
Balance

# Interaction Between Visual Acuity and Peripheral Vascular Disease with Balance

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**OBJECTIVES:** To determine whether visual acuity is related to balance in older adults with peripheral vascular disease (PVD) or diabetes mellitus.

**DESIGN:** Cross-sectional analysis.

**SETTING:** Canada.

**PARTICIPANTS:** Community-dwelling adults aged **45 to 85** from the Canadian Longitudinal Study on Aging **(N=30,097).**

**MEASUREMENTS:** **Visual acuity** was measured wearing habitual distance correction using the Early Treatment of Diabetic Retinopathy Study chart at a 2-m distance. **Poor balance** was defined as being unable to stand on 1 leg for at least 60 seconds. **PVD and diabetes** mellitus were assessed according to self-report of a physician diagnosis.

**RESULTS:**

People who reported **PVD (n=1,295)** were more likely to have **worse balance than** those who did not (odds ratio (OR)=1.50, 95% confidence interval (CI)=1.29–1.77).

In those who **did not report PVD (n=26,211), a 1-line worse score** on the visual acuity test was associated with **23%** higher odds of being unable to stand for at least 60 seconds after adjusting for age, sex, education, province, body mass index, and diabetes mellitus (OR=1.23, 95% CI=1.20–1.26).

In those who **reported PVD**, the odds of being unable to stand was almost **double** (OR=1.41, 95% CI=1.22–1.62). The interaction between visual acuity and PVD was **statistically significant** (P=.02).

# CONCLUSIONS:

- Visual acuity and PVD **interact** in their relationship with balance.

- People with poor vision and PVD may be at an especially **high risk of mobility difficulties.**

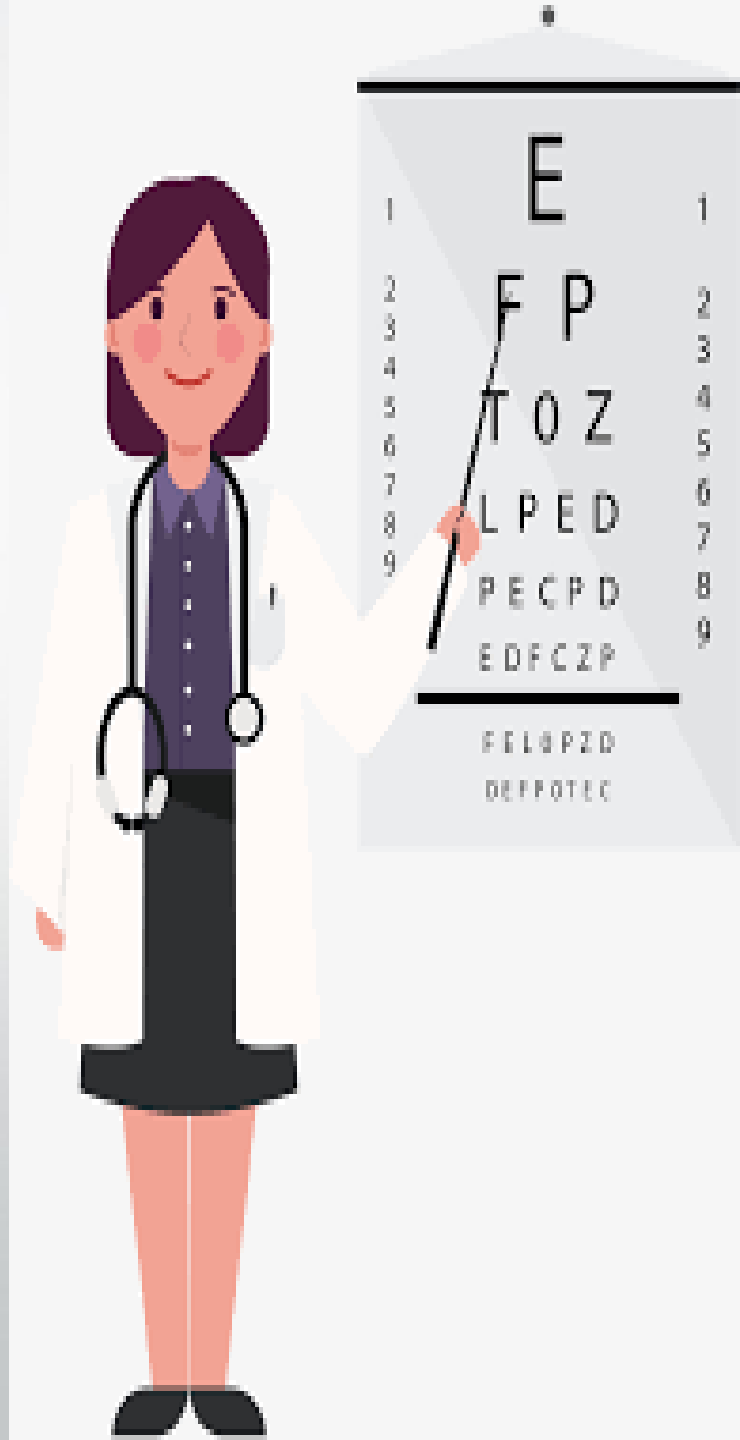
- **Mobility limitations** are an important predictor of poor quality of life, institutionalization, and mortality in older adults.

