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Reducing avoidable visual impairment in elderly home healthcare patients by basic ophthalmologic screening

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ABSTRACT.

Purpose: **To investigate the prevalence of potential age-related eye conditions in elderly who are assisted by home healthcare nurses. The number of referrals to the general practitioner (GP), feasibility of screening and associations between vision loss and health outcomes were also studied.**

Methods: **Cross-sectional study in which trained home healthcare nurses screened the eyes of 151 patients [mean age 80 (50–96 years)] using their available correction, with VISION 2020 *Netherlands* screeners (e.g. acuity/field loss). Health outcomes were assessed with questionnaires.**

Results: **Distance decimal visual acuity was ≤0.3 in 20.5% (unilateral) and 19.9% (bilateral) of patients, and near visual acuity was ≤0.4 in 17.7% (unilateral) and 33.3% (bilateral). Macular dysfunction was present in 21.5% (unilateral) and 8.3% (bilateral) and peripheral field problems in 11.4% (unilateral) and 7.9% (bilateral). GP referrals were proposed in 21.5%; in 40%, the GP or ophthalmologist was already aware of eye problems. Although health problems were prominent in participants (8.6% fractures, 22% depression and 18% anxiety), no significant associations were found between vision loss and self-reported outcomes.**

Conclusion: **Sixty per cent of frail elderly home healthcare patients had an ophthalmologic condition. Although a large number was already known in eye health care, >20% was referred with an unrecognized ophthalmologic problem. Basic ophthalmologic screening by home healthcare nurses might be a potentially relevant tool to reduce the burden of age-related vision loss, contributing to the joint World Health Organization – VISION 2020 initiative to eliminate avoidable blindness. Relevant health outcomes do not seem to be clearly related to having visual impairment, but rather to having general health problems.**

Key words: elderly – eye screening – home health care – quality of life – VISION 2020 – visual impairment

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Introduction

In the Netherlands, societal developments including the increased focus on self-management and healthy ageing have made older adults wanting to remain independent and keep their autonomy for as long as possible. Health economic measures to reduce societal costs have further stimulated them to live independently in their own homes (Kroneman et al. 2016). These developments have the intention to improve quality of life and to reduce admissions to nursing homes

(Kroneman et al. 2016). There are, however, several common problems in elderly people which limit independent functioning and living at home safely. One of them is vision loss. Vision loss is mainly a problem in older adulthood and is known to compromise quality of life (Langelaan et al. 2007; Lamoureux et al. 2009). Visually impaired elderly are at risk of specific detrimental health outcomes such as depression (van der Aa et al. 2015; van Nispen et al. 2016), anxiety (van der Aa et al. 2015), falls and bone fractures (de Boer et al. 2004). Vision loss has been ranked third, behind arthritis and heart disease, amongst the most common chronic conditions that require older adults to have assistance with activities of daily living (Watson 2001). It is known that visually impaired older adults participate less than their peers and that they encounter restrictions in activities, such as reading, mobility, hobbies but also in social interaction (Lamoureux et al. 2009). This may be reflected by the dependency on family members or home health care (Wang et al. 1999). Moreover, older age, lower perceived health, worse instrumental activities of daily living, psychiatric problems and living alone have been associated with early nursing home admissions (Cai et al. 2009), indicating that visually impaired elderly could be one of the populations needing special focus. However, it has been estimated that by the year 2020 more than 70% of people who are visually impaired in the Netherlands will be over 50 years and live independently, whereas 17% will stay in a nursing home or other inpatient care facility (Keunen et al. 2011a). In order for them to stay independent, at least their eye health should be optimized.

