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ORIGINAL RESEARCH ARTICLE

Visual Impairment Contributes to Frailty among a Group of Healthy Community Dwelling Older Population

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Abstract

Aim: To assess visual ability among healthy community dwelling old people and explore the relationship between visual ability and frailty.

Method: Community dwelling subjects aged > 60 were recruited from a district-wide health check program. Basic demographics were collected. Frailty was assessed by FRAIL scale. Binocular visual acuity (VA) was measured by Snellen chart. Functional status was assessed by the Timed-up-and-go test and Lawton IADL was used to assess independency.

Results: 207 subjects were recruited with a mean age of 74.6 (SD 8.5). 28.2% of them were robust according to the FRAIL scale and only 2% have normal vision. The frail group has a higher BMI, poorer IADL, longer timed-up-and-go test and low vision. Logistic regression found that low vision was the independent predictor for frailty (OR 16.6).

Conclusion: Visual impairment is independently associated with frailty. There is a need for systematic assessment of visual ability and frailty and to incorporate it as part of the existing healthcare services for the detection of at- risk subjects.

Keywords

Frailty, Elderly, Visual acuity

Introduction

Research studies [1] have shown that visual ability is of considerable importance for daily living and social functioning. Loss of vision or its limitation can be hazardous to independent living and quality of life. Deficits in vision and the ability to respond to visual cues can cause incorrect sensory inputs and lead to difficulties in perceiving the geographical environment, hazards and moving stimuli [2,3]. Visual impairment was shown to be one of the main deficiencies leading to limitation in activities [4]. On the other hand, frailty has a growing importance towards unfavorable clinical outcome among older people. Frailty is defined as a clinical geriatric syndrome characterized by increased 'latent vulnerability' resulting from the reduction of physiological reserves and the decreased capacity to cope with exogenous as well as endogenous stresses [5]. Many epidemiological studies have proved that frailty can predict many adverse outcomes, quality of life, use of hospital services and mortality, independent of diseases and disability [6]. It is proposed that interplay between visual impairment and frailty exists. One study [7] has indicated that poor vision is at high risk of falling. Although the risk of fall is usually multifactorial [8], visual disturbances such as reduced visual acuity, contrast sensitivity, and visual field loss can play a leading role [9]. Patients who fall may lead to adverse outcomes such as fractures and neurological injury and lead to increase in dependency, which may aggravate frailty. An English group found that older adults who experience poor vision and are not frail will have doubled the risk of becoming pre-frail or frail over 4 years [10]. Understanding the relationship between visual impairment and frailty may help to prevent or delay the onset of frailty in old people.

The aim of this study is to assess visual ability among a convenient sample of community dwelling older people and to assess the relationship between visual ability and frailty. It is hoped that early correction of visual impairment can help to protect against the development of frailty.

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Materials and Method

Subjects aged > 60 attending a district-wide voluntary body check program was included. Information on the body check program was advertised through district council board and flyers were set up in the elderly social centres on the details of the program which include the measurement of basic demographics, the collection of medical information based on the client's memory, functional assessment including measurement of the Timed-up-and-go test and visual acuity. Invitation of older subjects was made by the district council office and elderly social centres. Subjects who were interested in the program were registered through the district council office. Exclusion criteria were those who were chair bound, unable to communicate in Cantonese and poor vision that cannot undergo visual acuity examination.

Basic demographic information including age, sex, body weight measured by a standard clinic weight and body height were recorded. Body mass index (BMI) was calculated accordingly. Clinical information on major medical problems such as diabetes, hypertension, stroke, ischemic heart diseases was collected based on subjects' history. FRAIL scale was used for screening of frailty [11]. This is a 5-item scale which consists of 5 components: Fatigue, resistance, ambulation, illness, and loss of weight. Frailty range from 0 to 5 (1 point for each component; 0 = best to 5 = worst). A score of 3-5 is considered frail, 1-2 as pre-frail and 0 is robust. Binocular visual acuity (VA) was measured by Snellen chart under standard illumination at 5 meters. Subjects were allowed to wear their corrective lens during visual acuity measurement. Visual acuity was classified as no visual impairment (VA > 0.8), mild visual impairment (VA 0.7-0.33), moderate/severe visual impairment (VA 0.25-0.1) and blindness (VA < 0.1) according to the WHO classification for visual acuity [12]. Functional status was assessed by the Timed up and go test [13]. The subject was asked to stand from a sitting position, walk 3 meters and then turn around and walk back to the chair and sit. Each subject has 1 practical trial and the second trial is timed. They were instructed to walk as quickly, but as safely as possible. Use of their usual walking aids is allowed. A result below 10 s indicates normal mobility and above 10 s indicate an increasing problem with gait and balance with a consequence of an increased risk of falls. Lawton IADL test [14] was used to assess independence which provides a quantitative assessment of the patient's ability to perform activities of daily living. There are 8 domains: Ability to use the telephone, shopping, food preparation, housekeeping, laundry, mode of transportation, responsibility of own medications and ability to handle finances. It scored from 8 (very low function) to 24 (independent). Subjects were also enquiring on the history of falls and injuries in the past 12 months.

