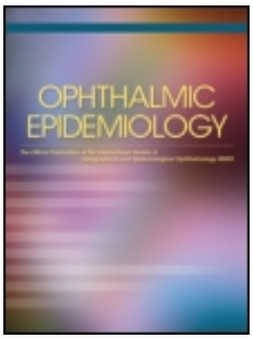

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Visual Acuity and Mortality in Older People and Factors on the Pathway

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ABSTRACT

Purpose: **To examine vision as a predictor of mortality in older people and the role of mobility, depressed mood, chronic diseases, body mass index, physical activity and injurious accidents in this possible association.** ***Methods:*** **223 persons aged 75 and 193 persons aged 80 years at the baseline participated in visual acuity measurements. Visual acuity (VA) of $<$0.3 in the better eye was defined as visual impairment, VA of $\geq$ 0.3 but $\leq$ 0.5 as lowered vision and VA$>$0.5 as normal VA. Death dates were received from the official register. Cox regression models were used to determine the relative risks of mortality and to study what factors lie on the pathway from poor vision to mortality.** ***Results:*** **Over the 10-year follow-up, 107 (48%) persons aged 75 years and 138 (72%) aged 80 years at the baseline died. The risk for mortality among the 75-year-olds with lowered vision was 1.98 (95 % CI 1.25–3.13) and with visual impairment 1.90 (95% CI 1.12–3.20) compared to those with normal VA. Lower walking speed, physical inactivity, cardiovascular diseases, injurious accidents, diabetes and depressed mood each attenuated the risk markedly. Nevertheless, lowered vision remained a significant predictor of mortality even after including all these variables in the model. Among the 80-year-olds vision did not correlate with mortality.** ***Conclusions:*** **Lowered vision and severe visual impairment predicted mortality in the 75-year-old but not 80-year-old population. The increased risk was partially explained by lower walking speed, physical inactivity, cardiovascular diseases, depressed mood, diabetes and injurious accidents.**

INTRODUCTION

Several studies have indicated that mortality rates are higher among older people with lowered visual acuity[1–8] as well as among people with total blindness.[9–10] In addition, eye-related diseases, such as age-related maculopathy, cataract, diabetic retinopathy and glaucoma correlate with shorter survival.[11–17]

The mechanisms behind the association between visual impairment and mortality, other than eye-related diseases, have not been widely studied. However, there is some evidence to suggest that there may be several factors on the pathway explaining the association. Lee et al. (2003) reported that severe bilateral visual impairment was associated with increased unintentional injury mortality in adults aged 18 and over.[18] In another study, after controlling for a broad range of confounders, such as depression, body mass index, reported number of falls and self-reported physical activity, the association between visual acuity and mortality was markedly attenuated.[19] However, in contrast to this in older adults between the ages of 65 and 84, depressive symptoms did not mediate the association between visual acuity and mortality.[2]

We hypothesized that factors known to increase mortality risk, which also often coexist with visual impairment, such as presence of diabetes, cardiovascular diseases, low level of physical activity, depressive mood and injurious accidents could underlie the association between poor vision and higher mortality. The purpose of this study was to determine whether visual loss is associated with increased all-cause mortality in a ten-year follow-up and what factors might lie on the pathway from poor vision to mortality in 75- and 80-year-old community-dwelling people.

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MATERIAL AND METHODS

Participants

The data are drawn from the multidisciplinary Evergreen project, which is a prospective study on health and functional capacity among older people resident in the city of Jyväskylä, Finland. The aim of the Evergreen Study is to describe the health and functional capacity of the older population, to examine changes during the follow-up and to identify factors related to conditions that predict the development of health and functional capacity. The Evergreen project has been described in detail elsewhere.[20] The target group for this study comprised all the community-dwelling older people aged 75 in 1989 (N = 388, 261 women and 127 men) and 80 in 1990 (N = 291, 213 women and 78 men) living in Jyväskylä, Finland. Altogether 295 (76%) persons aged 75 and 205 (70%) persons aged 80 participated in the laboratory measurements. Complete data on visual acuity was available for 223 persons aged 75 and 193 persons aged 80 years at the baseline. No significant differences were found in gender, baseline walking speed, ability to read a newspaper or mortality in 10-year follow-up between those with and without visual acuity measurements at baseline (Table 1). This study adhered to the tenets of the Declaration of Helsinki. Before the baseline measurements all participants signed an informed consent. The study was approved by the Ethical Committee of the University of Jyväskylä.