Although prevalence decreases due to better treatments and preventive measures, the absolute number of older adults with visual impairment is still increasing due to demographic ageing (Bourne et al. 2017). In older adults, the most common causes for treatable visual impairment and blindness are cataract and uncorrected refractive error, the latter still being the leading cause of visual impairment (Flaxman et al. 2017). Other important causes of visual impairment and blindness globally leading to both acuity and visual field loss are age-related macular degeneration, diabetic retinopathy and glaucoma (Flaxman et al. 2017). Field loss caused by stroke in older adults is also a common nonocular condition in older adulthood leading to problems with visual functioning (Rowe et al. 2013). Since a large proportion of visual impairment or blindness in older age is preventable or treatable (Bourne et al. 2017), home healthcare nurses could play an important role in detecting potential ophthalmic conditions in frail elderly.

The aim of this study was to investigate the prevalence of potential age-related eye conditions in frail elderly who receive home healthcare services in the Netherlands. Secondly, the advices of home healthcare nurses to visit the general practitioner, optician or optometrist were evaluated and included referral pathways of patients to other care providers such as the ophthalmologist and feasibility of screening. Thirdly, the association between vision loss and quality of life, depression, anxiety, falls, fractures and the ambition to stay independent were studied as well.

Materials and Methods

Design and participants

A cross-sectional study was conducted by 17 teams of 'Buurtzorg' home healthcare services across the Netherlands. The number of nurses per team that collected data (of between 2 and 20 participants) varied and was according to their commitments regarding caseload distribution. One nurse per team acted as data coordinator. Data were collected between May and November 2016. The Medical Ethics Review Board of the VU University Medical Center in Amsterdam declared that the study protocol did not fall under the scope of the Medical Research Involving Human Subjects Act. The study was conducted according to the principles of the Declaration of Helsinki.

Inclusion criteria were receiving home health care for any reason, age 50 years or older, sufficient knowledge of the Dutch language, no severely impaired cognitive function and having a reasonable physical condition allowing eye screening. Participants gave written consent for the ophthalmologic screening by nurses, collecting ophthalmic information from the care providers to whom they were referred to and data analysis by researchers. If ophthalmic information from other care providers was required, participants were contacted by telephone to verify consent.

Based on the nurses' initiative, terminally ill patients and patients with severe cognitive problems, for example due to Alzheimer's disease, were excluded from participation. The teams invited approximately 230 patients either with or without known eye complaints to participate in the study.

Ophthalmologic screening

Four screening charts which were printed on the front and backside of two cards and were designed by VISION 2020 *Netherlands* were used to detect global loss of acuity and/or macular function or central and peripheral visual field loss in a simple and quick manner (for examples, see Keunen et al. 2011b). Home healthcare nurses who had been trained according to a strict protocol and instruction video used the screeners for both eyes separately, with available correction and by occluding one eye at a time. Nurses made sure that there were sufficient light and no inappropriate reflection of light on the charts.

Distance visual acuity was measured using tumbling Es in both eyes separately which were printed on one chart in four print sizes. Participants were asked to sit on a chair four metres from the chart. Participants with multifocal glasses were asked not to look through the reading addition but straight over it. The chart was divided into four lines, which represented a decimal visual acuity of 0.8, 0.5, 0.3 (5 letters) and 0.1 (2 letters). A thick red line separated the upper two larger printed lines from the two smaller print sizes to easily determine a positive from a negative outcome. A decimal acuity of $\leq$0.3 in the better eye with available correction, except for reading addition, indicated at least moderate visual impairment as suggested by the WHO (2016).

Near visual acuity was measured at approximately 40 cm distance with one eye occluded and available addition using the VISION 2020 reading chart which has short sentences in four print sizes. The lines corresponded with a decimal visual acuity of 0.5, 0.4, 0.3 and 0.2. The lower line was separated from the larger print sizes by a red line,

indicating a decimal acuity of ≤0.4 as visual impairment at near.

Overall macular function, which included the central visual field and metamorphopsia, was tested using the VISION 2020 Amsler grid in two eyes separately. The test was performed with one eye occluded and with reading addition if required and was held at reading distance. The specific instruction to the nurse was to ask the participant whether he/she (1) was able to see the small black dot in the middle of the grid; (2) was seeing a black dot or a larger stain; and (3) whilst staring at the black dot, if he/she was able to see parallel lines, or was seeing irregular or curved lines, limited contrast or blurred areas instead anywhere on the grid, indicating potential macular problems.