The primary outcome was the proportion of subjects with different visual ability. Secondary outcome was the association between visual impairment and frailty.

Subjects were classified into 3 groups based on their visual ability as normal (VA > 0.8), mild to moderate visual impairment group (0.8 > VA > 0.33) and low vision (VA < 0.25). Between-group differences on basic demographic data were analyzed by ANOVA for continuous variables and chi-square test for categorical variables. Logistic regression was set up to determine the association between visual impairment and frailty with adjustment for age, history of fall and physical function. A p-value < 0.05 is considered as statistically significant.

Results

230 subjects attended the body check program and 207 were eligible. There were 165 (79.7%) female and 42 (20.3%) male with a mean age of 74.6 (SD 8.5). The mean visual acuity was 0.426 (SD 0.19), mean timed up and go test was 11.8 s (SD 4.9), BMI was 32 (SD 5.23) and IADL was 22.5 (SD 3.1). Visual acuity was negatively correlated with FRAIL scale (r = -0.2, p = 0.004). When FRAIL scale was stratified into frail, pre-frail and robust group, there were 18 (8.7%), 130 (63.1%) and 56 (28.2%) subjects respectively. For visual acuity, only 4 out of the 207 belonged to the normal VA group. 176 have moderate visual acuity and 24 have low vision. Table 1 showed the demographic variables among the different frailty

Table 1: Basic demographics with visual acuity group.

	Frailty group			
	Frail (N = 18)	**Prefrail (N = 130)**	**Robust (N = 58)**	**P value**
Age (years)	77.39 (SD 9.33)	74.99 (SD 8.28)	72.83 (SD 8.61)	0.094
Female sex (%)	16 (88.9%)	104 (80%)	45 (77.6%)	0.576
BMI	35.19 (SD 6.11)	32.19 (SD 5.1)	30.72 (SD 4.88)	0.005
Visual acuity group				
low	5 (27.8%)	16 (12.3%)	3 (5.2%)	
moderate	13 (72.2%)	113 (86.6%)	52 (89.7%)	
good	0 (0%)	1 (0.8%)	3 (5.2%)	0.028
Timed up and go test (sec)	15.26 (SD 9.96)	11.83 (SD 4.31)	10.96 (SD 3.53)	0.007
Lawton IADL	19.11 (SD 6.58)	22.72 (SD 2.37)	23.1 (SD 2.23)	< 0.001
History of fall (%)	3 (16.7%)	35 (26.9%)	13 (22.4%)	0.568
Number of comorbidities	1.06 (SD 0.94)	0.91 (SD 0.79)	0.97 (0.84)	0.731

groups. There were no statistically significant differences between different frailty groups with age, sex, history of fall and the number of self-reported comorbidities. However, the frail group has a higher BMI, longer Timed-up-and-go test, poorer IADL performance and lower VA.

Subjects with low vision were significantly older than the moderate and the normal vision group (79.5 vs. 74.2 vs. 69, p = 0.005). BMI was also significantly higher in the low vision group than the moderate and normal vision group (34.4 vs. 31.8 vs. 29.6, p = 0.048).

52 of the study population has reported a history of fall within the previous 12 months. Among them, 13 has a history of fracture. However, there was no relationship between fall or fracture with frailty or VA.

Logistic regression was set up using the combined frail and pre-frail group vs robust group as the dependent variable, it was found that low vision was the only independent predictor for frailty (OR 16.69, 95% CI 12.4, 224.1, p = 0.034) after adjusting for age, BMI, Timed up and go test, IADL and number of self-reported co-morbidities.

Discussion

A lot of gerontological researchers focused mainly on defining the clinical and psychological characteristics of frailty [5,15,16]. Currently, frailty affects 25-50% of subjects older than 85 years of age [5] and multiple medical and social complications contribute to the development of frailty which could lead to an increase in mortality [5,17]. In our study, more than 70% of our sample are frail with a FRAIL scale > 1. Early intervention and preventive measures are necessary to deal with this functional decline and help to prevent these frail persons from deteriorating to more serious disabilities and dependency and the associated adverse events that resulted from these frailty states. Identification of at-risk population (i.e. Both frail and pre-frail state) and introduce effective intervention with the collaboration of primary care and specialist care are thus essential.

The prevalence of impaired VA is very common in our study, with only 4 out of the 207 subjects were considered as having a normal vision. These data are consistent with previous reports [18]. Among our group, low vision was associated with older age (p = 0.006), higher BMI (p = 0.048) and frailty (p = 0.028). Among these characteristics, the most important finding is that low vision was the only independent predictor of frailty.

As indicated in previous studies [7], visual disturbances play a major cause for fall. However, in our study, there is no relationship between visual acuity with falls and fractures and functional status. Fracture prevalence was not increased as a consequence of impaired vision. It is postulated that fracture risk may be affected by other factors and that visual impairment was not significantly sufficient to show its influence alone [19].