- A requirement for **good mobility** is the ability to maintain balance while performing various tasks. **Balance control** in older adults uses **sensory input** from the visual, vestibular, and proprioceptive systems and requires neural and musculoskeletal control to **correct postural disturbances**.

- **Diseases** that impair any of those sensory or correction systems may affect balance. Impairments in **more than 1** system may have a magnified effect on balance.

- **Vision loss** is a known risk factor for poor balance, in **complex balance** tasks such as **standing on a compliant surface or on 1 foot**.

- **visual acuity** **was not related** to simple standing balance positions such as **side-by-side or semi-tandem** but **was related to more complicated standing balance positions such as tandem and on 1 foot.**



- **balance control** is so **multifactorial**, it is important to consider the interactions between **vision** and other factors.

- **Interactions are important** to investigate because people who have **compromises in multiple balance control systems** may have a **much higher risk of poor balance** and may require more **urgent intervention.**

- **PVD and diabetes** may affect balance by **impairing proprioception and lower body strength.**

# METHODS:

**Participants**

**A random sample** of **30,097** community-dwelling adults aged **45 to 85** participated in the Comprehensive Cohort of the CLSA.

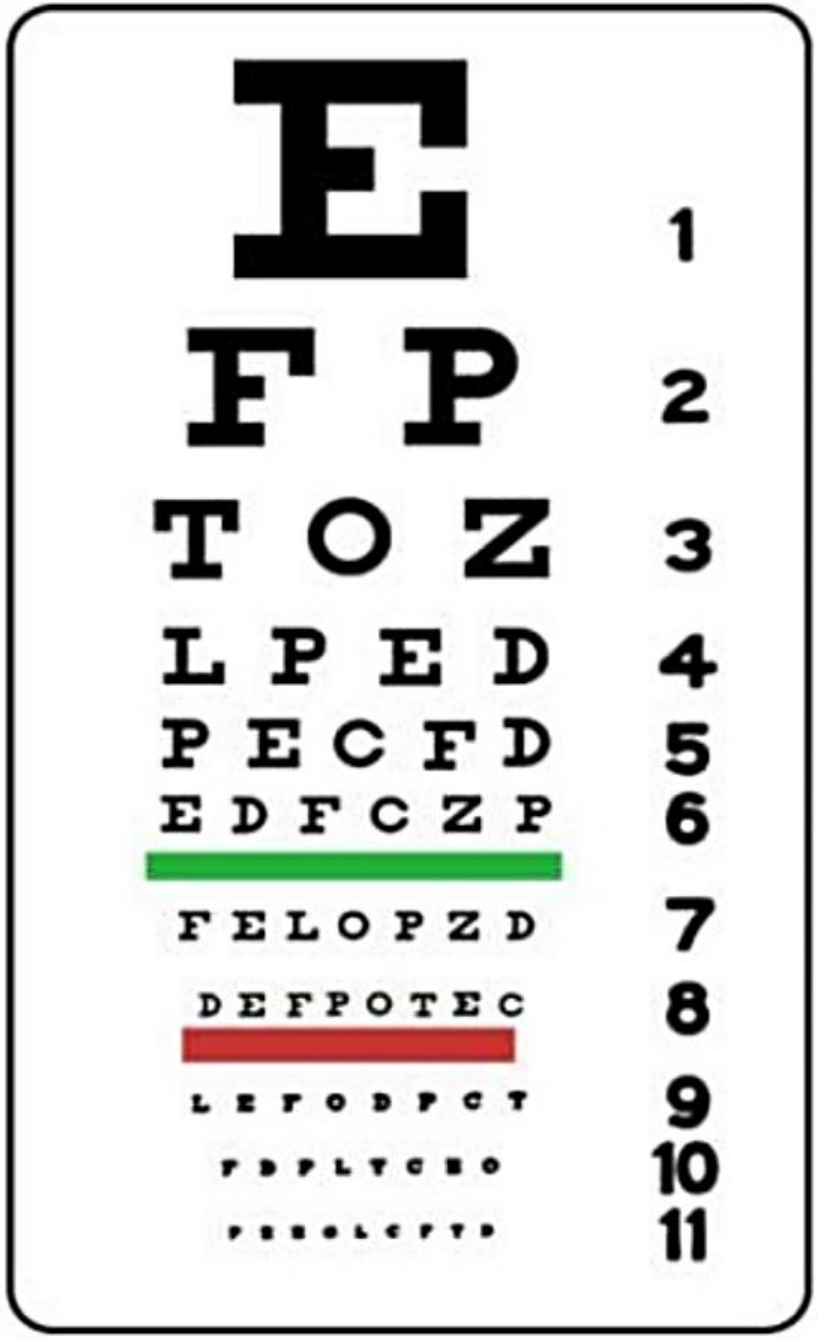
**Visual Acuity**

**both eyes open ,**Early Treatment of Diabetic Retinopathy Study (**ETDRS**) **chart at 2 m**.

**Acuity was scored** as the **total number of letters read correctly** and then converted to the log of the minimum angle of resolution **.**

**A logMAR** of 0.0 is **normal (20/20)** and of 1.0 indicates **blindness (20/200).**

# LOGMAR CHART:



# Balance Assessment

- The **1-leg standing test** is predictive of adverse events such as **falls and incident disability.**