The peripheral visual field was tested with the confrontation visual field examination in two eyes separately, with which large and dense visual field defects should be easily identified (Pandit et al. 2001). The nurse sat across and close to the participant on a chair, and the participant was asked to look at the opposite eye of the nurse; the other eye was occluded. The nurse moved one hand towards the central field whilst making finger movements. The normal peripheral visual field was considered to be 60° upwards, 75° downwards, 60° inwards and 90° outwards. Any suspected deviation within the peripheral field was reported and was considered to be a reason for referral. Peripheral visual field loss could be caused by various medical conditions, such as glaucoma, neurological problems including stroke, optic neuropathy or medication (Kedar et al. 2011).

Number and feasibility of referrals

The outcomes of ophthalmologic screening, including the referral advice, were registered by the home healthcare nurses on preprinted forms and were sent to the research team. Participants with either a unilateral or bilateral problem were advised to consult their GP. Nurses discussed the outcome with participants and referred them if there was any reasonable doubt that a participant was not already known in an eye healthcare service or had not visited an eye healthcare professional for a long period of time. Alternatively, if it was absolutely clear as expressed by the participant that the problem was due to inappropriate glasses, the participants were advised to visit an optician or optometrist, who would also refer patients to a GP if necessary. If participants had an aberrant result and were already in eye health care, which was confirmed by the participant, relative or by patient file information, the participant was not referred. To evaluate the relevance of referrals, information about the diagnosis and treatment (e.g. refraction or cataract surgery) was directly obtained from the GP, optician, optometrist or, after referral by the GP, from the ophthalmologist. If the care provider did not respond, participants were approached to provide information. In addition, after data collection, nurses were asked via an online questionnaire about their experiences with eye screening and feasibility; 19 nurses participated.

Health outcomes

After the ophthalmologic screening, the nurses provided participants with a questionnaire, which could be filled out by themselves or with help from others including the research team; however, very often the nurses decided to help out. First, patient characteristics were completed, that is gender, age, education level, marital status, self-reported vision problems (six response options from 'excellent' to 'completely blind'), restrictions in daily life due to vision problems (five response options from 'no' to 'severe' limitations) and a global question about hearing loss (four response options from 'yes, without any effort' to 'no, I cannot').

Health-related quality of life was investigated with the EuroQol 5-Dimension 5-Level questionnaire (EQ-5D-5L) which covers the dimensions mobility, self-care, daily activities, pain and discomfort, and anxiety and depression (Versteegh et al. 2016). Each dimension has five response options ranging from no problem to severe problems. Analyses were performed using the utility scores based on the Dutch tariff ranging from 0 ('death') to 1 ('full health'); negative values represent health states worse than death (Versteegh et al. 2016).

Depressive symptoms were measured with the Patient Health Questionnaire (PHQ-9) with nine questions corresponding to the Diagnostic Statistical Manual symptoms for major depressive disorder during the past 2 weeks (Kroenke et al. 2001). The response options follow a four-point Likert scale from not at all (0) to nearly every day (3). The summed PHQ-9 score ranges from 0 to 27 with scores 5–9 indicating mild depression, 10–14 moderate depression, 15–19 moderately severe depression and 20–27 major depression.

The Hospital Anxiety and Depression Scale – Anxiety subscale (HADS-A) was used which is a seven-item subscale designed to measure anxiety symptoms during the past four weeks. Response options follow a four-point Likert scale from seldom or never (0) to (nearly) always (3), with a total score ranging from 0 to 21 and with higher scores indicating more severe anxiety symptoms (Snaith & Zigmond 1986). Subclinical anxiety is defined as a cut-off score of ≥8 with adequate sensitivity and specificity (Bjelland et al. 2002).

A shortened version of the 'fall and fracture calendar' was used (Pluijm et al. 2006). Questions were about the number of falls in the previous 6 months and about fractures in the previous 12 months.