Assessment of vision and mortality data

Visual acuity (VA) was measured with and without spectacles with illuminated Landolt ring optotypes (Oculus 4512) at five meters distance. Both eyes were examined separately, first without spectacles and then if the participant had spectacles, the test was repeated with them on. Landolt ring chart consisted of 13 lines, scored from 0.125 to 2.0. The smallest line seen either with or without the subjects' own spectacles was regarded as the VA of the subject. By modifying the World Health Organization (WHO) classification[21] three visual acuity groups were formed: VA of <0.3 in the better eye was defined as visual impairment (VI) and VA of ≥ 0.3 but ≤ 0.5 in the better eye was defined as lowered vision (LV). In this study, visual acuity of >0.5 was defined as normal vision (NV). Death dates over the ten years after baseline measurements were received from the official population register of the province of Central Finland. Mortality data were received for every deceased subject who took part in the visual acuity measurements at the baseline.

Table 1. Comparisons between persons in the study target group with and without baseline visual acuity (VA) measurements. Frequencies, percentage and statistical significance (chi-square tests).

Characteristics	Participated in VA measurements	Did not participate in VA measurements	*p*-value
75-year-old persons			
Number of people	223	133	
Female gender	143 (64%)	93 (71%)	0.222
Major difficulties in reading a newspaper	15 (9%)	10 (10%)	0.443
Baseline walking speed*	1.6 ± 0.4	1.6 ± 0.4	0.866
Died during the 10-year follow-up	107 (48%)	65 (49%)	0.871
80-year old persons			
Number of people	193	75	
Female gender	137 (71%)	51 (74%)	0.643
Major difficulties in reading a newspaper	24 (13%)	9 (15%)	0.649
Baseline walking speed*	1.3 ± 0.4	1.1 ± 0.6	0.108
Died during the 10-year follow-up	138 (72%)	56 (77%)	0.393

*mean ± SD, statistical significance tested with independent samples *t*-test

Measures of potential factors on the pathway from poor vision to mortality

Physiological and psychological factors were selected for the analyses on the basis of their known or postulated association with increased risk for mortality. The following factors were measured at the baseline. Presence of diabetes or cardiovascular diseases was assessed by a physician on the basis of the subjects' self-report, current medication and clinical examination. Participants' weight and height was measured in the laboratory. Body mass index (BMI) was calculated by dividing weight (kg) by height (m) squared. Maximum walking speed was measured over ten meters in the corridor using a stop watch.[22]

Self-reported physical activity level was assessed on a six point scale modified from Grimby (1986)[23]: 1) most activities done sitting down, 2) light physical activity, 3) moderate physical activity about 3 hours (h) per week, 4) moderate physical activity at least 4h per week or heavy physical activity $\leq$ 4h a week, 5) physical exercise at least 3h per week and 6) competitive sports several times a week. For the statistical analysis, the answers were re-classified into 3 categories: 1) only low physical activity (answers 1 and 2), 2) moderate physical activity (answers 3 and 4) and 3) high physical activity (answers 5 and 6) . Depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale (CES-D).[24] The CES-D scale consists of 20 items with the total score ranging from 0 (no symptoms) to 60 (maximal number of depressive symptoms). In our analyses, persons, who scored 16 points or over were classified as having depressed mood.[24] Information about injurious accidents, which required medical inspection, was collected for 10 years after the baseline from the patient records of the local health care centers and central hospital.

Data analysis

Differences in baseline characteristics and mortality between persons with and without visual acuity measurements were tested with cross-tabulation with chi-square tests for categorical variables and independent samples t-test for continuous variable.

Mortality rates were expressed as number of deaths per 1000 person-years. Follow-up time was calculated from the date of

the baseline measurements to the date of death or to the end of the follow-up.

