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Age, Self-Assessed Health Status, and Cognition

Timothy A. Salthouse,[1] Donald H. Kausler,[2] and J. Scott Saults[2]

[1]School of Psychology, Georgia Institute of Technology.
[2]Department of Psychology, University of Missouri–Columbia.

Data from a recent project involving 362 adults ranging from 20 to 79 years of age were reanalyzed to examine the effects of statistical control of self-assessed health status on the age trends in several measures of cognitive functioning. The major result was that the age trends were virtually identical with, and without, control of the health-status variable. Implications of the views that the lack of health influences was due to a narrow range of health status or to insensitive assessment of health status were discussed.

IT is sometimes suggested that age-related effects on measures of cognitive functioning are not due to intrinsic maturational processes or to differential patterns of experience at different phases of life, but instead are attributable to a variety of pathological diseases. This is clearly a plausible argument because the incidence of many diseases does increase with age, and at least some of those diseases have been documented to be associated with lower levels of cognitive functioning. Unfortunately, however, the role of health variables in the relations between age and cognitive measures has seldom been systematically investigated. The analyses described in the present report represent one attempt to determine whether there are significant relations among age, self-assessed health status, and measures of cognitive functioning, and whether an age-related decrease in health status might account for some of the observed age-related differences in cognitive functioning.

Health status of research participants in the current project was evaluated by asking individuals to rate their health on a 5-point scale ranging from 1 for excellent to 5 for poor. The primary reason for relying on this type of evaluation of health is that it is much less expensive and quicker than a complete examination by a physician. Furthermore, there is some evidence that self-ratings are valid because they have been found to be correlated with a number of reported medical problems (e.g., Fillenbaum, 1979; Kaplan & Camacho, 1983; Liang, 1986; Mossey & Shapiro, 1982; Pilpel, Carmel, & Galinsky, 1988; Tissue, 1972), with current or future physician evaluations of overall health based on medical examinations (e.g., Friedsam & Martin, 1963; Heyman & Jeffers, 1963; LaRue, Bank, Jarvik, & Hetland, 1979; Maddox, 1962, 1964; Maddox & Douglass, 1973; Suchman, Phillips, & Streib, 1958), and with future survival (e.g., Botwinick, West, & Storandt, 1978; Heyman & Jeffers, 1963; Kaplan & Camacho, 1983; LaRue et al., 1979; Mossey & Shapiro, 1982; Pfeiffer, 1970; Suchman et al., 1958). It can also be argued that these types of self-appraisals of health have considerable practical significance because they are likely used by individuals when deciding to continue in their current occupation, or whether or not to engage in specific activities. In addition to the self-ratings of health, information was also available from each participant concerning the number of prescription medications taken per week, and whether or not the individual has been treated for heart or blood pressure problems in the last five years. Although this information represents only a very small subset of what would be desirable to know about the individual's health, it does allow a modest test of the validity of the health ratings. That is, if the ratings are valid, one might expect them to be lower among individuals for whom there has been prior or current medical treatment.

The cognitive variables examined in these analyses were described in two recent articles by Salthouse, Kausler, and Saults (1988a, 1988b). Four composite measures were formed by averaging the z-scores of measures representing perceptual-motor speed, spatial and verbal memory spans, associative memory, and inductive reasoning.

METHOD

Descriptive characteristics of the sample of participants and details of the experimental procedures have been described in Salthouse et al. (1988a), and therefore only a brief summary of the relevant features will be presented here. The participants consisted of 362 adults (166 males and 196 females) between 20 and 79 years of age, with from 54 to 65 in each decade from the 20s through the 70s. Each participant rated his or her health on a 5-point scale ranging from 1 for excellent to 5 for poor. No explicit comparison group was mentioned in the instructions, but if asked, the examiner indicated that the question should be interpreted as "relative to the general population." Each participant also reported the number of prescription medicines taken per week, and indicated whether he or she had been treated for heart problems or for blood pressure problems in the last five years. For purposes of analysis, the last two variables were aggregated such that a "1" represented a positive answer to either question, and a "0" represented a negative answer to both questions. Participants were also asked to indicate whether or not they had been diagnosed as having diabetes, but because the incidence was so low (i.e., 12 individuals) this information was not considered further in the present analyses.

