Assessing Functional Status: Correlation Between Performance on Tasks Conducted in a Clinic Setting and Performance on the Same Task Conducted at Home

Sheila K. West,1 Gary S. Rubin,2 Beatriz Munoz,1 Deepa Abraham,1 Linda P. Fried,3 and the Salisbury Eye Evaluation Project Team

1Dana Center for Preventive Ophthalmology, 2Lions Vision Center, and 3Department of Medicine and Epidemiology, Johns Hopkins University School of Medicine, Baltimore.

Background. Many studies of functional status in elderly people use performance-based measures. There is an underlying assumption that these measures reflect, at least for some tasks, functional abilities in everyday tasks carried out at home. The purpose of this study was to determine the correlation between tasks carried out in the clinic and at home, and the role of visual impairment in performance at either setting.

Methods. We compared the performance of 97 participants in the Salisbury Eye Evaluation (SEE) project at the clinic and at home on eight different tasks: semitandem stand, functional reach, stair climb and descend, inserting a plug, looking up and dialing a telephone number, and reading.

Results. The correlations were good for all tasks, with coefficients ranging from .52 to .86. Those with visual impairment were slightly more likely to perform better at home compared to the clinic, although the differences were statistically significant only for the reading task. The most important predictor of performance on any task in the home was performance on the task at the clinic, even after adjusting for age, race, sex, education, and visual impairment. Educational level and visual impairment were consistent predictors of performance in the home for most tests.

Conclusions. We conclude that performances on standardized tasks in the clinic setting do correlate with similar tasks performed in the home, although the relationship is complicated in the presence of visual impairment.

Men and women aged 65 years and older are a rapidly growing segment of the population in the United States and internationally. It is estimated that more than 20% of the U.S. population will be aged 65 and older by the year 2020 (1,2). While the majority continue to live independently, over 40% of people aged 65 and older report difficulty in performing their usual activities (3). There is currently considerable interest in identifying the relationship between various age-related diseases and their consequences for functional status.

The methods for characterizing functional status are still evolving. Currently, investigators use methods that assess self-report of difficulty carrying out activities, and methods involving the observation of the performance on tasks. Performance-based measures are thought to have a number of advantages compared to self-report (4,5). First, performance-based measures offer the ability to assess change over time on a continuous scale, rather than broad, categorical changes. Second, the reliability may be better for individuals with mild to moderate cognitive impairment who are able to follow the task instructions, and performance can be assessed even if recall is impaired. Finally, performance-based measures of function may be better for “between-subject” comparisons, because the basis of comparison (i.e., performance on a specific task as observed by a grader) is the same.

Performance-based measures of function, particularly of activities of daily living (ADL) and instrumental activities of daily living (IADL) tasks, when collected in a standardized clinic setting, are presumed to be a meaningful reflection of the conduct of similar tasks as usually performed in the home. However, the extent to which performance on tasks conducted in a clinic setting under “idealized” conditions of lighting and clinic staff support reflects performance on the same task conducted in the home, which may have the advantage of being in a familiar environment, is not known. The purpose of this study was to determine the correlation between several performance-based tasks conducted at the Salisbury Eye Evaluation Clinic and the same tasks conducted in the participant’s home. Other aims included the determination of the role of visual impairment and other explanatory factors in predicting better performance in either setting.

METHODS

Population

The study is based on a subsample of participants enrolled in the Salisbury Eye Evaluation (SEE) project, a population-based study designed to determine risk factors for age-related eye disease and the impact of visual impairment on function in older adults. For this project, a random sample of more than 2,500 men and women aged 65–84 who reside in Salisbury, MD, have been recruited for a
home interview and a series of tests at the clinic. The visit at the clinic consists of a 4-hour session that includes vision tests, ocular photographs, questionnaire administration, and performance-based measures of function.