- **Only** those who could **stand unassisted** were asked to perform the balance test. positioned **without shoes** approximately **1 m from a wall** and instructed to stand **on 1 foot** while **lifting the other leg to calf level** with **hands on hips**.

- **practice the procedure before** the timed test

- The time the person stood without putting the raised leg down, touching the wall, or losing balance was recorded for **up to 60 seconds**.
- The test was performed first on the right leg and then repeated on the left leg. The **better time of the 2 legs** was used for analysis.

- this **score was dichotomized** such that the person **could or could not stand for at least 60** seconds on the better leg.

**Sociodemographic Data**

Information was collected on age, sex, and education.

**Health Behavior and Health Status**

- Participants were grouped into 3 smoking status groups: current, former, and never.

**Former** smokers were people who had smoked at least 100 cigarettes in their lifetimes but had not smoked in the last 30 days.

**Current** smokers had smoked in the last 30 days.

- Participants were asked about a **physician diagnosis of diabetes ,PVD** or **poor circulation in the limbs**.

- BMI was calculated.

# RESULTS

who **were unable to stand unassisted** did not perform the standing balance test **(n=1,767, 5.9%).**
This group was **much older** (67.5) than those who performed the test (59.1) and **had worse visual acuity.**

- Of those **who attempted** the standing balance test, **44%** were **able to stand for at least 60 seconds** on one leg.

- A description of those **who could and could not stand for at least 60 seconds** on one leg can be found in **Table 1.**

