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Estimating premorbid IQ from demographic variables: Regression equations derived from a UK sample

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The purpose of the study reported here was to build regression equations for the estimation of premorbid IQ from demographic variables in a UK population. Subjects *(n* = 151) free of neurological, psychiatric or sensory disability, were administered the Wechsler Adult Intelligence Scale (WAIS) and had their demographic details recorded (age, sex, occupation and education). WAIS Full Scale (FSIQ), Verbal (VIQ), and Performance IQ (PIQ) were regressed on the demographic variables. The regression equations generated by this procedure predicted 50, 50, and 30 per cent of the variance in FSIQ, VIQ, and PIQ respectively. These equations should provide a convenient and useful supplement to psychometric estimates of premorbid IQ. Unlike psychometric estimates, demographic estimates are *entirely independent* of a patient's current cognitive status.

Whether for clinical, medico-legal or research purposes, attempts to quantify intellectual impairment require a means of estimating premorbid intelligence since previous psychometric test results are rarely available. The most common method of obtaining an estimate of premorbid IQ is to use psychometric tests which (1) correlate highly with IQ in a normal population and (2) are resistant to the effects of cerebral dysfunction. It is questionable, however, whether any existing test fully meets this second criterion. The National Adult Reading Test (Nelson, 1982) is probably the most resistant but even for this test there are indications that a degree of decline takes place in some neuropsychiatric conditions (Crawford, 1989).

An alternative approach, developed recently in the USA, is to build a regression equation to predict IQ from demographic variables (i.e. occupation, years of education, etc.). This approach takes advantage of the well-established relationship between such variables and IQ (e.g. Matarazzo, 1972). Wilson, Rosenbaum, Brown, Rourke, Whitman & Grisell (1978), using the Wechsler Adult Intelligence Scale (WAIS) standardization sample, built equations which predicted 54, 53 and 42 per cent of the variance of WAIS Full Scale, Verbal, and Performance IQ respectively. Broadly similar figures have been obtained in subsequent validation studies in normal subjects (e.g. Karzmak, Heaton, Grant & Matthews, 1985).

•f Requests for reprints. An extended version of this paper is also available from the first author.

As Wilson *et a/.'s* (1978) equations were derived from a US sample, they clearly cannot be used in a UK population because (1) occupational coding systems differ between the two countries and (2) more importantly, it cannot be assumed that the relationship between IQ and demographic variables (e.g. education) is the same in the two countries. The aim of this study, therefore, was to develop demographic regression equations to estimate WAIS IQ in a UK population and to determine their predictive accuracy.

The sample consisted of 151 subjects (79 males and 72 females) who were free of neurological, psychiatric and sensory disability, age range 16—88, mean of 42.0 (SD = 17.1). Mean years of education were 12.6 (SD = 3.1). Subjects were administered the WAIS according to standardized procedures and had their demographic details recorded (age, sex, years of education and occupation). Occupation was used to determine social class using the OPCS Classification of Occupations (married females were coded by their husband's occupation). The major lifetime occupation was coded for subjects who were retired (this procedure was adopted in preference to using last occupation since some retired subjects had 'wound down' into full retirement by taking part-time jobs). In addition to years of full-time education, subjects were credited with 0.25 of a year for every year of attendance at day-release or evening classes (provided that the evening classes were leading to a qualification). Sex was dummy variable coded with males = 1; females = 2.

The social class distribution of the sample was as follows: social class 1 = 14.6 per cent, 2 = 27.2 per cent, 3 = 38.4 per cent, 4 = 11.3 per cent, 5 = 8.6 per cent. Although there was an overpresentation of social classes 1 and 5, this distribution did not differ significantly from the distribution derived from the 1981 census for the general UK population (chi-square test: $\hat{}^2$ = 9.34, d.f. = 4, n.s.). To further assess the representativeness of the sample three arbitrary age bands were formed (16—35, 36-55, 56-83) and the proportions of the sample in each band were compared with the corresponding proportions derived from the 1981 census. The sample's proportions did not differ significantly from the census proportions (chi-square test: X^2 = 1.04, d.f. =2, n.s.).