The ambition to remain independent was measured with the investment in independence questionnaire (iii) which was derived from the Memory Achievement subscale of the Metamemory in Adulthood questionnaire and has been used in the Longitudinal Aging Study Amsterdam. It consists of 16 statements with which participants could (strongly) agree or (strongly) disagree on a four-point scale (Ponds & Jolles 1996).

Statistical analysis

Descriptive statistics were used to analyse outcomes of the eye screeners, referrals and patient characteristics. Differences in health outcomes between participants with vision loss (defined as a decimal visual acuity ≤0.3 of the better eye) and participants with 'normal' vision were assessed with linear regression models that were adjusted for patient characteristics. The assumption of normally distributed outcome measures, linearity and multicollinearity were checked. A $p < 0.05$ (two-sided) was considered to reflect a significant difference. SPSS version 22 (SPSS IBM, New York, USA) was used to perform the analyses.

Before performing the regression models, the PHQ-9, HADS-A and iii

were analysed with item response theory models (i.e. the graded response model, van Nispen – unpublished) to establish relevant psychometric properties (Embretson & Reise 2000). For the PHQ-9 and HADS-A, the root mean square error of approximation, the Tucker–Lewis indices and comparative fit indices were considered to be adequate. Local independence of items was checked by the size of residual covariances and were <0.25. Monotonicity was checked with Mokken scaling and item fit tests; no relevant deviations were found. However, for the iii, some adaptations needed to be made to meet the above-mentioned assumptions. The response options 'disagree' and 'strongly disagree' were collapsed, and four questions were removed. Analyses were performed in RStudio, version 0.99.896. Thetas that were obtained from the graded response models were entered in SPSS and served as dependent variables for the three questionnaires (latent traits).

Moreover, for handling missing data in the EQ-5D-5L multiple imputation techniques were used and deemed appropriate (Hayati Rezvan et al. 2015).

Table 1. Patient characteristics.

	Questionnaire data $N = 170$
Gender, % female	68.0%
Age, mean years (SD)	80.2 (0.9)
Marital status, % living alone	61.9%
Education level, median years (IQR)	9 (4–14)
EQ-5D-5L, mean quality of life (SD)	0.62 (0.02)
PHQ-9, % depressive symptoms	
No	44.9%
Mild	32.7%
Moderate	17.3%
Moderately severe	3.2%
Major	1.9%
HADS-A, % subclinical anxiety	18.4%
Falls, % past 6 months	41.4%
Fractures, % past 12 months	8.6%
Hearing loss, % severe problems	17.8%
Independence (iii), median (IQR)	43 (32–54)

iii, investment in independence questionnaire; EQ-5D-5L, EuroQol 5-Dimension 5-Level; HADS-A, Hospital Anxiety and Depression Scale – Anxiety subscale; IQR, interquartile range; PHQ-9, Patient Health Questionnaire; SD, standard deviation.

Table 2. Eye screening outcomes.

	Screening data $N = 151$
Distance visual acuity, %	
No eye problems	59.6%
Unilateral problem	20.5%
Bilateral problem	19.9%
Near visual acuity, %	
No eye problems	49.0%
Unilateral problem	17.7%
Bilateral problem	33.3%
Macular function, for example central visual field loss %	
No eye problems	70.1%
Unilateral problem	21.5%
Bilateral problem	8.3%
Peripheral visual field loss, %	
No eye problems	80.7%
Unilateral problem	11.4%
Bilateral problem	7.9%
Referral required, %	
No, no eye problems	38.3%
No, already in eye care	40.3%
Yes	21.5%

Results

Demographic characteristics and response

Of an estimated 230 invited patients (exact number could not be established), 184 provided written informed consent (80%). Reasons for nonresponse were not willing to participate, not seeing any reason to participate since the patient is already under treatment of an ophthalmologist, too burdensome or refusal initiated by family members of patients. Eye screenings were completed in 151 participants, questionnaires were obtained from 170 participants, and 138 completed both. There were no significant differences in patient characteristics between responders who completed both tests and nonresponders on either test. The average age of the total study population at baseline was 80 years, and the majority of participants were female and living alone. Of all participants, 41% reported falls in the past 6 months, with the majority not having any fractures. About 18% had severe hearing loss, 22% had moderate to major depression, and 18% met criteria for subthreshold anxiety (Table 1). The mean PHQ-9 score was 5.5 (SD 0.5), and mean HADS-A was 3.6 (SD 0.3).