**Table 1. Participant Characteristics According to Ability to Stand for 60 Seconds (N = 28,330)**

| Variable | 60 Seconds, n = 13,577 | <60 Seconds, n = 14,753[b] |
|---|---|---|
| Visual acuity, logMAR, mean ± SE (n = 28,102) | −0.02 ± 0.00 | 0.05 ± 0.00 |
| Age, mean ± SE (n = 28,330) | 55.14 ± 0.06 | 64.2 ± 0.10 |
| Sex, % | | |
| Female (n = 14,326) | 48 | 54 |
| Male (n = 14,004) | 52 | 46 |
| Education, % | | |
| > Bachelor's degree (n = 6,211) | 41 | 53 |
| Bachelor's degree (n = 6,797) | 31 | 25 |
| < Bachelor's degree (n = 15,272) | 28 | 22 |
| Smoker, % | | |
| Current (n = 2,374) | 8 | 10 |
| Former (n = 12,325) | 38 | 45 |
| Never (n = 13,535) | 54 | 45 |
| Diabetes mellitus, % | | |
| No (n = 23,467) | 90 | 80 |
| Type 1 (n = 147) | 0 | 1 |
| Type 2 (n = 2,446) | 4 | 12 |
| Neither or suspect (n = 1,991) | 6 | 8 |
| BMI, kg/m$^2$, mean ± SE (n = 28,308) | 26.77 ± 0.04 | 29.36 ± 0.06 |
| PVD (n = 28,207) | 3 | 6 |

Categories not adding to 28,330 had missing data for that variable: visual acuity (n = 228), smoking (n = 96), diabetes mellitus (n = 279), body mass index (BMI) (n = 22), peripheral vascular disease (PVD) (n = 123)
[b]All variables were statistically significantly different between the two groups using chi-square tests or t-tests.

who **could not stand for at least 60** seconds **had worse visual acuity**; were **older**; and were more likely to be **female** and to have **less education**, to have **smoked**, to have **diabetes**, to have **PVD**, and to have a **higher BMI**.

In Figure 1, the percentages of those who could not stand for 60 seconds are shown according to whether they had impaired visual acuity (<20/40) or PVD.

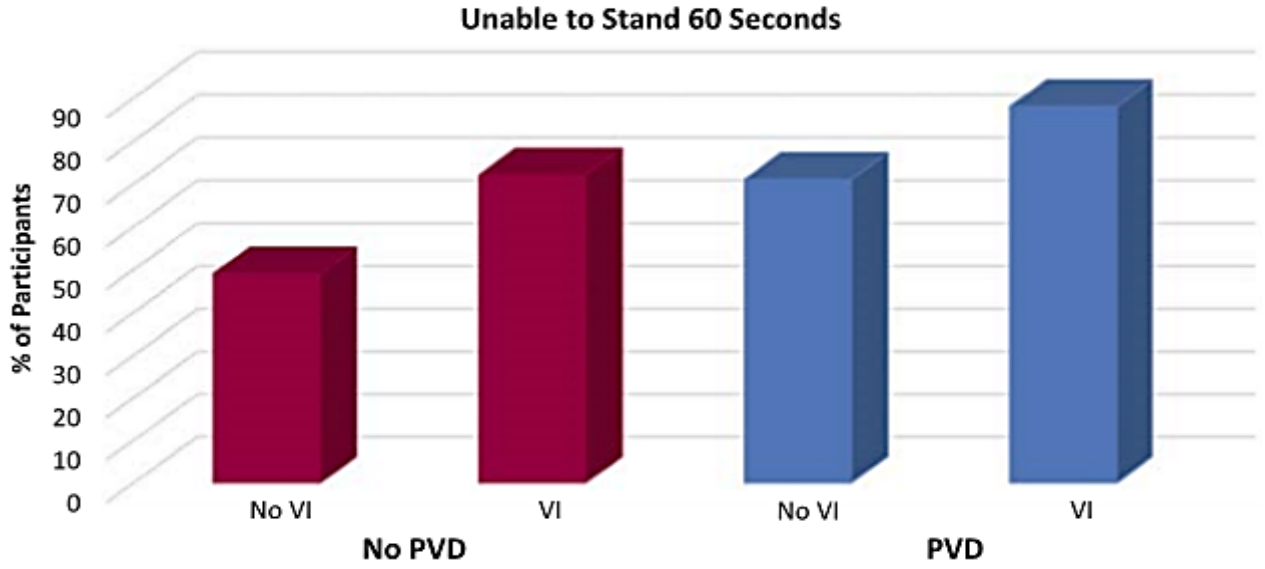



**Figure 1.** Percentages of participants who were unable to stand at least 60 seconds according to visual impairment (VI) and peripheral vascular disease (PVD).