Using the Kaplan-Meier procedure with log-rank tests, mortality functions for the three different visual acuity levels were estimated. Multivariate analyses were performed using the Cox proportional hazards model. In order to assess differing mortality risk in the age and vision groups we tested the significance of an interaction term involving vision and age in the Cox model. Scaled Schoenfeld residuals were used to test proportionality of hazards using the method developed by Grambsch and Therneau (1994).[25] Plots of these residuals against untransformed time variable and using rank of time were used to gain insight into potential outlying observations. The outcome was the number of days from the baseline measurements to the date of death. The base model was adjusted for gender and socioeconomic status (net personal income per month).

The analyses was continued in order to find factors on the pathway from poor vision to mortality. Diabetes, cardiovascular diseases, body mass index (BMI), physical activity, walking speed, depressed mood and injurious accidents were added to the base model one at a time. As the event dates for the injurious accidents were known, they were added into the Cox regression model as a time-dependent covariate. In constructing the time-dependent variable, we assumed that the effect of an injurious accident would last for six months. The participant was counted in the category of having an injurious accident from the date of the accident until 180 days later. After six months, unless another accident had occurred, the participant was recategorized as having no injurious accident until another accident occurred or until the end of the follow-up.

The relationship between VA and each potential factor on the pathway was tested with one-way analysis of variance for continuous variables. For categorical variables cross-tabulation with chi-square tests was used. The association of each potential factor on the pathway with mortality was studied with independent samples t-test for continuous variables and cross-tabulation analysis with chi-square tests for categorical variables. When the variable was significantly related to both VA and mortality and attenuated their association, it was considered to be a factor on the pathway from poor vision to mortality.

The relative contribution of a potential factor on the pathway was estimated by first computing the hazard ratio (HR) for the vision terms in the model unadjusted for the factor on the pathway ($Risk_{baseline} = HR_{baseline}$-1), and then by calculating the hazard ratio for the vision terms in the model adjusted for a factor on the pathway ($Risk_{adjusted} = HR_{adjusted}$-1). The relative contribution of the factor was then calculated using the expression: $[(Risk_{baseline}\text{-}Risk_{adjusted})/Risk_{baseline}] *100\%$. Statistical analyses were carried out using SPSS version 13.0 and STATA statistical software.

RESULTS

Out of 223 persons aged 75 years, 47 subjects (21%) had VI, 75 subjects (34%) had LV and 101 subjects (45%) had NV. Among the participants aged 80 the corresponding numbers were 18 (9%), 48 (25%), and 127 (66%). Among the 75-year-olds, 156 persons (70%) attained the best VA with spectacles, with the corresponding number 144 (75%) among the participants aged 80 years.

There were no significant differences between men and women in baseline visual acuity levels. Men and women also had parallel results in the further analyses and therefore they were kept together. Although the test of Grambsch and Therneau (1994)[25] indicated that in some of the models the effect of gender was non-proportional at the conventional alpha-level of 0.05, plots of the residuals against time indicated that treating gender as time-dependent variable would not lead to substantial changes in the hazard ratios. Because the interaction term of visual impairment with age was statistically significant ($p = 0.030$), we decided to analyze the 75- and 80-year-old persons separately.

Over the follow-up 107 (48%) persons aged 75 years and 138 (72%) aged 80 years at the baseline died. The mean length of the follow-up until death or the end of the surveillance was 3172 (SD 1127) days among the 75-year old persons and 2654 (SD 1248) days among the 80-year-old participants. The mortality rate per 1000 person-years was 70 among the 75-year-old men and 47

