

Wechsler Adult Intelligence Scale full scale IQ of male admissions to a high secure psychiatric hospital over six decades

Journal:	<i>International Journal of Forensic Mental Health</i>
Manuscript ID	UFMH-2020-022.R2
Manuscript Type:	Original Article
Keywords:	High secure psychiatric care, Intelligence, Wechsler Adult Intelligence Scale
Abstract:	The present study describes the Wechsler Adult Intelligence Scale (WAIS) full scale IQ (FIQ) of admissions to one UK High Secure Psychiatric Care hospital. WAIS IV comparative data and the FIQ of admissions from the 1960s to the 2010s are presented (n= 639). Results suggest 75% of current admissions have FIQs within the 'low average' and 'extremely low' classifications, with significant discrepancies between composite scales being common and processing speed being the most compromised area of cognitive functioning. A one standard deviation decline in FIQs of admissions since the 1960s to the 2010s is also present. The results are discussed in terms of the changing clinical presentations of admissions, along with research and clinical implications.

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Introduction

Few concepts within psychology have created as much controversy as the assessment of human intelligence (Gould, 1981). Among the many theories and definitions of intelligence put forward, it has been Spearman's (1904) concept of 'g' or general factor theory (that there is a broad mental capacity that individuals possess which influences performance on cognitive ability measures) that has been widely adopted, followed by Cattell's (1943) idea of 'fluid' (ability to solve novel problems by using reasoning) and 'crystalized' (knowledge based ability) intelligences. In terms of the assessment of intelligence, the majority of tests aim to assess these forms of intelligence and quantify 'g', with most using the concept of an 'intelligence quotient' (IQ). Devised by the German psychologist William Stern (1912) IQ refers to a summary score of an individual's performance across several cognitive abilities. IQ is calculated by dividing an individual's mental age by their chronological age and multiplying by 100. When compared with a normed group there is an average of 100 and a standard deviation of 15, with approximately 66.6% of the population having IQ scores falling between 85 and 115, and around 2.5% of the population scores above 130 and 2.5% below 70. However, crucial to calculating an accurate IQ is the regular standardisation of the test, i.e. using contemporary comparative data with appropriate age ranges. Regardless of the method used for assessing intelligence is the observation that during the twentieth century the full scale IQ of the general population has steadily increased by approximately three points every decade (Flynn, 2009). In order to compensate for this increase, it has also been suggested that a calculated full scale IQ needs to be adjusted by deducting 0.3 points for every year since the collection of the comparative data used (Flynn, 2009). Although a detailed debate for and against using Flynn adjustment is beyond the scope of this paper, support has varied (Williams, 2013). For example, in some specific forensic circumstances it has been suggested that the Flynn adjustment does not correspond with 'prevailing standards