The variables associated with being **unable** to stand at least 60 seconds after adjustment for each other in a multiple logistic regression model are shown in Table 2.

**Table 2. Variables Related to Poor Balance Using Multiple Logistic Regression**

| Variable | Odds Ratio (95% Confidence Interval) |
|---|---|
| Visual acuity, per line | 1.23 (1.20–1.27) |
| Age, per year | 1.13 (1.12–1.13) |
| Female | 1.45 (1.35–1.55) |
| Education (reference >bachelor's degree) | |
| Bachelor's degree | 1.02 (0.93–1.13) |
| < Bachelor's degree | 1.45 (1.32–1.57) |
| Smoking (reference never) | |
| Past | 0.99 (0.92–1.07) |
| Current | 2.24 (1.97–2.55) |
| Diabetes mellitus | |
| Type 1 | 3.41 (2.04–5.70) |
| Type 2 | 1.67 (1.46–1.90) |
| Neither or suspect | 1.05 (0.92–1.19) |
| Body mass index, per $kg/m^2$ | 1.13 (1.12–1.14) |
| Peripheral vascular disease | 1.50 (1.29–1.77) |

- **Visual acuity and PVD interacted** such that the odds of being unable to stand were **almost double** in those who reported PVD (Table 3).

- There **was not** a statistically **significant multiplicative interaction between visual acuity and diabetes** because the interaction term was not statistically significant (stratified data not shown) (interaction term P=.11).

- **Sensitivity analyses** were conducted to determine whether the results if we assumed that all **1,767 people who did not attempt** the standing balance test were unable to stand for 60 seconds. **The results did not change.**

Table 3. Results of Multiple Logistic Regression Models Showing Relationships Between Visual Acuity and Poor Balance Stratified According to Report of Peripheral Vascular Disease (PVD)

| Strata | Variable | Balance<60 Seconds Odds Ratio | 95% Confidence Interval |
|---|---|---|---|
| No PVD | Visual Acuity, Per 1 Line | 1.23 | 1.20, 1.26 |
| PVD | Visual Acuity, Per 1 Line | 1.41 | 1.22, 1.62 |

Models were adjusted for age, sex, education, smoking, body mass index, diabetes mellitus, and province.

# DISCUSSION

- we found for the **first time** that the relationship between visual acuity and standing balance was **much stronger in those** with a report of PVD, indicating **an interaction**.

- Conversely, although **diabetes** was **independently** associated with balance problems, **it did not interact** with vision because the OR for vision was the **same** regardless of the presence of diabetes.

- **Studies have reported** that other measures of **visual function such as visual field and motion detection** are **even more strongly** related to balance than visual acuity.

- **Another study** found that people with PVD were able to stand on 1 leg for **28% less** long than those without it.
- PVD is thought to affect balance through its effect on **leg strength** and **ischemic neuropathy** in severe cases.

- **Additional potentially modifiable variables were also related** to poor balance : 1.current smoking 2.Diabetes 3.BMI

- It is **not clear** whether this relationship is because of confounding factors (e.g., **smokers exercise less**) or a **direct effect of tobacco** on the vestibular system, peripheral nervous system, leg muscles, peripheral circulation, or brain.

- People with **Type 1 or Type 2 diabetes** also had worse standing balance. because of the effect of diabetes on the **peripheral nervous system**, although it could also be partially because of confounding factors such as muscle weakness and BMI.

- people with **higher BMI** had worse standing balance. It has been hypothesized that mechanisms such as **poor plantar sensitivity** and high mechanical demand due to a **large body mass** lead to worse balance.

- **A previous study** found that **inability** to stand on 1 leg for at least **5 seconds** was a predictor of an injurious **fall** in the **next 3 years** in adults aged 60 and older.

- Clinicians **treating people for PVD** may want to :

1. check their **vision**
2. **sensory testing** for neuropathy
3. **ankle-brachial index (**to exclude PVD).

- **Interventions designed** to improve balance could target :

  1.leg strength

  2.proprioceptive (tactile intervention for diabetes )

  3.Vestibular (for vestibular disorders)

  4.visual

**refractive error** is the leading cause of visual impairment, so an **ocular assessment** would be a wise addition to a multifactorial balance intervention.

# *Thank you*