

Purdue Pegboard Age and Sex Norms for People 40 Years Old and Older

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A group of 212 healthy 40- to 85-year-olds were administered the Purdue Pegboard test of manual dexterity. The four subtests included dominant hand, nondominant hand, and bimanual performance as well as a more complex bimanual task, assembly. Differences between scores of each hand were calculated to evaluate lateralization. Performance on all subtests slowed significantly with increasing age. Women were significantly faster than men on all tasks, but the rate of age-related decline in performance did not differ between sexes. Lateralization, which was significantly greater in women ($p < .01$), tended to increase with age, but this trend was not statistically significant. This study provides age- and sex-specific normative values for Purdue Pegboard performance in individuals over age 40 and specifically emphasizes the need to consider sex when evaluating manual dexterity.

The Purdue Pegboard is a commonly used test of manual dexterity (Tiffin, 1968). Originally developed in 1948 to evaluate industrial applicants, it is

now often used clinically to assess central nervous system impairment. In the early 1960s, Purdue Pegboard performance scores were suggested as a means of screening for organic brain dysfunction (Costa, Vaughan, Levita, & Farber, 1963). Despite widespread use of this instrument, normative values by age and sex are not available for the general population over the age of 40.

Aging is classically associated with slowing of nearly all timed motor activities. Reports of normative values for Purdue Pegboard performance nevertheless tend to ignore age or, as in the case of early clinical studies, divide groups into "young" and "old" at a single arbitrary point such as age 60 (Costa et al., 1963; Vega, 1969). Sex is also frequently ignored, although women demonstrate superiority over men on many tasks of manual dexterity (Kellor, Frost, Silberberg, Iverson, & Cummings, 1971; Mathiowetz, Volland, Kashman, & Weber, 1985). Yeudall and colleagues have begun to address the problem of inadequate normative data on the Purdue Pegboard and other neuropsychological tests by publishing results by sex and age group for those aged 19 to 40 (Yeudall, Fromm, Reddon, & Stefanyk, 1986). Similarly, Purdue Pegboard norms have been reported for adolescents (Mathiowetz, Rogers, Dowe-Keval, Donahoe, & Rennells, 1986). Such measures are missing, however, for older adults, perhaps the most important group of concern.

Lezak (1987) pointed out the dearth of instruments with appropriate age-graded norms in light of proven age-related changes in cognitive, sensory, and motor functions. The elderly make up a substantial proportion of patients seen for central nervous system evaluations, yet age-specific norms for performance on this relatively simple motor test are lacking for even those as young as age 40. Purdue Pegboard test results by sex and decade of age for nonimpaired persons over the age of 40 are therefore presented here.

METHOD

Participants were 212 (91 male, 121 female) healthy volunteers enrolled in the Johns Hopkins Teaching Nursing Home Study of Normal Aging. Written informed consent was obtained from each participant. To be eligible for the study, a person could not have had a reported history of any of the following conditions: head trauma, stroke, seizure, uncontrolled hypertension, pulmonary edema, liver failure, renal failure, congestive heart failure, uncontrolled thyroid dysfunction, electroconvulsive therapy, sleep disorders, coma, psychiatric disorders, or alcohol/drug abuse. Full use of both hands (as reported by the participant) was also required for inclusion in the analysis of Purdue Pegboard test results. Participants were

screened for cognitive impairment by the Mini-Mental State Examination (M. F. Folstein, S. E. Folstein, & McHugh, 1975).

The Purdue Pegboard test was administered according to standardized procedures (Tiffin, 1968) as part of a comprehensive neuropsychological evaluation. Participants placed metal pins, one at a time, into a row of pegboard holes first with the dominant hand, then with the nondominant hand, followed by placing pairs of pins with both hands simultaneously. In the fourth and final subtest, a pin, washer, collar, and second washer were assembled in an operation requiring both hands. Three 30-sec trials were conducted for each subtest, with the exception of the assembly subtest, which is scored on three 60-sec trials. Subtest scores consisted of the average number of pins placed in the first three subtests and the average number of components properly placed in the assembly subtest. Differences between dominant- and nondominant-hand scores were also calculated as an index of lateralization.

RESULTS

A description of the group volunteers is presented in Table 1. Most participants had at least a high-school education. Their occupational backgrounds represented a mix of occupations, including professionals, clerical workers, and laborers. There were no significant differences in mean age or education level by decade of age. None were found to have evidence of cognitive impairment on the Mini-Mental State Examination (i.e., a score less than 24 of 30).