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3 of psychological practice' and where it may vary based on various contextual factors such as
4 country, age tested and contrast measured (Hagen, Drogin & Guilmette, 2008; 2010). The
5 application of the Flynn adjustment with individuals who present with intellectual difficulties
6 has also been debated where the stability of the effect appears inconsistent (McGrew, 2015),
7 as well as the observation that there may be a 'reverse' Flynn effect among individuals of
8 'lower' ability levels (Platt, Keyes, McLaughlin & Kaufman, 2019). In contrast, a large meta-
9 analysis of 285 studies and 14,031 individuals since 1951 suggested that the Flynn effect
10 remains robust across different age groups, measure of intelligence, samples and levels of
11 performance (Trahan, Stuebing, Hiscock, & Fletcher, 2014).
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28 The most widely used test of adult intelligence among neuropsychologists and forensic
29 psychologists is the Wechsler Adult Intelligence Scale (WAIS), designed to measure
30 cognitive ability in individuals 16 years old and above (Archer et al., 2006; LaDuke et al.,
31 2018). The initial WAIS (Wechsler, 1955) was produced to replace the Wechsler Bellevue
32 Intelligence Scale (Wechsler, 1939) with several revisions being developed including the
33 WAIS R (1981), the WAIS III (1997) and the WAIS IV (2008). At the time of writing data
34 collection for the WAIS V is due for completion in 2020. Of significance is that whilst the
35 early Wechsler tests were originally based on practical and clinical perspectives rather than
36 theory per se (Lichtenberger & Kaufman, 2009), the WAIS IV (2008) represents the most
37 comprehensive version of the test to date, with specific theoretical foundations and enhanced
38 measures of discrete areas of cognitive functioning. The WAIS IV is comprised of ten core
39 subtests and five supplemental subtests that fall into a four-factor structure including two
40 verbal factors (verbal comprehension and working memory) and two performance structures
41 (perceptual reasoning and processing speed). Regardless of WAIS version and specific
42 subtest changes, raw scores in each subtest can be converted into age scaled scores (with an
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3 average score of 10) and a general estimate of intellectual functioning is calculated (based on
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5 summing the age scaled scores) reflecting an individual's IQ. In terms of normative data,
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7 each version of the WAIS was originally based on the US population and with UK
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9 supplementary scales and normative data being subsequently developed. The current WAIS
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11 IV^{uk} (2008) validation sample as described in the manual is based on 270 individuals (142
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13 females and 128 males) with an age range of 16 to 89 and is reported as matching the general
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15 adult UK population in terms of basic demographic characteristics as outlined in the 2001 UK
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17 census. There is no data within the WAIS IV (2008) manual derived from any forensic or
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19 psychiatric samples. Based on such small numbers and no appropriate comparison groups, the
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21 use of WAIS IV manual data is limited with forensic psychiatric samples.
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31 Despite the criticisms against summarising an individual's cognitive functioning into a single
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33 figure, including the suggestion that an IQ score 'is inherently meaningless and misleading'
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35 (Lezak, Howieson, Bigler, & Tranel, 2012, p 22), an individual's IQ in many circumstances
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37 continues to hold a great deal of influence in 'high stake' decision making where having a
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39 full scale IQ two or more standard deviations below average is required for accessing most
40
41 intellectual disability services. Within some US states an individual's IQ score can also
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43 determine eligibility for capital punishment, with a full scale IQ below 70 considered to be
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45 too intellectually disabled to receive the death penalty (Cooke, Delalot & Werner, 2015).
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53 **WAIS performance within psychiatric populations**

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56 The majority of research on intelligence in psychiatric populations has also focused on those
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58 with schizophrenia. Neuropsychological 'impairments' are typical among individuals with
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3 schizophrenia (Green & Harvey, 2014) and may be a core feature of the disorder (Keefe,
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5 2008). Whilst a decline in intellectual functioning is often associated with the onset of
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7 schizophrenia (Fujino, Sumiyoshi, Yasuda, et al., 2017), other studies suggest cognitive
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9 difficulties are present from early childhood with individuals vulnerable to developing
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11 schizophrenia failing to follow a 'normal' cognitive trajectory compared to non-psychotic
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13 peers (Mollon, David, Zammit, et al., 2018). Having a 'high' level of intelligence has also
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15 been suggested to protect an individual from developing schizophrenia, especially in those
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17 with a genetic vulnerability (Kendler, Ohlsson, Sundquist et al., 2015) and that performance
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19 within intelligence tests may support the idea of a 'psychosis spectrum', with 'high'
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21 intelligence in individuals with a psychosis possibly reflecting a 'high IQ variant' that is
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23 associated with significantly fewer negative symptoms (Cernis, Vassos, Brebion et al. 2015).
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25 IQ may also have some influence on relative risk of violence to others in those with
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27 schizophrenia (Webb, Langström, Runeson, et al., 2011).
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37 In terms of the specific aspect of intelligence regularly associated with most psychiatric
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39 conditions, it is processing speed (including the ability to process and learn information
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41 quickly, as well as psychomotor coordination and visual discrimination) as measured using
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43 the WAIS IV that appears to be particularly sensitive to being compromised (Michel,
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45 Goldberg, Heinrichs et al., 2013). Research also suggests that an individual's processing
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47 speed and some dimensions of executive functioning serve as significant predictors of
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49 psychological resilience, i.e. likely to enhance reasoning abilities by allowing an individual to
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51 utilise protective factors during periods of adversity or risk (Stainton, Chrisholm, Uptegrove
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53 et al., 2018). Indeed, the importance of processing speed within schizophrenia has also been
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55 argued to be a core feature of the disorder (Dickenson, Ramsey, & Gold, 2007). For example,
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57 Ojeda et al. (2012) compared healthy controls and individuals with schizophrenia on a range
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3 of cognitive measures. After controlling for the effects of processing speed, most cognitive
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5 differences between these groups were reported to have significantly decreased. Bechi,
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7 Spangaro, Agostoni et al. (2019) also suggested that whilst working memory, executive
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9 functioning and verbal fluency may be significantly influenced by global intellectual
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11 functioning and show a high degree of variability among individuals with schizophrenia, it is
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13 difficulties with processing speed, psychomotor speed and coordination that appear to be
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15 common in most with the condition.
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23 **Intelligence testing within High Secure Psychiatric Care (HSPC)**