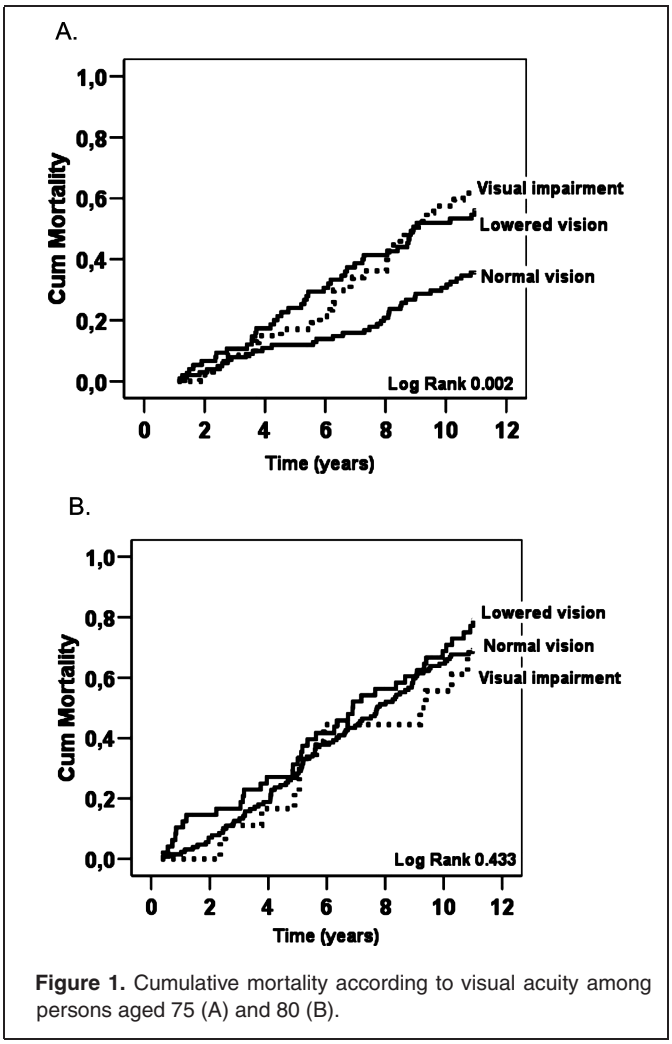

Figure 1. Cumulative mortality according to visual acuity among persons aged 75 (A) and 80 (B).

among the 75-year-old women. The mortality rates for the 80-year-old men and women were 101 and 81, respectively. Among the 75-year-olds, the follow-up mortality rate per 1000 person-years was 34 among participants with NV, 70 among participants with LV and 75 among participants with VI. The corresponding numbers among the 80-year-olds were 83, 101, and 75.

The log-rank tests showed that in the 75-year-old persons mortality differed significantly according to level of visual acuity ($p = 0.002$). Participants with normal vision had lower mortality through the ten-year follow-up than the participants with LV or VI. Among persons aged 80 mortality did not differ according to visual acuity ($p = 0.433$). Figure 1 shows the cumulative mortality in the different visual acuity groups in both age groups.

In Cox regression model visual acuity did not predict mortality among 80-year-old persons. However, among the 75-year-old persons in base model (adjusted for gender and socioeconomic status) both LV and VI increased the risk for mortality almost twofold in comparison with subjects having NV. We further investigated the possible effects of body mass index, diabetes, cardiovascular diseases, physical inactivity, walking speed, depressed mood and injurious accidents, because of their postulated association with mortality and visual loss among older people.

The analyses presented in Table 2 showed that in 75-year-old people presence of cardiovascular diseases, physical inactivity and lower walking speed correlated with both poorer vision and increased mortality. In addition, we found that the prevalence of depressed mood was higher among persons with LV and VI, compared to those with NV. Among the 80-year-old persons higher prevalence of cardiovascular diseases, lower physical activity and lower walking speed were associated with mortality. Lower walking speed also correlated with poor vision.

Table 3 shows the association between vision and mortality after adjusting for gender and socioeconomic status. Each factor potentially on the pathway from poor vision to mortality was added to the base model one at the time. We found that among the 75-year-old persons higher prevalence of cardiovascular diseases explained 28% of the association between LV and mortality and 19% of the association between VI and mortality. Lower physical activity explained 24% of the association between VI and mortality, but it did not attenuate the association between LV and mortality. Lower walking speed explained 22% of the association between higher mortality and VI, but it did not attenuate the association between LV and mortality. Depressed mood explained 17% of the association between VI and 13%

Table 2. Baseline characteristics in relation to vision and mortality. Percentage and statistical significance between the groups.