Four composite cognitive measures were derived by converting the raw scores on each of two tests into z-scores based on the mean and standard deviation from the entire sample, and then averaging the two z-scores. Each composite measure therefore represents performance from two separate assessments, and is scaled in units of population variability.

The two speed measures were the median time per item in computer-controlled digit symbol substitution and number comparison tests. In both cases accuracy was quite high (i.e., average of 96.1% for digit symbol and 94.8% for number comparison), and therefore most of the variability across individuals was evident in the speed measure. The memory span measures were the average number of letters correct in a verbal memory task involving the reproduction of the identities of target letters in a matrix, and the average number of positions correct in a spatial memory task involving the reproduction of the locations of target letters from the matrix. Measures of associative memory were obtained from the accuracy of paired-associate recall in the first and second trial of eight pairs of words. Inductive reasoning was represented by the average accuracy in series completion and geometric analogy problems. Only 233 of the 362 participants were administered these latter two tests.

RESULTS

Across the entire sample, the mean rating of health was 1.97, the mean number of prescription medications per week was 0.80, and the percentage of people who had received medical treatment for heart or blood pressure problems in the last five years was 26.2. Values of these variables by age decade are illustrated in Figure 1. Notice that there was no relation between age and self-rated health ($r = .03$), but there were age-related increases in the number of prescription medications per week ($r = .30$, $p < .01$) and in the percentage of people treated for cardiovascular problems (point-biserial $r = .35$, $p < .01$).

The different age trends for the self-rating measure and the two other measures indicate that there is an interesting dissociation between the two types of health indices. In order to determine whether the absence of an age relation in the self-rating measure reflects an insensitivity to objective medical problems, it is useful to examine the correlations among the various health measures. Table 1 summarizes these correlations by each decade. Notice that all but one of the correlations are positive (indicating poorer health ratings with more medications or reports of treatments), with those in the two oldest groups statistically significant. These results therefore suggest that the ratings are sensitive to actual medical problems, but apparently very few of the people in the present sample felt that they were seriously limited by those problems.

Four sets of linear regression analyses were conducted on the composite cognitive measures. The first was a regression analysis on the data from the entire sample, ignoring health status. The second analysis was a multiple regression analysis in which the linear age effects were examined only after adjusting for the variables of self-rated health, number of medications, and reported treatments for cardiovascular problems. The third analysis conducted on each composite measure involved computing linear age regressions from the healthiest individuals in the total sample. This subsample consisted of the research participants who rated their health

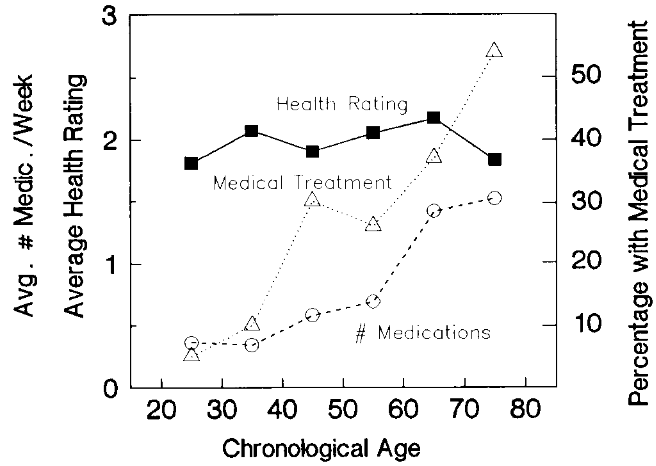

Figure 1. Means at each decade for self-rated health, average number of prescription medications per week, and percentage of people reporting treatment in last five years for blood pressure or heart problems.