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26 Within the UK, HSPC is the highest level of adult secure psychiatric care. All admissions are
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28 18 years old or older, considered to present with a grave and immediate risk of harm to
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30 others, as well as viewed as having a mental disorder as defined by the Mental Health Act
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32 (Department of Health, 1983) and requiring hospital treatment. Individuals typically transfer
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34 from prisons or other less secure psychiatric units. Background histories of individuals
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36 admitted vary significantly with some having had experience within the psychiatric system
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38 for many years and others developing psychiatric difficulties whilst serving a custodial
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40 sentence or during a remand period following or predating a serious offence. While the
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42 relative seriousness of the offences varies, the majority of admissions also have forensic
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44 histories resulting in contact with the criminal justice system.
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53 Individuals admitted to HSPC also include a complex and wide range of diagnostic groups.
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55 Although individuals with schizophrenia comprise the majority of individuals within HSPC
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57 (Völlm, et al., 2018), other conditions can be present including personality disorders, genetic
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3 and chromosomal conditions, neurodevelopmental disorders, histories of acquired and
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6 neuropathological difficulties such as epilepsy and other conditions such as HIV and
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8 Hepatitis C. Many individuals admitted to HSPC also present with histories of early and
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10 sustained illicit substance misuse, alcohol misuse and significant early psychological traumas.
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12 All these conditions can be associated with psychiatric and cognitive disturbance (Lezak,
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14 Howieson & Loring, 2012; David, Fleminger, Kopelman et al., 2012). In addition, many
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16 patients present with complex poly pharmaceutical histories with known negative side effects
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18 on cognition (Campbell & Boustani, 2015; Husa, Moilanen, Murray, et al., 2017).
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28 Within one HSPC hospital, psychological archives suggest that cognitive assessments date
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30 back to at least the 1940s and that, following a survey of male patients completed in 1962
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32 (unfortunately with the results of any write up from the survey being lost), the majority of
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34 male admissions have received a routine neuropsychological assessment. Although the
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36 complexity of neuropsychological examinations has increased over the years, the Wechsler
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38 Adult Intelligence Scale (WAIS) has remained the cornerstone of these assessments, with all
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40 versions of the WAIS being administered. However, despite the WAIS being routinely
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42 administered, there has been little examination of how individuals admitted to HSPC perform
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44 specifically in the WAIS. Among the published research, Wint and Hill (1997) examined the
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46 cognitive profiles of long-stay and short-stay admissions (defined as having a length of stay
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48 of two years or less) and found no significant differences between the two groups in the
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50 WAIS R subtests. Murphy (2003) examined the WAIS III profiles and other cognitive
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52 features of three diagnostic groups of male admissions to Broadmoor hospital (including
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54 those with Asperger's syndrome, those with Schizophrenia and those with a personality
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56 disorder as a primary diagnosis). Subsequent analysis found that whilst there was no
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3 significant difference in full scale IQ between individuals with Asperger's syndrome and
4 those with a personality disorder, individuals with Asperger's syndrome had full scale IQs
5 significantly higher than those with a mental illness. More recently, Flinn, Hassett and
6 Braham's (2018) study of a small and diverse sample of HSPC patients (n = 63) found a wide
7 range in general levels of intellectual functioning between 'extremely low' to 'superior'
8 classifications. The sample also included men and women, mental health patients, personality
9 disorder patients, as well as those from the learning disability service. Following the
10 recommendations of Lichtenberger and Kaufman (2012) with regard to avoiding
11 uninterpretable full scale IQs (i.e. with the lowest scoring composite score being subtracted
12 from the highest scoring composite score and with all those with differences larger than 1.5
13 standard deviations being removed from the dataset), other than individuals from the learning
14 disability service having significant differences in their composite scores compared to those
15 with a mental health problem and those personality disorder, no other significant between
16 group differences were found. Consistent with other research on the cognitive profiles of
17 individuals with a psychosis, processing speed was found to be the weakest area of
18 functioning for most. Given the varied presentations and presence of a mental disorder, etc.,
19 unsurprising significant differences were found between all the diagnostic groups and the
20 WAIS IV validation manual data (2008). The Flinn et al. (2018) study is not without several
21 methodological limitations. For example, the dates of the assessments are reported to have
22 spanned from 2010 to 2017 and may have included re-assessments. With the relatively long
23 period of time between the manual data and individual assessments for some, there is also no
24 mention of the need for a Flynn adjustment. Furthermore, whilst the likelihood of co-morbid
25 difficulties such as acquired brain injuries is highlighted, no mention is made of possible
26 medication side effects on cognitive functioning and notably processing speed.
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Aims of present study