A standard Snellen chart was used to measure visual acuity in this study. This is a quick and repetitive screening test. As suggested by Harwood [19], the overall visual function is more important than any particular ophthalmic diagnosis. Binocular vision is of importance when one evaluates the risk of fall and frailty. Of course, one can also measure VA in each eye and also test for stereopsis and contrast sensitivity. However, these detail ophthalmological assessments need expert input and is time and resource consuming, which is difficult to apply in the community screening project.

Timed up and go test is a reliable test for assessment of physical function which has been confirmed by multiple studies on its content validity, concurrent validity and predictive validity [13].

FRAIL scale was used as a screening tool for frailty among community dwelling older person. A study has shown that FRAIL scale has a high specificity but with a low sensitivity in predicting physical limitation and mortality similar to frail phenotype and the golden standard of the multiple deficit model [20]. Other screening tests such as walking speed with a sensitivity and specificity of 83-92% and hand grip strength with 80-90% sensitivity and specificity on the identification of frailty also provide a good screening method. However, trained personnel are needed and the assessment is much more time-consuming. In the community setting with mass screening, a rapid and simple screening tool will be more favourable.

Increasing age has been reported as an independent risk factor for the decrease in visual acuity and ocular diseases and fall [21]. This is supported by the finding that those with moderate and low vision were significantly older than those with normal vision. Furthermore, age was correlated with Timed up and go test (r = 0.3, p < 0.001) and negatively correlated with IADL (r = -0.23, p = 0.001). This is explained by the physiological change in older people in which their physical performance will be reduced from their ageing body system.

The prevalence of frailty in this study is similar to other studies using different tools. The prevalence of community living Chinese people using the frailty phenotype definition range from 44-53% for pre-frail and 4.8% for frail state [22] which is similar to this study population in which 63% were pre-frail and 8.7% frail. Thus FRAIL scale can be considered for use as a first step in a step-care approach to detect frailty in the community so that clinicians can introduce target intervention to retard the decline in functional status and resultant disability. By early intervention, it is hoped that it can reduce the use of healthcare resources, hospitalization and promote psychological well-being.

Visual acuity was found to be the most significant factor for frailty. Despite this, many commonly used tools for frailty assessment [15,23] did not include sen-

sory function. In other words, the contribution of visual acuity to frailty is often missed. Visual loss was considered to produce a significant impact on daily function. Kallstrand-Eriksson [24] found a significant association between recurrent falls and lack of stereopsis with OR = 3.1. An Asian study also confirmed that autonomy is associated with visual impairment [25]. Incorporation of visual assessment into frailty assessment may help better detection of frailty among our older population. Frailty Risk Index (FRI) [26] include visual impairment as a criterion to define frailty. This FRI includes 13 independent predictors that represent an essential set of clinical risk indicators for pre-frail and frailty. These sets of criteria include psychological, central nervous system, mood, sensory, cardiovascular, respiratory, renal, nutritional and immune system. This indicates the multicausation of frailty. However, these 13 predictors were more time consuming since it includes blood parameters and lung function test. This limit its applicability in the community setting in which both personnel and equipment resources are limited.

A large population study by Zoler [27] did not find any relationship between frailty and visual disorder which is in contrast with this study results. The imbalance of frail and robust patients and their use of Fried criteria which focus mostly on physical performance and sarcopenia as indicators for frailty may have decreased the power of their analysis.

It is interesting to note that those frail and low vision groups have a higher BMI. It is well described in the literature that the association between BMI and frailty showed a U-shaped curve and this relationship was consistent across different frailty measures [28]. This study cannot show the other end of the spectrum of low BMI with frailty may be due to the relatively small sample size and the relatively high BMI among the study subjects. Similarly, an epidemiological study [29] reported those over-weight and obese people had poor visual acuity than the under-weight. There is not much literature to explain the association between BMI and visual acuity in the general population. It is suggested that there is a relationship between the grading of papilloedema and visual loss among patient with idiopathic intracranial hypertension [30]. These groups of severely obese patients are generally asymptomatic and that they might have been exposed to the deleterious effect of papilloedema for a longer period of time before the presentation and thus lead to high risk of visual loss. However, this study was done among patients with idiopathic intracranial hypertension. It is necessary to explore this relationship in a large sample of subjects without idiopathic intracranial hypertension.

There are limitations in this study. The degree of visual acuity may be overestimated when measurement of visual acuity under optimal standardized conditions with adequate lighting. Recall bias on fall history cannot be excluded since data were collected retrospectively based on the individual's memory. The underlying cause of visual impairment was not identified and general medical conditions were not reliable since it is only obtained by self-reporting. We cannot identify subjects with undiagnosed glaucoma which is a major cause of visual impairment.

The sample size may not have enough power to detect any significant association between frailty and any other risk factors and also explained the wide confidence interval of low vision as the independent predictor of frailty.

In conclusion, this study showed that visual impairment is independently associated with frailty. Given these results on the high prevalence of visual impairment and frailty, there is a need to have systematic screening for visual impairment in older people in clinical practice. Future research on the use of a simple assessment tool in the hospital and clinic setting for visual ability and frailty and establish a priority for the detection of at- risk subjects should be incorporated as part of the existing healthcare services.

Conflict of Interest

The author declares that there is no conflict of interest.

This study is approved by the local hospital research ethics committee.

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