Table 2 shows results of performance on each of the Purdue Pegboard subtests by sex and decade of age. Results of a two-way analysis of variance (ANOVA) yielded significant effects of sex on the dominant-hand, $F(1, 202) = 24.44, p < .001$, nondominant hand, $F(1, 202) = 6.48, p < .05$, bimanual, $F(1, 202) = 4.77, p < .05$, and assembly, $F(1, 202) = 5.78, p$

TABLE 1
Characteristics of Study Population

	Age Group				
	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89
<i>n</i>	40	47	53	48	24
Men/women	19/21	20/27	24/29	17/31	11/13
Mean age in years (<i>SD</i>)	44 (3.3)	55 (2.9)	65 (3.0)	74 (2.6)	83 (2.8)
Mean years of education (<i>SD</i>)	15 (3.0)	13 (3.0)	13 (2.7)	15 (3.2)	16 (2.5)

TABLE 2
Performance on Purdue Pegboard by Age and Sex

	Age Group									
	40 to 49		50 to 59		60 to 69		70 to 79		80 to 89	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<i>Women (n = 121)</i>										
Dominant hand	15.9	1.45	15.0	1.56	14.6	2.03	13.8	1.27	12.9	1.80
Nondominant hand	15.2	1.48	14.4	1.69	13.9	1.78	12.9	1.52	11.3	2.05
Both hands	13.1	1.56	12.1	1.30	11.6	1.87	10.5	1.19	9.2	1.92
Assembly	39.8	4.54	34.6	8.21	31.7	6.83	29.1	4.85	21.9	4.54
Difference between hands ^a	0.73	1.047	0.63	1.312	0.71	1.234	0.94	1.394	1.56	1.235
<i>Men (n = 91)</i>										
Dominant hand	14.6	2.06	14.4	2.15	13.6	1.74	13.0	1.90	10.8	1.33
Nondominant hand	14.4	2.35	13.9	2.19	13.1	1.56	12.4	1.48	10.6	1.84
Both hands	12.2	2.43	11.9	2.22	10.9	1.46	10.4	1.27	8.5	1.21
Assembly	34.9	7.66	33.8	9.66	28.0	5.06	27.5	5.06	21.5	4.81
Difference between hands ^a	0.16	1.193	0.23	1.205	0.44	1.859	0.59	0.932	0.18	1.463

^aDominant-hand score minus nondominant-hand score.

< .05, subtests. The performance of women was better than that of men. An even stronger effect of age was seen on all four subtests, with older age groups performing more slowly than younger age groups. For dominant, nondominant, bimanual, and assembly subtests, $F_s(4, 202) = 16.89, 21.48, 23.80$, and 27.02 , respectively, with $p < .001$ in each case. No interaction effects between age and sex were apparent when tested by ANOVA.

As mentioned, degree of lateralization was evaluated for each individual based on the difference between the first two subtests—that is, the difference between average performance with each hand. With the exception of a few individuals, dominant-hand performance typically was better than nondominant-hand performance. There was a tendency for the mean of this difference to become greater with increasing decades, as seen in Table 2, although age did not prove to exert a statistically significant effect when tested by ANOVAs. This measure of lateralization varied widely within each decade. A consistent sex difference was apparent for all age groups, with women showing more lateralization. This sex effect was significant in a two-way ANOVA, $F(1, 202) = 9.61, p < .01$.

Although the performance of both men and women declined with increasing age, a test for equality of slopes failed to show a significant difference in that decline between the sexes. The rate of age-related change, therefore, did not differ by sex.

DISCUSSION

Psychomotor slowing with age has been described and studied extensively (Salthouse, 1976; Salthouse & Somberg, 1982). The results presented here confirm the expected association between aging and motor performance on the Purdue Pegboard test among participants who were healthy and carefully screened for cognitive impairment. Screening with the Mini-Mental State Examination avoided the possibility of accentuating an association between age and performance decrement by including impaired individuals (Benton, 1977).

Several sets of normative data have been presented in the manual that corresponds to the most recent version of the test (Tiffin, 1968). These demonstrate that performance is expected to vary according to skill level and sex. Job applicants do not require age-specific norms for evaluation because they tend to be homogeneous in age. The studies that originally introduced the test to clinical use did attempt to take age into account but only by dividing the groups at either age 40 or age 60, a very crude stratification. Sex of those in that early sample was not even reported. According to the results presented here, age and sex must be taken into account when attempting to assess whether performance is "normal."

The Purdue Pegboard test is a test on which women generally perform faster than men (Tiffin, 1968; Yeudall et al., 1986). The same trend has even been demonstrated in adolescents (Mathiowetz et al., 1986). Men, however, are faster on many timed motor tasks such as finger tapping (Bornstein, 1985; Yeudall, Reddon, Gill, & Stefanyk, 1987) and simple visual reaction time (Bleecker, Bolla-Wilson, Agnew, & Meyers, 1987). The component of pegboard tasks that seems likely to provide the advantage to women is heavy reliance on dexterity or fine-motor movements. Consistent with the current findings, women are more successful than men on other tests involving fine-motor dexterity (Kellor et al., 1971; Mathiowetz et al., 1985).