Characteristics	Survival Died	Survived	p-value	Vision NV	LV	VI	p-value
75-year-old persons	n = 107	n = 116		n = 101	n = 75	n = 47	
Female (n = 143)	56%	72%	0.016	59%	68%	68%	0.409
Diabetes (n = 15)	9%	4%	0.134	5%	9%	6%	0.515
Cardiovascular dis. (n = 132)	48%	71%	0.001	49%	69%	66%	0.012
Physical activity							
Low* (n = 50)	33%	14%		14%	25%	38%	
Moderate† (n = 156)	61%	80%		76%	71%	60%	
High‡ (n = 14)	7%	6%	0.003	10%	4%	2%	0.011
Depression§ (n = 68)	35%	28%	0.278	22%	45%	29%	0.006
Walking speed (m/s)	1.46 ± 0.45	1.71 ± 0.39	<0.001‖	1.7 ± 0.4	1.6 ± 0.4	1.4 ± 0.5	<0.001#
Body mass index	26.8 ± 5.1	27.4 ± 3.9	0.385‖	26.8 ± 4.1	27.4 ± 5.3	27.4 ± 4.2	0.618#
80-year-old persons	n = 138	n = 55		n = 127	n = 48	n = 18	
Female (n = 137)	68%	78%	0.164	66%	77%	89%	0.078
Diabetes (n = 26)	16%	7%	0.111	9%	21%	22%	0.075
Cardiovascular dis. (n = 128)	55%	71%	0.029	63%	75%	67%	0.325
Physical activity							
Low* (n = 63)	43%	11%		29%	50%	22%	
Moderate† (n = 120)	55%	86%		67%	50%	78%	
High‡ (n = 5)	2%	4%	<0.001	4%	0%	0%	0.052
Depression§ (n = 74)	45%	37%	0.326	44%	43%	29%	0.540
Walking speed (m/s)	1.27 ± 0.41	1.50 ± 0.38	<0.001‖	1.4 ± 0.4	1.2 ± 0.4	1.3 ± 0.2	0.010#
Body mass index	26.2 ± 3.9	27.0 ± 4.2	0.199‖	26.4 ± 4.2	26.3 ± 3.6	27.0 ± 3.5	0.790#

*moderate physical activity less than 4 hour per week.
†moderate physical activity more than 4 hours per week.
‡physical exercise more than 3 hours per week or competitive sports.
§Depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale (CES-D), the total score of 16 or over was defined as depression.
‖mean ± standard deviation, statistical significance calculated with independent samples t-test.
#mean ± standard deviation, statistical significance calculated with one-way ANOVA.
NV = normal vison; LV = lowered vision; VI = visual impairment.

Table 3. Association between different levels of visual acuity and mortality among 75-year-old persons (n = 223) and among 80-year-old persons (n = 193). Cox regression models for risk for death among those with lowered vision (LV) or visual impairment (VI) compared to participants with normal vision.

	75-year-old persons		80-year-old persons	
	LV	VI	LV	VI
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Base model*	1.98 (1.25–3.13)	1.90 (1.12–3.20)	1.13 (0.74–1.72)	0.92 (0.47–1.78)
Base model adjusted for†				
Body mass index	2.06 (1.28–3.32)	2.00 (1.16–3.45)	1.15 (0.75–1.76)	0.96 (0.50–1.87)
Diabetes	2.02 (1.28–3.20)	1.83 (1.08–3.09)	1.11 (0.73–1.70)	0.87 (0.45–1.69)
Cardiovascular dis.	1.71 (1.07–2.72)	1.73 (1.07–2.72)	1.13 (0.74–1.72)	0.94 (0.48–1.83)
Walking speed	2.04 (1.28–3.24)	1.70 (1.00–2.92)	0.93 (0.60–1.46)	0.89 (0.46–1.72)
Physical activity	2.02 (1.27–3.22)	1.68 (0.97–2.91)	0.98 (0.64–1.51)	1.10 (0.56–2.16)
Depression‡	1.85 (1.15–2.98)	1.75 (1.02–3.00)	0.71 (0.70–1.70)	0.74 (0.34–1.62)
Injurious accidents§	1.99 (1.25–3.14)	1.82 (1.08–3.08)	1.05 (0.69–1.61)	0.93 (0.48–1.80)
All of above	2.11 (1.27–3.48)	1.34 (0.75–2.39)	0.77 (0.48–1.26)	0.75 (0.33–1.67)