Table 1. Correlations Among Health Variables at Each Decade

	Age Decade					
	20s	30s	40s	50s	60s	70s
n	64	60	60	65	59	54
Self-rated health[a]						
Number medications[b]	.14	.19	.43*	.21	.50*	.57*
Medical treatments[c]	.16	.23	.31	.17	.40*	.40*
Number medications						
Medical treatments	−.01	.50*	.57*	.72*	.52*	.69*

[a]Self-rated health = Health status (1 = excellent, 5 = poor).
[b]Number of prescription medicines taken per week.
[c]1 if treated in last 5 years for heart or cardiovascular problems, 0 if not.
*$p < .01$.

as excellent (1 on the 5-point scale), and who reported using no prescription medications, and no treatment for heart or blood pressure problems in the last 5 years. Only 83 adults qualified for this healthy subsample, but the age distribution was roughly equivalent to that of the entire sample (i.e., range from 20 to 78 years, mean = 47 years). Finally, the fourth analysis consisted of tests of interactions between age and health status.

The results of these analyses are displayed in Figures 2 (for speed), 3 (for memory spans), 4 (for associative memory), and 5 (for inductive reasoning). The values increase with age for the composite speed measure because higher scores represent slower times (poorer performance), whereas in the other three measures higher scores represent better performance. In all cases, however, it is clear that very similar age relations were evident in the analyses based on all data, based on statistically adjusted data, and based on only the healthiest subsample of participants. Furthermore, with each measure the regression coefficients for age in the adjusted and subsample analyses were well within the 95% confidence interval around the regression parameter derived from the analysis of all data.

The analysis conducted to examine the possibility of

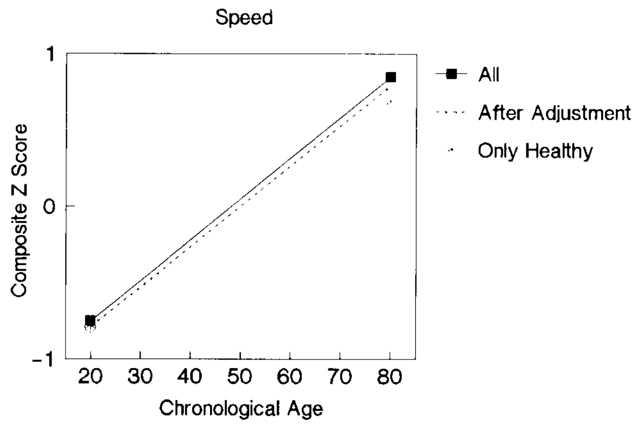

Figure 2. Regression lines relating age to the composite measure of speed for all research participants ignoring health variables, for all participants after adjusting for: (a) self-rated health, (b) number of prescription medications, and (c) treatments for cardiovascular problems; and only for participants with "excellent" self-ratings and no medications or reported treatments for heart or blood pressure problems.

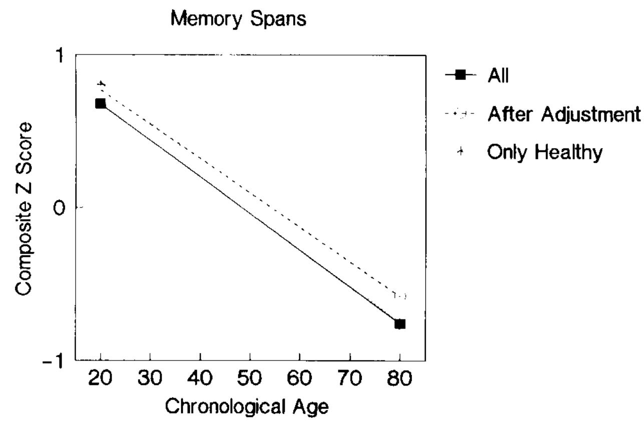

Figure 3. Regression lines relating age to the composite measure of memory spans for all research participants ignoring health variables, for all participants after adjusting for: (a) self-rated health, (b) number of prescription medications, and (c) treatments for cardiovascular problems; and only for participants with "excellent" self-ratings and no medications or reported treatments for heart or blood pressure problems.

