5	59	41	18
Glaucoma	0	4	3	6	2	1	0	16	9	7
Retinal problems	2	3	9	3	7	0	1	25	20	5
Other	3	8	6	0	1	0	1	19	10	9
Subtotal	10	31	33	18	13	7	7	119	80	39
No RR **	8	8	17	46	27	29	5	140	78	62
Total	18	39	50	64	40	36	12	259	158	101

\* R RR = Reason for Reported Referral to the ophthalmologist after optometric examination by the optometrist;

\*\* No RR = No Reported Referral to the ophthalmologist after optometric examination by the optometrist

After the optometric eye examinations of the 259 residents, the optometrist did not recommend further examination by an ophthalmologist for 140 residents. In these 140 residents, no eye pathology was discovered, the residents had a known eye disease, or they were already under the care of an ophthalmologist or low vision center. Nevertheless, the optometrist recommended that 119 residents receive an additional ophthalmologic consultation because eye pathology was suspected or detected. In 50% (59/119) of the referred residents, the main reason for referral was related to problems with cataracts, followed by retinal problems (25/119 or 21%), suspected glaucoma (16/119 or 13%), or other pathologies (19/119 or 16%).

Of the 259 client files, 158 files contained no information on visual functioning, and 101 files contained some information, such as the use of eyeglasses, visual acuity, use of eye medications, or known eye pathologies.

Furthermore, the results in Table 2 show that 80 of the 119 residents (67%) referred for additional examination by an ophthalmologist had no information on visual functioning in their client records; this finding was observed in 41/59 (70%) of the cataract referrals, 9/16 (56%) of the glaucoma referrals, and 20/25 (76%) of the retinal problem referrals. Similar results were found for individuals with other reasons for referral.

### 3.4 Status of Information in the Client Records

The type of information recorded in the clients' files was analyzed with respect to current and past data (Table 3). This analysis was performed for all client files (101) with information on visual functioning.

**Table 3. Cross tabulation of the information related to visual impairments and visual functioning (VF) found in client records and their reported reason for referral (R RR)**

Type of information in the record	Reason for Reported Referral R RR*				No RR**	Total
	Cataract	Glaucoma	Retinal	Other		
Wearing eyeglasses	-	-	-	-	4	4
Visual acuity	1	-	-	-	4	5
Eye medication	2	1	-	1	2	6
Eye disease	3	1	2	3	20	29
Subtotal	6	2	2	4	30	44
Past information on VF***	12	5	3	5	32	57
Subtotal	18	7	5	9		
Total	39				62	101

\*R RR = Reason for Reported Referral to the ophthalmologist after optometric examination by the optometrist;

\*\*No RR = No Reported Referral to the ophthalmologist after optometric examination by the optometrist

\*\*\*VF = Visual Functioning

Table 3 shows the type of information that was recorded in the 101 client files (of which 39 residents were referred and 62 residents were not referred for ophthalmological examination). The type of information is combined with the reason for referral mentioned in the optometrist's report.

In 57 of the 101 files (56%), the recorded information was related to past events and did not include current information on visual functioning. For 12 of the 18 residents referred for cataracts, the recorded information involved problems from the past, such as bacterial conjunctivitis.

The use of eyeglasses was not recorded for the 39 referred residents (18 for cataracts, 7 for glaucoma, 5 for retinal problems, and 9 for other pathologies) but was recorded 4 times for the non-referred residents.

Visual acuity was recorded in 1 client file for a resident referred for cataracts and 4 times for the non-referred residents. In a few cases (2 for cataracts, 1 for glaucoma, and 1 for other pathologies), an eye medication was recorded in the client files. Similar results were found for the recorded eye diseases.

The optometrist did not refer sixty-two of the 101 residents for an ophthalmologic consultation. In these residents, some vision-related information was recorded in their files. In 32 of these 62 cases, the recorded information was related to past events and did not include current information. In 30 client files of the non-referred residents, information was found but no progression of the known disease was noted or these residents were already receiving ophthalmological care or were in a known rehabilitation program.

#### **4. Discussion**

Visual impairments and poor lighting conditions in nursing homes are risk factors for falling (Legood, Scuffham, & Cryer, 2002). Thus, the environment can hinder older adults suffering from an eye disease or visual impairment (Aarts & Westerlaken, 2005). In contrast to this, a nursing home environment with adequate lighting conditions that have a positive effect on the circadian rhythm may facilitate nursing home residents in their daily activities (Turner, Van Someren, & Mainster, 2010; Riemersma-Van der Lek, Swaab, Twisk, Hol, Witte, Hoogendijk, & Van Someren, 2008).