SEE participants seen at the clinic between July 13, 1994, and August 29, 1994, were asked if an additional set of performance tasks could be carried out in their home at a convenient time. Participants were asked at random without regard to data obtained in the clinic. Participants seen in the clinic were asked to participate when one investigator (D. Abraham) was present to recruit them. To explore the impact of visual impairment on functional testing in the home versus the clinic, eight additional participants seen between October 19 and June 20 who had binocular, habitual (not best corrected) vision worse than 20/40 were also recruited. Of the 133 participants who were asked to permit a home visit, 97 (73%) agreed to participate. Those who did not participate were equally split between refusals and those for whom there were scheduling difficulties. (All home exams had to be completed by September, and several participants were unable to be scheduled within that time frame.)

Tests

During the clinic visit, six performance-based measures of function were evaluated, and a comprehensive evaluation of visual function was performed. For this study, we selected the results of our evaluation of binocular visual acuity test as a measure of visual function. Binocular visual acuity was measured in the SEE clinic using the participant’s usual glasses and the visual acuity chart standardized for the Early Treatment of Diabetic Retinopathy Study (6).

All performance-based measures of function were carried out by four trained observers who were standardized among themselves. One of the four did all the measurements in the participant’s home. The performance-based tasks in the clinic and home were as identical as possible. The procedures for the two locations, and differences when necessary because of location, are described below.

Semitandem stand. — The time (in 0.1 sec, up to 30 sec) that the participant could stand with the big toe of one foot placed at the side of the heel of the other foot (7).

Functional reach. — The number of centimeters the participant could reach, starting from an upright position with the arm extended at shoulder length, and then bending forward, keeping the arm parallel to the starting level. Feet were side-by-side and could not move during the test measurement. The test was performed twice, with the average of the measures used in the analyses (7–9).

Stair climb and descend. — The number of seconds to climb up a set of stairs and the time to descend the same set of steps at a lighting level used routinely by the participant. In the clinic, participants are asked to climb seven steps, set at a 32° incline. At the home, stairs to a second level or basement level were used, if available. Data were collected on the amount of light at the top and bottom of the house steps (measured in lux), the length and height of the first step, the number of steps, and the type of surface of the steps at home. The angle of the steps was also calculated. Data are presented as steps per second.

Plug insertion. — The number of seconds to insert a plug into an electrical socket. A socket in the kitchen, preferably at waist level or higher, was selected. Light readings on the surface of the socket and the height of the plug from the floor were recorded in the home. In the clinic, a board with a plug and socket is presented at eye level to a participant seated at a desk.

Telephone number look-up and dial. — The participant was tested for the number of seconds to locate a telephone number on a standard page in a telephone book. A photocopied page of the local directory and the same number for all participants were used in the clinic setting. A photocopied page but different numbers were used at home. The number of seconds required to dial the number on a push-button phone in the clinic was recorded. The usual phone in the home was used for the home test, and the type of phone was recorded.

Reading test. — In the clinic, the reading test consisted of a standardized computer screen test of varying letter size which the participant read aloud. The number of words read correctly per minute was recorded (10). At home the participant was asked to read a paragraph previously selected out of a local newspaper and screened for similar difficulty. The participant read the passage from the actual newspaper. In both places, a practice run with separate passages was permitted for everyone. Lighting conditions and the use of assistive devices such as magnifiers were recorded in the home.

These performance-based measures were selected for the SEE project based on hypotheses that are part of the research studies on impact of visual impairment on functional status. The stands, reaches, and climbs were included for the study on balance disability, and the plug, telephone, and reading test were included for the study on various measures of visual function. These performance-based measures are not inclusive of all measures that could be tested for the concordance with performance at home, but were already part of our ongoing study.

Other potential explanatory factors were assessed at a home interview administered by a trained interviewer prior to the clinic visit. These factors include age, sex, race, educational level, and self-report of difficulty reading, using the relevant questions from the Activities of Daily Vision (ADV) questionnaire. This questionnaire was designed to determine self-report of difficulties in a number of tasks related to near and distance vision, glare, and day and night driving (11).