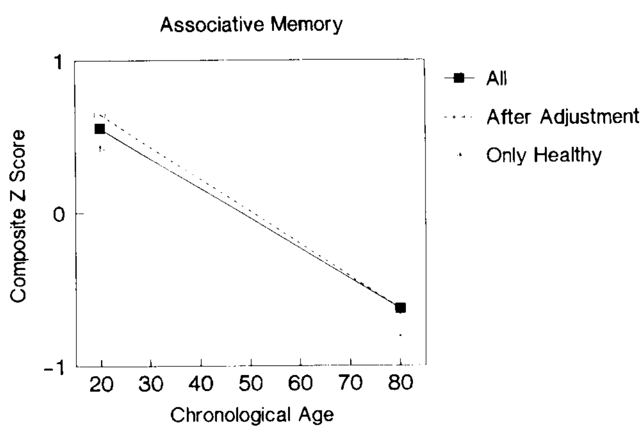

Figure 4. Regression lines relating age to the composite measure of associative memory for all research participants ignoring health variables, for all participants after adjusting for: (a) self-rated health, (b) number of prescription medications, and (c) treatments for cardiovascular problems; and only for participants with "excellent" self-ratings and no medications or reported treatments for heart or blood pressure problems.

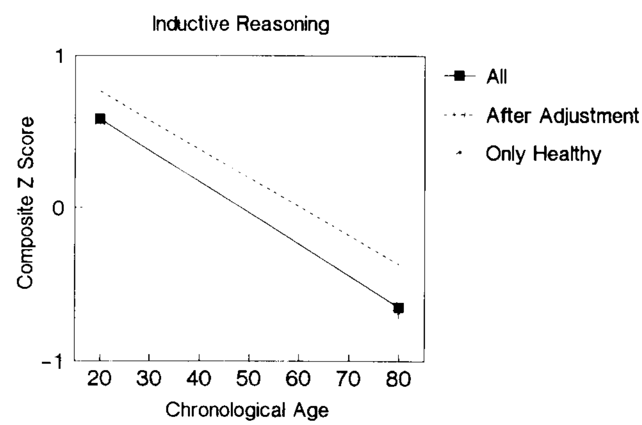

Figure 5. Regression lines relating age to the composite measure of inductive reasoning for all research participants ignoring health variables, for all participants after adjusting for: (a) self-rated health, (b) number of prescription medications, and (c) treatments for cardiovascular problems; and only for participants with "excellent" self-ratings and no medications or reported treatments for heart or blood pressure problems.

interactions between age and health status involved entering the cross-product of the age and self-reported health variables as a predictor in the regression equations after the age and health variables. The interaction did not approach significance (i.e., $F < 1.03$) for any of the composite cognitive variables.

Correlations were also computed between the health variables and the composite cognitive measures for the adults in each age decade. These data are relevant for examining the health-cognition relation as a function of chronological age. For example, it might have been expected that weak to nonexistent relations would be evident in young adulthood, but that health variables would have stronger relations to cognitive measures in later adulthood. However, this interpretation was not confirmed because the results reveal that only one of the 72 (3 health variables $\times$ 4 cognitive variables $\times$ 6 age decades) health-cognition correlations was significant, and this was among adults in their 30s (i.e., a correlation of $-.48$ between number of medications and inductive reasoning performance).

In order to examine the generality of the phenomenon that age trends in cognitive measures are largely independent of self-reported health status, similar analyses of the age effects from the entire sample and from the healthiest subsample were conducted on data from a recent study with more complex cognitive tasks. The tasks in this study (Salthouse, Mitchell, Skovronek, & Babcock, 1989) were integrative verbal reasoning, spatial paper folding, and a working memory task involving the storage of digits while also performing arithmetic operations. The complete sample consisted of 120 males between 20 and 79 years of age, and the healthy sample (defined by maximum ratings of excellent on the 5-point self-rating scale) consisted of 81 males between 20 and 76 years of age. Mean ages were 49.3 in the entire sample and 47.2 in the healthy subsample.

The accuracy measures in each task were converted into z-scores based on the mean and standard deviation from the entire sample, and then linear regression analyses conducted with chronological age as the predictor variable. The slopes in z-score units of accuracy per year were: reasoning, all = $-.031$, healthy subsample = $-.033$; paper folding, all = $-.032$, healthy subsample = $-.028$; and memory, all = $-.027$, healthy subsample = $-.028$. These results clearly replicate those described above because there is little or no change in the magnitude of the age relations when analyses are restricted to those research participants who evaluate their health as excellent. The age $\times$ health-status interaction also failed to reach statistical significance (i.e., $p > .10$) in any of these analyses.