*Adjusted for gender and socio-economic status
†The base model was adjusted for possible factors on the pathway one at a time.
‡Depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale (CES-D)
§Injurious accidents were added into the model as the time-dependent variable assuming that the effect of injurious accident would last for six months.
HR = Hazard Ratio; CI = Confidence Interval

of association between LV and higher mortality. Injurious accidents explained 9% and diabetes 8% of the association between VI and mortality, but they did not explain the association between LV and mortality. Body mass index did not attenuate the association between vision and poorer survival.

When the variable was significantly related to VA and mortality and attenuated their association in the multivariate model, it was considered to be a factor on the pathway from poor vision to mortality. Therefore based on these results, lower walking speed, physical inactivity and higher prevalence of cardiovascular diseases may be considered as factors on the pathway from poor vision to mortality among the 75-year-old persons. We also found that injurious accidents, diabetes and depressed mood each attenuated the increased risk markedly in Cox regression model. However, in the final model, lowered vision remained a significant predictor of mortality among the 75-year-old participants even after including all variables in the model.

DISCUSSION

Results of our analyses showed that visual loss predicted mortality among 75-year-old people. In addition, we found several factors which lie on the pathway connecting poorer vision with mortality. The association between visual loss and higher mortality has been found in previous studies,[1–5,7–8] but our findings of the factors on the pathway are new. Further, the interaction term involving vision and age in the Cox model showed that the vision related mortality risk differed according to age at baseline. Among persons aged 80 years at baseline, vision did not correlate with mortality.

Our findings suggest that different processes may underlie the role of vision and deterioration of health at different ages. There are some earlier studies which are in line with our observations. In the study by Thiagarajan et al. (2005) participants with a mean age of 81 years did not have increased risk for mortality after adjusting the model for a wide range of markers of frailty.[19] Knudsen et al. (2006) also found that visual acuity of 0.5 or lower decreased survival more in younger age group (persons aged 43–65) than among persons aged 65–84.[26] It has been suggested that predictors of mortality may change over time.[27] In our study, visual acuity was measured either at the age of 75 or 80 years. Even though there is overlap in mortality surveillance for ages 80–85, the situation is not necessarily comparable as the age of the baseline assessment differed. The previous studies have found that low vision becomes increasingly common after 80 years of age.[28,29] Therefore it is possible that among those with lowered vision or visual impairment already at aged 75, underlying serious systemic factors, such as disease processes, are causing the higher mortality. As shown in Table 2, among 75-year-old participants cardiovascular diseases were more prevalent among those with lowered vision or visual impairment. In comparison, among participants aged 80 at baseline, the prevalence of diseases did not correlate with VA. In our analyses cardiovascular diseases explained almost the third of the increased mortality risk among participants aged 75. Further, we found that among the 80-year-olds in our study the mortality rate also among those with normal vision was very high. As a low vision becomes more common with increasing age with the decline accelerating around 80, it is possible that vision correlates with health differently at different ages.

Although an association between visual loss and mortality has also been found in previous studies, only a few studies have differentiated between levels of visual loss and their association with mortality. In most analyses, severe visual impairment (VA 0.3 or lower) has been studied.[5,9,14,19] The results obtained by McCarty et al. (2001) are consistent with our results. They found

that mortality risk was highest among those with visual acuity between 0.5 and 0.3; however, the participants ranged widely in age.[6]

To discover the factors behind the association between lower vision and mortality, we examined the role of BMI, diabetes, cardiovascular diseases, walking speed, physical inactivity, depressed mood and injurious accidents because of their known correlation with poorer vision and survival. We found that lower walking speed, physical inactivity, and higher prevalence of cardiovascular diseases explained part of this association among those with either LV or VI. We also found that injurious accidents, diabetes and depressed mood each attenuated the increased risk markedly. In previous studies factors explaining the association between vision and higher mortality have not been widely studied. Freeman et al. (2005) investigated the mediating effect of depression behind the association between visual impairment and mortality, but in their study depression did not explain the increased risk for death among participants with visual loss.[2]Thiagarajan et al. (2005) reported that after adjusting for depression, body mass index, number of falls and physical activity, the association between vision and higher mortality was markedly attenuated. They did not, however, investigate the extend to which each variable separately attenuated this association.[19]