As shown in Sinoo, Van Hoof and Kort (2011), two buildings (building 6 and 7 in table 1) were both constructed in 2008 and had moderate (building 6) and low (building 7) light qualities. Another building (building 5) was constructed in 1977 and renovated in 2009, but had still low light quality. Hence year of construction or renovation of the nursing homes did not influence the quality of the lighting conditions.

Of almost two-thirds of all participating residents (158 out of 259), no information on visual problems was present. Nevertheless in more than half of the client records the recorded information was related to past events.

Participation of nursing home residents and their reduced daily activities can be improved when nursing home physicians, geriatric nurse practitioners and nurses have more knowledge about, and

insight into age-related eye pathologies of their residents. One prerequisite for this is that the charting of relevant information in the client records is accurate. Another requirement is that nursing home physicians, geriatric nurse practitioners and nurses have a greater understanding and awareness of the quality of lighting conditions offered to the residents (Turner, Van Someren, & Mainster, 2010). A recent study by Aarts, Aries, Straathof and Van Hoof (2014) also showed that the majority of care professionals were not aware of the reasons why a new lighting system was installed on their work floor. Awareness of lighting conditions is important not only in relation to the quality of illumination, but also in relation to the use of colors and contrasts. The most frequent eye pathology found in this study was cataract or related to cataract. Blurred vision and faded color (blue and purple), caused by the yellowing of the lens are the main complaints of people suffering from cataract. The use of colors and specifically attention towards contrasts contributes to ease finding the location of doors, furniture and light switches. Furthermore reducing environmental hazards are recommended to prevent the incidence of falls (The college of optometrists, 2011; Lord, 2006).

Visual problems differ among individuals and therefore demand specific lighting solutions to support individual nursing home residents in their daily activities. Selecting the appropriate environment and lighting conditions for all residents can be a complex task because of these individual differences (Brabyn, Schneck, & Haegerstrom-Portnoy, 2001). For example, bright light might be a problem for one resident, whereas another resident might require more light (Evans, Sawyerr, Jessa, Brodrick, & Slater, 2009; Jones & Van der Eerde, 2008; Brabyn, Schneck, & Haegerstrom-Portnoy, 2001). A study by Lindner, Huber, Schlote and Rölf (1989) on the subjective lighting needs of people with cataracts and glaucoma showed the impact of these eye diseases on preferred illuminance levels. For instance, their preferences could be hundreds of lux-units lower than those preferred by healthy subjects. Personalized impaired vision care is not addressed further in this study. However, there should be a greater awareness of residents' vision problems to enable personalized eye care.

#### *4.1 Limitations of the Study*

Bias in scientific research can occur in a variety of ways (Polit & Hungler, 1999). In this study, the nursing homes were not chosen randomly. Selection bias may have occurred by purposely sampling four nursing homes that were willing to improve eye care. However, all organizations were functioning under a different umbrella, which creates some diversity.

In addition, selection bias may have been occurred in the participation of residents in the eye examinations by the administration procedure for informed consent. As discussed by Elliott, McGwin and Owsley (2013), residents with known visual problems may have been excluded from the study if their legal representatives knew about their visual problems already and thus decided against participation in the eye examinations. Gathering information on participation refusal was not conducted in this study and may be considered to be a limitation as well.

In this field study, measurements of lighting conditions were restricted to common rooms and corridors because these are the spaces where residents spent most of their time during the day. Furthermore, the

distribution of luminance during the day was not taken into account, because lighting conditions measurements were not taken continuously. The lighting conditions of individual rooms were not assessed. The arrangement of private rooms is usually conducted by residents and their families and not by professional caregivers. Nevertheless, in daily practice, the optometrist can provide advice on the illuminance levels of private rooms of residents in which low vision or eye diseases are detected.

## 5. Conclusion

Within the ICF model, professional caregivers in nursing homes, such as nursing home physicians, geriatric or gerontological nurse practitioners, nurses, and optometrists, may be considered to be an environmental factor. The availability of these caregivers and the quality of care provided by them may hinder or improve the residents' daily activities and participation. The availability of the caregivers is not only related to their physical presence but also related to their knowledge, experience and competencies.

This study showed that no information on visual functioning was found in the majority of client records of the residents referred for additional ophthalmologic consultation. Furthermore, if information on visual problems was recorded, this involved mostly information from the very past.

Additionally, the lighting conditions in common rooms and corridors in all nursing homes were of low or moderate quality.

The finding of poor lighting conditions in nursing homes in combination with a high prevalence of age-related eye pathologies (with cataract found to be the most common age related pathology), stretches the need of enhanced awareness of eye care by professional caregivers.

## Contributions

MS and HK designed the study. MS and HK performed the data collection and analysis. MS, HK, MT, and JS prepared the manuscript.

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