Ophthalmologic screening outcomes

Fifty-two per cent of the participants had an aberrant result on at least one of the basic ophthalmologic screeners: 19% had one, 27% had two, 8% had three and 5% had four unfavourable outcomes. The proportions of no, unilateral or bilateral unfavourable outcomes per screener are presented in Table 2. The number and distribution of participants with either a positive or a negative screening result on the Tumbling E screener, the reading chart, Amsler and/or confrontation visual field test are presented in Table 3. Visual impairment of the better eye (distance decimal visual acuity ≤0.3) was detected in 19.5%. On the self-report vision loss item, 10.2% reported to have bad eyesight or worse (very bad/total blindness) and 5.4% reported to be (severely) restricted in activities due to vision loss. Of those who had visual

Table 3. Number and distribution of participants with either a positive or a negative screening result between the four screeners.

	Distance VA +	Distance VA −	Near VA +	Near VA −	Macular function +	Macular function −	Peripheral field +	Peripheral field −
Distance VA +	x	x	37%	3%	19%	21%	13%	26%
Distance VA −	x	x	14%	46%	9%	51%	7%	54%
Near VA +	53	20	x	x	24%	26%	15%	35%
Near VA −	5	66	x	x	4%	46%	3%	47%
Macular function +	27	13	34	5	x	x	12%	17%
Macular function −	29	71	37	64	x	x	7%	63%
Peripheral field +	18	9	21	4	17	10	x	x
Peripheral field −	36	74	47	64	24	88	x	x

VA, visual acuity; + positive screening result; − negative screening result.

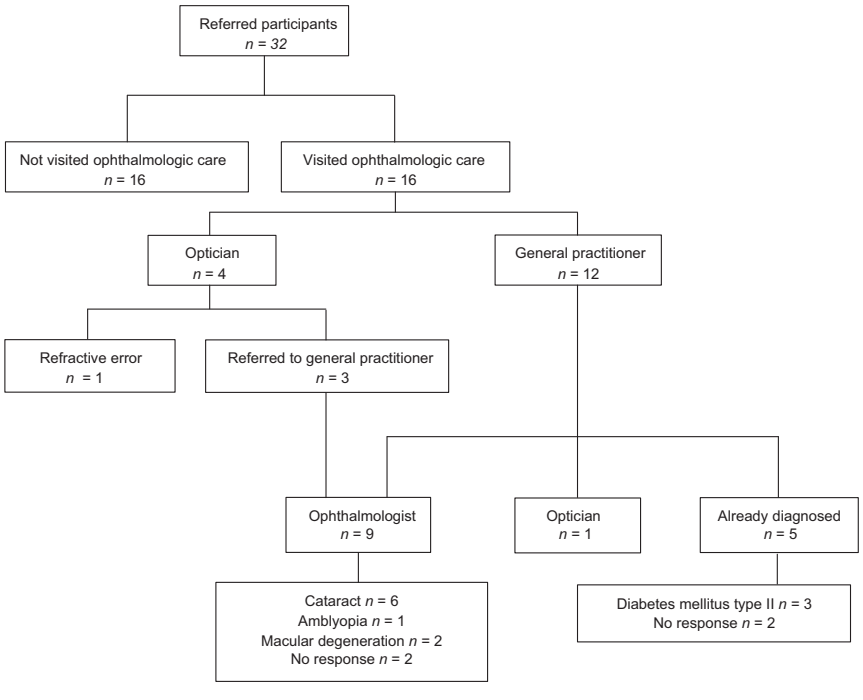

Fig. 1. Referral pathway from screening by home healthcare nurses to eye care providers.

impairment, 17.2% reported to have excellent or good eyesight and 34.5% reported not to be restricted in activities due to vision loss.