Discussion

One of the intriguing findings in these analyses was that although there was no relation between age and self-assessed health status, increased age was associated with more prescription medications and a higher percentage of reported treatments for heart or blood pressure problems. Perlmutter (1978) also reported a similar discrepancy between self-rating of health and the number of reported medical problems, with only the latter variable increasing with age. Furthermore, LaRue et al. (1979), Maddox and Douglass (1973), and Suchman et al. (1958) all found that when self-ratings and physician ratings of health differed, the physician's evaluation was generally lower than the individual's self-rating (but see Friedsam & Martin, 1963, for an exception). It therefore appears that there is a general tendency for older adults to rate their health better than might be expected on the basis of "objective" medical characteristics. Unfortunately, because very few young adults with reported medical problems were available in the sample, it is impossible to determine whether this optimistic bias is evident among adults of all ages, or whether there is a systematic shift with age in the criteria used to evaluate health status. For example, it is possible that at least some of the older adults might have made their ratings relative to other individuals their own age, whom they perceive to be in poor health, and not with respect to the general population, which might be expected to have a higher average level of health.

The major purpose of the present analyses was to examine the possible mediational role of health status in the relations between age and measures of cognitive functioning. The findings of nearly identical age trends in the analyses of all data, of the health-adjusted data, and of the data from the presumably healthiest subsample, along with the absence of significant age $\times$ health-status interactions, suggests that health factors may be relatively unimportant in the relations between age and cognition. These results are subject to two quite different, although not necessarily mutually exclusive, interpretations.

One interpretation is that the present sample, and probably most samples of adults available for this type of cognitive testing, represents a very restricted range of health status. That is, because few investigators encourage participation by individuals who don't feel that they are in reasonably good health, the resulting samples are probably positively biased with respect to health. In support of this view is the finding that 77% of the participants in the current project reported their health as better than average (i.e., ratings of 1 or 2 on the 5-point scale). If the present sample underrepresented the true range of health status in the general population, then one cannot expect to obtain an accurate evaluation of the potential influence of health-related factors on cognition from these data.

A second interpretation of the current results is that the measures of health status were extremely crude, and probably insensitive to a number of health or medical factors that could influence cognitive functioning. Although there are certainly limitations to self-ratings as an indication of an individual's actual health status, it is important to remember that, at least among older adults, these ratings have been found to be correlated with number of prescription medications and reported treatments for cardiovascular problems (e.g., Table 1), with number of reported diseases or medical conditions, with physician evaluations, and with future survival. Self-ratings, therefore, cannot be dismissed as entirely lacking in validity as indices of actual health status.

We will now consider implications of these two interpretations for the role of health factors in the relation between chronological age and cognitive functioning. The first interpretation implies that health factors are probably not a very important determinant of the age-cognition relations because substantial age effects are found in the present analyses despite the narrow range of health. This view therefore suggests that "normative" effects related to age on measures of cognitive functioning are not determined by age-related changes in health status. Health factors could still influence an individual's level of cognitive functioning, and there may be a greater impact of health-related limitations with increased age. However, the finding that pronounced age-related trends are evident in a wide range of cognitive tasks even after controlling for variation in health suggests that health factors cannot account for all of the relations observed between age and measures of cognitive performance.

The second interpretation suggests that no definitive answer can yet be reached concerning the influence of health on age-cognition relations because of doubts about the sensitivity of measures used to assess health status. That is, because increased age could be associated with an increased number of health problems not reflected in either the self ratings or the medication or treatment variables, it may be premature to conclude that the relations between age and cognition are unaffected by health status. From this perspective, therefore, more sensitive and valid measures of health status are necessary before any conclusion can be reached about the contribution of health factors in age-related differences in cognition. Because additional information concerning health and biological status as a function of age would be useful for further evaluations of both interpretations of the current results, a reasonable goal for future research is to identify additional measures of health status that could be used together with self-ratings to examine the interrelations of age, health, and cognitive functioning.

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Address correspondence to Dr. T. A. Salthouse, School of Psychology, Georgia Institute of Technology, Atlanta, GA 30332-0170.

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