Data analyses. — These data represent a comparison of performance on the tasks conducted in the clinic compared to the performance on the same tasks conducted in their home for 97 participants. The association between testing in the clinic versus in the home was analyzed using Pearson correlation coefficients, and these coefficients are displayed in Figures 1, 2, 4–7. Paired t-tests were used to provide a measure of how closely performance at the clinic compared to performance at home. To predict performance at home,
multiple regression models were constructed with other variables hypothesized to be related to home performance included as predictor variables. Educational level and self-report of difficulty reading were ordinal variables in the model predicting reading speed.

**RESULTS**

The 97 participants were 67% female, 24% Black, and 60% aged 65-74 (see Table 1). A total of 20% of the participants in the sample had usual vision worse than 20/40. Between 95% and 100% of participants attempted each task in the home, except for the task of stair climbing, where 56 participants (58%) had no home staircase. Of the 41 participants with a staircase, 40 attempted the task at home. Participants who did not attempt to carry out activities in the home did so because they were unable or refused. Three persons did not attempt or refused to do certain tasks in the home that they had done in the clinic. In addition, three persons did perform the reading test in both the clinic and home, but the data for the home values were inadvertently not recorded. Two participants who did not attempt to do a functional reach in the clinic did perform the test at home.

We included two tests that were not expected to differ between home and clinic: the semitandem stand and the functional reach. It was thought that both tests did not require environmental cues to perform, and within the limits of measurement error, should be performed equally well in both sites. Most of the participants (71%) could perform the semitandem stand at home and at the clinic with no difficulty. Only 5% were unable to or could not stand as long as 30 sec in both sites. The remainder (24%) were split between better performance at home and better performance at the clinic. For semitandem stand, there appeared to be no trend toward better performance in either site.

The correlation between the average value for functional reach at home and the average value at the clinic was .52 (Figure 1). Participants tended to perform slightly better in the clinic for the functional reach, although the difference in means was only 2.2 cm (paired t-test = 3.88, p = .002).

The correlations for stair climbing were determined for the 41 participants who had a staircase at home. The correlation coefficient for walking upstairs between home and clinic was .77, and for walking downstairs was .76 (in stairs per second) (Figure 2). (The correlation coefficient between the stairs up and down in the home was .90.) The slope of the regression line for the speed in the clinic versus in the home was not significantly different from 1 (shown as the dotted line in Figure 2). Participants generally did better (i.e., were faster) at home than in the clinic. Only three participants performed better at the clinic going upstairs, and five going downstairs. One of the three and one of the five had inadequate lighting (less than 5 lux) on the stairs.

We analyzed the data from the clinic measurements for those who did (n = 41) and those who did not (n = 56) have stairs in their home. Those who had stairs in their home did better going up and down stairs at the clinic compared to

<table>
<thead>
<tr>
<th>Task*</th>
<th>n</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semitandem stand</td>
<td>95</td>
<td>97.9%</td>
</tr>
<tr>
<td>Functional reach</td>
<td>93</td>
<td>95.9%</td>
</tr>
<tr>
<td>Insert plug</td>
<td>97</td>
<td>100</td>
</tr>
<tr>
<td>Telephone number</td>
<td>95</td>
<td>97.9%</td>
</tr>
<tr>
<td>Telephone dial</td>
<td>95</td>
<td>97.9%</td>
</tr>
<tr>
<td>Reading</td>
<td>93</td>
<td>95.9%</td>
</tr>
<tr>
<td>Stairs†</td>
<td>40</td>
<td>41.2%</td>
</tr>
</tbody>
</table>

*All percentages of tasks were for percent attempted at home.
†Only 41 persons had stairs: 40/41 attempted stairs (97.6%).

![Figure 1. Correlation between performance on functional reach in the clinic versus performance at home setting (data are in centimeters).](https://academic.oup.com/biomedgerontology/article-abstract/52A/4/M209/581540/100240251540 by guest on 24 December 2018)
those who did not have stairs at home, although the differences were marginally significant (Figure 3). The difference in going down stairs was .09 stair per second ($p = .15$), and going upstairs was .11 stairs per second ($p = .05$).