Number and feasibility of referrals

Of the 32 participants who were referred [21.5%, 95% confidence interval (CI) (14.9–28.1%), Table 2], 66% was referred because of a distance acuity problem, 84% because of a near acuity problem, 28% because of macular dysfunction and 25% because of peripheral field loss or due to multiple reasons.

Vision loss defined as a decimal visual acuity ≤0.3 of the better eye was present in 38% CI (20.7–54.3%) of referred participants; half of the participants actually visited their GP (n = 12) or initially their optician (n = 4) of whom three were sent forward to the GP. In 9 out of 15 cases, GPs referred their patients to an ophthalmologist, which is 6% of the total population that was screened. See Fig. 1 for the referral pathways and diagnoses.

Reasons for not visiting a GP or optician despite referral by the home healthcare nurses were as follows: forgetting (n = 2), not getting out of the house anymore or too ill (n = 3), not aware of being referred (n = 2) or still planning on going (n = 2). One participant died during the course of the study, and of six participants, the reason is unknown. There was no significant difference between the two groups who visited or did not visit the GP regarding age, gender and health outcomes. Of those who were referred, 39.2% reported to have excellent or good eyesight and 51.7% reported not to be restricted in activities due to vision loss on the self-report questions.

Nurses reported that depending on the participant it took 'a couple of minutes' to approximately 30 min to perform the eye screeners. Two-thirds of the nurses found the eye screeners not burdensome for their patients. Except for one, all nurses found the screeners feasible for use in practice, especially if the outcomes could be entered in the electronic patient registration system in future.

Differences in health outcomes between participants with vision loss and normal sight

Of participants both with screening and questionnaire data (N = 138), 29 [21% CI (14.2–27.8%)] had significant vision loss. When compared to participants with relatively normal sight, no significant associations were found on the PHQ-9, HADS-A and iii scores; however, differences in the EQ-5D-5L nearly reached significance, meaning a lower quality of life for participants with vision loss. Although relatively more participants with vision loss compared to normal sight had fallen in the past 6 months (52% vs. 38%), the odds ratios were not significant with respect to falls and fractures (Table 4).

Discussion

This study shows that basic ophthalmologic screening by home healthcare nurses has the potential to be feasible to reduce avoidable visual impairment. The number of frail elderly home

Table 4. Impact of visual impairment on health outcomes (N = 138)

	β unadjusted (95% CI)	p-value	β adjusted * (95% CI)	p-value
Quality of life (EQ-5D-5L)	−0.031 (−0.070–0.008)	0.115	−0.039 (−0.079–0.001)	0.057
Depression (PHQ-9)	0.177 (−0.163–0.517)	0.305	0.263 (−0.087–0.612)	0.140
Anxiety (HADS-A)	−0.133 (−0.474–0.207)	0.439	−0.068 (−0.419–0.282)	0.701
Independence (iii)	0.038 (−0.297–0.373)	0.823	−0.016 (−0.360–0.327)	0.925
	OR unadjusted (95% CI)	p-value	OR adjusted* (95% CI)	p-value
Falls	0.53 (0.22–1.23)	0.138	0.51 (0.20–1.29)	0.153
Fractures	0.51 (0.06–4.24)	0.529	0.48 (0.05–4.39)	0.516

β, regression coefficient; iii, investment in independence questionnaire; CI, confidence interval; EQ-5D-5L, EuroQol 5-Dimension 5-Level; HADS-A, Hospital Anxiety and Depression Scale – Anxiety subscale; PHQ-9, Patient Health Questionnaire; OR, odds ratio.
* Adjusted for gender, age, education level, marital status and self-reported hearing loss.