Lateralization on a pegboard task has been reported to increase with increasing age (Weller & Latimer-Sayer, 1985). Although a similar trend was seen in this study, the effect of age was not statistically significant. When the effect of sex was considered, however, women showed significantly more lateralization than men. Although Weller and Latimer-Sayer (1985) stated that there were no sex differences on any of their measures, there is no indication that those comparisons were adjusted for age. The sex distribution by age group was not presented for their study.

The greater degree of lateralization in females on this fine-motor dexterity task contrasts with the general agreement that men are more lateralized on verbal and visuospatial functions (Lezak, 1983). Further investigation of lateralization on dexterity tasks would be of interest.

As Lezak (1987) pointed out, age-specific norms are badly needed for

many neuropsychological tests popularly used to evaluate aged adults. In the development of those norms, however, it is important to consider the potentially confounding effects of sex differences. Study populations made up of normal, healthy volunteers tend to acquire a disproportionate number of women in the older age groups because, demographically, there are more older women available in the general population to participate. If the sexes are not equally represented in each age group following recruitment and there is an association between test results and age, then sex must be treated as a potentially confounding variable in the analysis. In our study of a task performed faster by women, a disproportionately higher number of women in the older age groups would have diminished the effect of age if sex had not been considered separately.

This study of healthy individuals has demonstrated age-related change in performance on one test of fine-motor dexterity, the Purdue Pegboard. Sex differences were also apparent, confirming the need to also take sex into account when evaluating normal performance on this test or on any other test where sex may operate as a confounding variable.

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REFERENCES

- Benton, A. L. (1977). Interactive effects of age and brain disease on reaction time. *Archives of Neurology*, 34, 369-370.
- Bleecker, M. L., Bolla-Wilson, K., Agnew, J., & Meyers, D. A. (1987). Simple visual reaction time: Sex and age differences. *Developmental Neuropsychology*, 3, 165-172.
- Bornstein, R. A. (1985). Normative data on selected neuropsychological measures from a nonclinical sample. *Journal of Clinical Psychology*, 41, 651-659.
- Costa, L. D., Vaughan, H. G., Jr., Levita, E., & Farber, N. (1963). Purdue Pegboard as a predictor of the presence and laterality of cerebral lesions. *Journal of Consulting Psychology*, 27, 133-137.
- Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-Mental State: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, 12, 189-198.
- Kellor, M., Frost, J., Silberberg, N., Iversen, I., & Cummings, R. (1971). Hand strength and dexterity. *American Journal of Occupational Therapy*, 25, 77-83.
- Lezak, M. D. (1983). *Neuropsychological assessment* (2nd ed.). New York: Oxford University Press.

- Lezak, M. D. (1987). Norms for growing older. *Developmental Neuropsychology*, 3, 1-12.
- Mathiowetz, V., Rogers, S. L., Dowe-Keval, M., Donahoe, L., & Rennells, C. (1986). The Purdue Pegboard: Norms for 14- to 19-year-olds. *American Journal of Occupational Therapy*, 40, 174-179.
- Mathiowetz, V., Volland, G., Kashman, N., & Weber, K. (1985). Adult norms for the Box and Block Test of manual dexterity. *American Journal of Occupational Therapy*, 39, 386-391.
- Salthouse, T. A. (1976). Speed and age: Multiple rates of age decline. *Experimental Aging Research*, 2, 349-359.
- Salthouse, T. A., & Somberg, B. L. (1982). Isolating the age deficit in speeded performance. *Journal of Gerontology*, 37, 59-63.
- Tiffin, J. (1968). *Purdue Pegboard examiner manual*. Chicago: Science Research Associates.
- Vega, A. (1969). Use of Purdue Pegboard and finger tapping performance as a rapid screening test for brain damage. *Journal of Clinical Psychology*, 25, 255-258.
- Weller, M. I., & Latimer-Sayer, D. T. (1985). Increasing right hand dominance with age on a motor skill task. *Psychological Medicine*, 15, 867-872.
- Yeudall, L. T., Fromm, D., Reddon, J. R., & Stefanyk, W. O. (1986). Normative data stratified by age and sex for 12 neuropsychological tests. *Journal of Clinical Psychology*, 42, 918-946.
- Yeudall, L. T., Reddon, J. R., Gill, D. M., & Stefanyk, W. O. (1987). Normative data for the Halstead-Reitan neuropsychological tests stratified by age and sex. *Journal of Clinical Psychology*, 43, 346-367.