We tested hand-eye coordination and upper extremity function using the task of putting a two-prong plug in an outlet. The correlation coefficient between the time to put in a two-prong plug in the clinic and home was .56 (Figure 4). Most participants (76%) performed better at home at this task. However, those with poor lighting at home tended to perform better at the clinic compared to those with adequate lighting at home (27% vs 16%), but the differences were not significant ($p > .05$). There was not enough variation in height of the plug from the floor at home to examine the impact of this variable. Those with poor vision defined as visual acuity worse than 20/40 were as likely to perform better in the clinic as those with good vision (Table 2).

For the telephone and reading tests, the association between performance at the clinic and at home was more complex. The correlation coefficient between finding a telephone number in the phone book at home and in the clinic was .62 (Figure 5). For those participants unable to perform the task in the clinic, or who took longer than 25 sec, performance was generally better at home. For those who took less than 25 sec, performance was generally better in the clinic. Those who were visually impaired were slightly more likely to perform better at home (62%) compared to those who were not impaired (55%), although the difference was not statistically significant (Table 2). All three participants who used magnifiers at home did better at home.

The correlation between performance at the clinic and home for the time to dial a number correctly on a phone was calculated, excluding the 14 participants with a rotary phone at home (Figure 6). Again, performance was generally better at home for those who took longer than 7 sec. Those who performed faster at home tended to have large numbers on the phone (11% vs 6%), but the difference was not significant. Lights in the dial of the home phone did not seem to affect performance. Participants with visual impairment were slightly more likely to do better at home (60%) compared to those with no visual impairment (56%), but the differences were not significant (Table 2).

Comparisons were made between the reading speed using a newspaper at home and the reading speed in the clinic of (a), text with letters subtending 0.5° (letters comparable to newsprint held at 40 cm), and (b), maximum speed of any letter size (Figure 7). The correlation between home and clinic reading at 0.5° text was .75. The correlation between speed at home and the maximum reading speed in the clinic was .86. For both comparisons, those

Figure 2. Correlation between speed climbing up and down stairs in the clinic versus in the home setting (data are in stairs per sec).
PERFORMANCE-BASED TESTING OF FUNCTIONAL STATUS

Figure 3. Comparison of the speed going up and down stairs between those who do, and those who do not, have stairs at home.

Table 2. Impact of Visual Impairment on Performance of Several Tasks in the Clinic Compared to Home

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Visually Impaired</th>
<th>Not Impaired</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n )</td>
<td>( % )</td>
</tr>
<tr>
<td>Put in plug</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Better at clinic</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>Better at home</td>
<td>14</td>
<td>74</td>
</tr>
<tr>
<td>Locate telephone number†</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Better at clinic</td>
<td>6</td>
<td>38</td>
</tr>
<tr>
<td>Better at home</td>
<td>10</td>
<td>62</td>
</tr>
<tr>
<td>Dial a number‡</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Better at clinic</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>Better at home</td>
<td>9</td>
<td>60</td>
</tr>
<tr>
<td>Reading a newspaper§</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Better at clinic</td>
<td>9</td>
<td>50</td>
</tr>
<tr>
<td>Better at home</td>
<td>9</td>
<td>50</td>
</tr>
</tbody>
</table>

*Habitual binocular vision worse than 20/40.
†Three subjects with visual impairment either refused or were unable to perform this task at home and one in the clinic.
‡Fourteen subjects (including 2 with visual impairment) had a rotary phone and are not included in the table. Two subjects with visual impairment did not attempt the task.
§Compared to maximum reading speed at clinic. Four subjects had no data recorded at home; one subject with visual impairment was unable to do the tests (\( \chi^2 = 16.5, p < .001 \)).

who were unable to read in the clinic or read 50 words per minute or less did better at home. Three people used magnifiers and did better at home than in the clinic. In the clinic, none of the three could perform the test with 0.5° text, but could read 50, 125, and 140 words per minute at home. Those with visual impairment read significantly better at home (50%) than those with no visual impairment (9%) (Table 2).