healthcare patients with a unilateral or bilateral ophthalmologic condition in this study was considerable (>60%); however, it turned out that a large number was already known in eye health care (40%) which is probably not a surprising result in a developed country where health care is accessible to most people. Nevertheless, over 20% (CI 15–28%) of frail elderly in need of home health care had newly detected significant vision loss and needed to be referred to a GP or other eye healthcare provider for further diagnostics or treatment; however, only 10% actually made use of the referral leading to the detection of treatable ophthalmologic conditions in approximately 5% of patients (e.g. cataract and uncorrected refractive error). Low referral uptake could be explained by frailty of patients having many other health issues that may have been more urgent and patients having forgotten to act upon the referral. Of those who were referred, 40% indicated to have excellent or good eyesight. Care professionals should be aware, however, that 17% with severe vision loss also indicated to have excellent or good vision, indicating that patients might not always be aware of their visual impairment. It might be necessary not to just advise patients to go to their GP, but to check the referral uptake regularly with the patient. Moreover, in a few cases, nurses referred participants to the optician or optometrist. For participants who actually visited an optician or optometrist (N = 4), three were subsequently referred to the general practitioner. Due to lack of power, it is not possible to draw strong conclusions about whether it should be recommended to always immediately refer to the GP instead of an optician or optometrist.

Since 20.4% of persons older than 65 years received home care in the Netherlands in 2014–2015 (Central Bureau of Statistics, 2016), screening could potentially be helpful in at least 30 000 patients in our country. Digital testing and electronic communication between home healthcare nurses and GPs or optometrists may even further stimulate easy detection of potential ophthalmological conditions that are treatable or preventable. In turn, early detection and treatment of visual impairment could lead to fewer falls (Harwood et al. 2005) and other unfavourable health outcomes such as fractures, depression or anxiety (de Boer et al. 2004; van der Aa et al. 2015). Interventions for the most common causes of visual impairment are cost-effective and might prevent early inpatient long-stay admissions (Baltussen et al. 2004; Cai et al. 2009; Limburg et al. 2014).

In addition, about 20% (CI 14–28%) turned out to have a significant visual impairment or blindness, which is comparable to Dutch nursing home populations (24%, Limburg et al. 2014), and indicates the increasing vulnerability in ageing populations at large. Moreover, the mean EQ-5D-5L index score for participants with vision loss (0.58, SD 0.19) was slightly lower compared to another Dutch elderly population with vision loss and comorbidity (0.63) but much lower compared to those without comorbidity (0.76, van Nispen et al. 2009), indicating worse health-related quality of life. The presence of depression, anxiety, falls and fractures was prominent in participants with vision loss, but also in participants with relatively normal vision suggesting the influence of comorbidity. Hence, relevant health outcomes did not seem to be clearly related to having visual impairment, but rather to having health problems in general. In addition, the ambition to stay independent was not different in home healthcare patients with significant vision loss compared to participants with normal vision. Still, in patients with irreversible vision loss, prescription of optical aids and/or low vision rehabilitation is recommended to improve quality of life and participation (van Nispen et al. 2010a; Alma et al. 2011).

Based on caseload, working hours and intrinsic motivation, some teams chose to appoint one nurse to do all measurements, whereas others decided to spread the workload of these measurements amongst team members. This explains why some nurses within one team only performed few measurements, whereas others performed many. Despite these differences between teams, the participating home healthcare service was able to quickly reach a large group of participants from across the Netherlands, which can be considered a strength of this study. However, due to heavy caseloads of the teams and limited time and resources to perform the study, information about nonresponse or reasons for exclusion could not always be obtained. In addition, home healthcare teams were reminded to actually perform vision screening with patients who provided informed consent; however, this did not always happen. Therefore, we cannot conclude with certainty that the study population is representative and that results are generalizable to all home healthcare patients. Other limitations are the lack of information about comorbidity and about the reason and nature of home health care which could be temporary