In our study, the major part of the association between poor vision and higher mortality in 75-year-old community-dwelling persons remained, however, unclear. This indicates that the relationship between visual loss and mortality could also be direct. This is suggested by the results obtained by Freeman et al. (2005), who reported that persons aged 65 and older who gained in visual acuity (owing to cataract surgery or proper correction of refractive errors) over a 2-year follow-up period had a lower risk for death compared to those whose acuity worsened or did not change.[2]

Changes of vision could for example be a marker of physiological age. In our analyses, lower walking speed, one marker of frailty, explained only a minor part of this association. However, in all likelihood there are also other intervening factors behind the association between loss of vision and poorer survival than those studied here. Because we measured visual acuity with the participants wearing their own spectacles, best corrected VA could in some cases have been better than the values obtained in this study. The use of health care services may therefore also be one factor on the pathway from poor vision to mortality in our study population. It is possible that persons with inappropriate correction of refractive errors do not seek the care they may need for other health issues either and therefore their risk for mortality is increased. Lowered vision, due to inappropriate correction of refractive errors, may lead to several other difficulties in daily activities, which increase the risk for death. A previous study by Lupsakko et al. (2003) reported that deterioration in cognitive function was strongly associated with the lack of eye examination for visual impairment among persons aged 75 and over.[30] Therefore cognitive capacity or dementia could also explain some of the association between visual loss and mortality.

We do not believe that in our study selective drop-out would explain the association between loss of vision and higher mortality. As shown in Table 1, mortality during the ten-year follow-up did not significantly differ between non-participants compared to participants. Also self-reported inability to read newspaper in baseline was similar among between the participants and non-participants. Therefore, our results can be considered a rather realistic estimate of the effect of visual loss on mortality in relatively well functioning, urban older people. However, we can not completely rule out the possibility that VI and LV correlate with mortality also among the 80-year-old and older people. Visual acuity is not a static state. Data are not available about possible cataract surgery or other eye-related events, which may have affected visual acuity during the ten-year follow-up. In addition, we are not aware of the duration of visual loss. Although our potential factors on the pathway attenuated the risk for mortality, it is unclear whether loss of vision precedes or follows the factors included in the model. The available data are not sufficient to identify the causal relationships, with the exception of injurious accidents. For example diabetes and cardiovascular diseases may have occurred earlier and therefore they may be factors leading to visual loss. On the other hand, visual loss may have preceded physical inactivity and depressed mood and therefore these factors could be mediators between visual loss and higher mortality. Ideally, potential factors on the pathway from poor vision to mortality should be measured as events occurring after incident visual loss. However, the strengths of this study include relatively large number of participants, the use of a standardized measure of VA, a long follow-up period and register-based collection of the mortality data. We also had detailed data on the health and functional status of the participants.

In sum, this study showed that a significant and independent relation exists between both lowered vision and visual impairment and mortality in 75-year-old persons in a prospective study design. Further, higher prevalence of cardiovascular diseases, lower maximum walking speed, self-reported physical inactivity, depressed mood, diabetes and injurious accidents attenuated the risks. However, visual acuity is most likely associated with higher mortality via numerous pathways. Visual loss may be a marker of other underlying serious systemic factors or the aging process. Factors on the pathway from poor vision to higher mortality may also be behavioral or economic, for example inadequate use of health care services.

Future studies should focus on the effectiveness of measures to prevent visual loss and also the effect of proper correction of refractive errors. Our findings on depressed mood, cardiovascular diseases, physical inactivity, lower walking speed, diabetes and incidence of injurious accidents attenuating the association between VA and mortality could also provide targets for interventions. By providing opportunities for physical exercise and by effectively preventing and treating cardiovascular diseases, diabetes and depressed mood, increased mortality rates among older persons with visual loss could be attenuated.

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