Regression models were developed to describe characteristics associated with performance at home for six tasks. We hypothesized that, in addition to performance in the clinic, age, sex, race, educational level, and visual impairment would predict performance (Table 3). Because clinic performance was so highly correlated with home performance, it was not entered into the model. Neither age nor gender was predictive of performance on any of the six tasks. None of the predictor variables was associated with performance on the stair climbs. Education and visual impairment were each associated with time to insert a plug, find a phone number and dial a phone, and reading speed. Those with vision worse than 20/40 read 56 words per minute slower than those with better vision. Interestingly, self-report of difficulty reading was not associated with reading speed at home after controlling for other factors.
DISCUSSION

Considerable work has been carried out evaluating the association between self-report of functional status and performance-based tests of function (4,5,12-18). While there appears to be moderate correlation between self-report and performance-based tests of function, performance-based tests appear to provide additional dimensions, at least in the area of mobility, beyond self-report of function (15,18). Performance-based testing appears to provide important information about the functional status of individuals and predicts subsequent disability and mortality, suggesting validity for use in assessing functional status (4). A premise of testing function with tasks in a clinic setting is that the data from these tests are representative of performance on tasks carried out in everyday activities. We evaluated this congruency by comparing participants’ performance on functional tasks carried out at the SEE clinic compared to performance on the tasks at home; the tasks were performed in a standardized fashion in a clinic setting compared to tasks done in the home setting using usual, adaptive mechanisms.

In general, there was good correlation between the scores on selected tasks performed at home and at the clinic. The correlation coefficients ranged from .52 to .86. Where performance was consistently better at home, such as on the task of stair climbing, the ranking of participants on performance at either site was similar. Within the limitations of our study, we conclude there is a good correlation between tasks performed in the clinic and at home.

For tasks with a strong vision component, such as reading speed or finding a phone number, the correlation was also good, but the slower participants tended to perform better in their home setting. This finding contradicted our expectation of a better performance in the clinic setting as a result of generally better lighting and other conditions. In fact, lighting was not necessarily a predictor of performance in either site, and it appears that a familiar environment and use of usual adaptive mechanisms may have led to an improvement of performance at home in those who generally performed slowly. While there was good correlation between performance in tasks at the clinic compared to at home, other factors were also predictive of home performance on some tasks. For tasks involving a strong visual component, such as inserting a plug, finding a phone number and dialing, and reading, predictors of better performance included education and having habitual vision of 20/40 or better.
There are limitations to our study. First, the home-based testing may itself generate somewhat artifactual data because of the presence of an observer in the home. Participants may try harder to be “successful” in the task in order to please staff. This limitation is inherent in performance-based testing procedures that require the presence of an observer, and it would also be true in the clinic. Although all observers were standardized, because of the study design the person evaluating performance at home was different from persons evaluating clinic performance. However, in the tests where we expected no difference between home compared to clinic performance there was no evidence of bias in performance at either site. Second, our sample size of 97 participants does not permit extensive data analyses on the explanatory factors for differential performance. For example, there was a trend for better performance at home compared to the clinic for those with visual impairment, but most differences did not reach statistical significance, except reading speed. Some differences may be significant if we had more power. Third, in order not to bias the larger study, the design of this substudy placed the clinic-based testing first, followed by the home testing. It is possible that performance-based testing was better at home for some tasks because of the “practice” in the clinic. However, for the tasks that were not expected to differ between environments, the semitandem stand and functional reach, performance was similar in both settings, and for the functional reach, slightly better in the clinic. Therefore, the impact of familiarizing the task in the clinic first was probably modest. Fourth, the structure of the tasks themselves may involve behaviors or functions that affect the performance apart from the function the test is designed to measure. For example, the reading test required the participant to read the words aloud in order to ascertain that words were read correctly. Participants with faster speech patterns will score higher on the reading test compared to participants who speak more slowly, even though the reading speed may be identical. Finally, we cannot generalize from these specific tasks.