after hospital stay or long term due to chronic disease, and incomplete data on either the eye screener or questionnaire. Some limitations about the eye screeners should be mentioned as well: the precision of the distance of performing both acuity tests and the Amsler grid was estimated by the nurses and not measured. Although having four screening tests increases the probability of finding a problem (tests may pick up several visual function problems due to one ophthalmic disease), the confrontation visual field examination can be considered gross and is difficult to perform; that is these tests, but also the Amsler grid, are known for their false positives and low sensitivity when it comes to detecting smaller defects (Pandit et al. 2001; Crossland & Rubin 2007). Lack of precision and our test choice may either have over- or underestimated the results of the study. Moreover, the evidence from our data seems compelling to conclude that with a near acuity test alone we would have captured most of the referred participants with aberrant visual functioning (84%). However, with a CI between 72% and 97%, in theory, we could have missed between 9.1 and 1.0 persons out of the 32 who were referred on the basis of testing near acuity alone. If the starting point would have been near acuity and we added only the distance acuity test, in retrospect we would have captured 91% of the referrals CI (81–100%), that is, we may have overlooked between 6.2 and 0 persons. Although the design of our study does not allow to evaluate with certainty that a specific test would be superfluous, that is, test order was not randomized, there was no external criterion and inadequate power, more referrals with the Amsler grid were not captured if the near acuity test would have been our starting point, and only one more person would have been captured with the confrontation test. From a medical point of view, it can also be argued whether one should only use a near acuity test and choose between the other visual functions tests. For triage purposes and a sense of urgency of aberrant findings by home healthcare nurses (of the entire patient sample, 40% had more than one unfavourable outcome), the added value of using different tests addressing various visual functions is something to be considered in more detail in future studies.

In addition, according to the self-report items, fewer patients than expected based on the screeners reported to have problems with their vision. However, it is known that correlations between visual acuity and the self-reported experience of vision loss are low (van Nispen et al. 2010b). Findings are also in line with a study by Haanes et al. (2015) who found that over 80% of patients living at home with significant vision loss requiring a referral reported their own vision to be adequate. Furthermore, in this study four different aspects of visual functioning were screened compared to the rapid assessment of avoidable blindness studies that have been performed in many international studies assessing only distance visual acuity with a Tumbling E chart (Flaxman et al. 2017). Moreover, considering our results, we believe the four screeners are feasible as a first quick indication of potential ophthalmologic problems which, subsequently, should be repeated by the GP, optician, optometrist and/or ophthalmologist with advanced equipment. However, even if visual impairment is diagnosed, older adults do not always seek help, for example reasons not mentioned in this study but well-known are because of healthcare costs, especially the increasing obligatory deductible excess or expenses of new glasses and anxiety to undergo cataract surgery. Future studies should look into improving the referral pathways, the uptake of referrals by patients and the role of home healthcare nurses, and into optimizing precision and feasibility of the basic screeners by using digital charts.

As governments and society expect older individuals to live at home independently as long as possible and the absolute numbers of visual impairment in developed countries are increasing (Bourne et al. 2017), more resources are needed for practice and research in eye care. In turn, general implementation of ophthalmologic screening in vulnerable groups such as patients receiving home health care or living in nursing homes will put more pressure on eye care in general, making a broad debate with health policymakers, patient organizations, the ophthalmologic and optometric societies and low vision rehabilitation services an absolute necessity.

In conclusion, although this study should be replicated using larger numbers of patients to confirm findings, the number and referral of frail elderly home healthcare patients with a unilateral or bilateral ophthalmologic condition, which included patients having significant vision loss or being at risk, is considerable, but also a large number is already known in eye health care. One in five patients were visually impaired or blind, but relevant health outcomes did not seem to be clearly related to significant vision loss, but rather to having general health problems. One in five patients were referred to follow-up care, but only half of them made use of their referral. Basic ophthalmologic screening in a home healthcare setting seems a relevant and feasible measure to further reduce the burden of vision loss, thereby also contributing to the goal of the joint programme of the WHO and VISION 2020 The Right to Sight, a global initiative to eliminate avoidable blindness also in high-income countries.

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