The means and standard deviations for WAIS Full Scale IQ (FSIQ), Verbal IQ (VIQ) and Performance IQ (PIQ) were 111.8 (12.7), 112.1 (14.2) and 110.1 (11.6) respectively. The corresponding IQ ranges were 75-140, 72-143 and 73-134. Using a stepwise procedure, WAIS FSIQ, VIQ and PIQ were regressed on the four demographic variables. For all three WAIS scales, social class was the single best predictor of IQ. All three remaining demographic variables significantly increased predicted variance at each step. The total percentage of variance predicted was 50, 50 and 30 per cent for FSIQ, VIQ and PIQ respectively. The equations for predicting WAIS IQ's are presented below:

Predicted FSIQ = 104.12-4.38 (class) + 0.23 (age)+ 1.36 (educ)-4.7 (sex) SE_{Est} = 9.08

Predicted VIQ = 103.56-5.07 (class)+ 1.54 (educ) + 0.25 (age)-5.2 (sex) SE_{Est}' = 10.17

Predicted PIQ = 105.73-3.28 (class) + 0.18 (age) + 0.88 (educ)-3.7 (sex) SE_{Est}' = 9.83

These results suggest that demographically based regression equations can be used to estimate WAIS FSIQ and VIQ with reasonable predictive accuracy in the UK population. The percentage of IQ variance accounted for by these equations is similar to that obtained by Wilson *et al.* (1978) in a US sample. However, both the

Table 1. Distribution of positive predicted–obtained IQ discrepancies in normal subjects[a]

Predicted–obtained discrepancy	Percentage of subjects when FSIQ is predicted	VIQ is predicted	PIQ is predicted
1	45	48	47
2	42	43	42
3	40	40	37
4	37	38	34
5	30	34	31
6	25	30	27
7	23	26	25
8	21	21	23
9	20	21	19
10	17	18	16
11	14	17	16
12	12	15	13
13	9	12	9
14	8	11	8
15	7	9	7
16	5	7	6
17	4	5	5
18	2	4	4
19	1	3	3
20	1	2	3
21	1	2	3
22	0	2	1
23	0	1	1
24	0	0	1
25	0	0	1
26	0	0	1
27	0	0	1
28	0	0	1
29	0	0	1
30	0	0	1
31	0	0	0

[a] The figures opposite the discrepancy scores represent the percentage of normal subjects who exhibited that size of positive discrepancy *or larger.* For example, in the case of FSIQ, 3 per cent of subjects exhibited a positive discrepancy of 10 IQ points and a further 14 per cent of subjects showed a discrepancy greater than 10. Therefore the percentage opposite a discrepancy of 10 is 17 per cent.

present UK equation and Wilson *et al.'s* equation for PIQ were markedly inferior, in terms of predictive accuracy, to the corresponding equations for FSIQ and VIQ. Indeed the present results suggest that the UK PIQ equation (which had a multiple R of 0.54 with PIQ thereby predicting only 30 per cent of PIQ variance) is of limited practical value. In clinical practice the predicted IQ derived from these equations should be compared with the actual IQ obtained by testing. A substantial discrepancy in favour of predicted IQ raises the possibility of intellectual deterioration. The probability that a particular size of discrepancy in favour of predicted IQ could occur in the normal population can be assessed by referring to Table 1. For example, it can be seen that, in the case of FSIQ, a discrepancy in favour of predicted IQ of more than 17 IQ points occurred in only 1 per cent of the present normal sample. Therefore, a discrepancy of this magnitude would strongly suggest the presence of intellectual impairment.

As was noted, at present the most common method of obtaining an estimate of premorbid IQ is to use psychometric tests. The advantage of these tests (e.g. the NART) over the demographic approach is that they are liable to have greater predictive accuracy (i.e. exhibit a stronger correlation with IQ in the normal population). In the NART standardization sample *(n* = 120) (Nelson, 1982), the NART predicted 55 and 60 per cent of FSIQ and VIQ variance respectively compared with 50 and 50 per cent obtained in this . study with demographic equations. It is notable, however, that the NART appears to fare no better than the demographic approach in the estimation of PIQ, in that it predicted only 32 per cent of PIQ variance. The lower predictive accuracy of demographic methods is offset by their major advantage — namely that the estimates they provide are *entirely independent* of current cognitive capacity. As demographic IQ estimates can be rapidly calculated they should provide a valuable and convenient supplement to psychometric methods in clinical and medico-legal practice and research.

The ideal approach to the present problem woufd have been to obtain a census-based, fully stratified, random sample. Practical constraints, however, rendered this impossible and as such the equations (and discrepancy tables) presented here should be used with caution until their predictive accuracy has been investigated in a cross-validation sample. Finally, the encouraging results from the present attempt to predict WAIS IQ from demographic variables in a UK sample, suggests that carrying out a similar procedure with the WAIS-R would be a valuable exercise.

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