![Figure 6. Correlation between the speed to dial a telephone number in the clinic versus in the home setting.](https://example.com/fig6.png)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Speed Downstairs (stairs/sec)</th>
<th>Speed Upstairs (stairs/sec)</th>
<th>Insert Plug (1/sec)</th>
<th>Find Phone No. (1/sec)</th>
<th>Dial Phone (1/sec)</th>
<th>Read at Home (words/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-.023</td>
<td>-.022</td>
<td>.000</td>
<td>-.001</td>
<td>-.002</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>(-.054, .008)</td>
<td>(-.049, .005)</td>
<td>(-.003, .002)</td>
<td>(-.001, .000)</td>
<td>(-.004, .000)</td>
<td>(-1.88, 1.96)</td>
</tr>
<tr>
<td>Sex (males)</td>
<td>.209</td>
<td>.145</td>
<td>.019</td>
<td>.000</td>
<td>.000</td>
<td>-3.18</td>
</tr>
<tr>
<td></td>
<td>(-.077, .495)</td>
<td>(-.112, .402)</td>
<td>(-.006, .004)</td>
<td>(-.007, .007)</td>
<td>(-.023, .013)</td>
<td>(-16.38, 22.73)</td>
</tr>
<tr>
<td>Race (White)</td>
<td>.246</td>
<td>.156</td>
<td>-.011</td>
<td>.009</td>
<td>.019</td>
<td>34.65</td>
</tr>
<tr>
<td></td>
<td>(-.119, .611)</td>
<td>(-.171, .483)</td>
<td>(.002, .021)</td>
<td>(.001, .018)</td>
<td>(.002, .041)</td>
<td>(9.93, 59.37)</td>
</tr>
<tr>
<td>Education</td>
<td>.036</td>
<td>.052</td>
<td>.014</td>
<td>.009</td>
<td>.019</td>
<td>19.17</td>
</tr>
<tr>
<td></td>
<td>(-.125, .197)</td>
<td>(-.193, .197)</td>
<td>(.001, .029)</td>
<td>(.005, .013)</td>
<td>(.008, .030)</td>
<td>(7.28, 31.06)</td>
</tr>
<tr>
<td>Visual acuity worse 20/40</td>
<td>.122</td>
<td>.174</td>
<td>-.051</td>
<td>-.016</td>
<td>-.026</td>
<td>-56.46</td>
</tr>
<tr>
<td></td>
<td>(-.294, .538)</td>
<td>(-.200, .548)</td>
<td>(.083, -.020)</td>
<td>(.025, -.007)</td>
<td>(.049, -.003)</td>
<td>(-85.15, -27.77)</td>
</tr>
<tr>
<td>Self-Report of difficulty reading</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

**Notes:** Performance in the clinic for the same tasks was not entered into the regression models because of the high correlation with the performance at home. The odds ratios in bold face are significant, p < .05.
performance-based tests to other tests that may be used to assess function. There are many other performance-based tests of functional status that may have a better, or worse, correlation with comparable tasks carried out in the home.

Our participants were part of a random sample of the Salisbury population aged 65–84 and were representative of the community-dwelling elderly (19). In addition, the sample was enriched with participants who had visual impairment. In general, the functional status was good in this sample, so caution is indicated in generalizing our findings to those populations with more physical functional impairment, where the associations may have more variability.

For reading tasks, those with visual impairment tended to perform better at home. In fact, clinic-based measures may underestimate the usual functioning of persons with visual impairment unless adaptive mechanisms, such as the use of magnifiers or large letter sizes, are incorporated into testing. Presumptions of actual performance at home, based on tests conducted under standardized clinic situations, may need to take into account visual impairment status, use of adaptive mechanisms, and other factors. Future research should focus on adaptive mechanisms that are used by participants to improve performance in the home. Such mechanisms may well be simple and could prove useful to others with functional impairment.

ACKNOWLEDGMENTS

This research was supported by Grant AG-10184 from the National Institute on Aging.

Address correspondence and requests for reprints to Dr. Sheila West, Wilmer 129, Johns Hopkins Hospital, 600 N. Wolfe Street, Baltimore, MD 21287-9019.

REFERENCES


Received March 12, 1996
Accepted October 11, 1996