Within the context of the limited background literature on WAIS profiles of forensic psychiatric populations, the study set out to:

1. Describe the WAIS IV profiles of male patients admitted to one HSPC hospital. Using the Lichtenberger and Kaufman (2012) criteria for valid full scale IQs, specific areas of focus included the frequency of qualitative descriptions for full scale IQs, Flynn adjusted and unadjusted full scale IQ values, composite and subtest scores. The prevalence of discrepancies between the composite scores (verbal comprehension, perceptual reasoning, working memory and processing speed) are also described. Although no specific hypotheses were tested, in line with previous research it was expected that processing speed would be the most compromised area of cognitive functioning in admissions.
2. Describe WAIS full scale IQs of admissions within a historical context. Using the WAIS version as a covariate, specific comparisons of full scale IQ are made between six decades, including the 1960s, 1970s, 1980s, 1990s, 2000s and 2010s. Whilst no specific hypothesis was tested, it was expected that the average full scale IQ of admissions would follow the increase over the decades as observed in the general population.
3. Describe the number of admissions to the hospital with full scale IQs two standard deviations below the mean over these six decades. This analysis was exploratory with the intention of examining the number of admissions who meet the cognitive criteria for having a learning disability (LD) – although there is a move away from the concept of a LD, within the UK, the concept of LD typically includes individuals who have significant difficulties with different dimensions of adaptive functioning, significant difficulties with intellectual functioning (typically with full scale IQ two

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3 standard deviations below the mean) and with an age of onset being before adulthood
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5 (British Psychological Society, 2000).
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11 **Methods**

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15 Following research and ethics committee approval, a manual search of the paper records of
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17 male patient cognitive profiles including the WAIS profiles were examined and transferred to
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19 an electronic database. This database also followed the protocol for keeping records as
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21 outlined by the General Data Protection Regulation (2018).
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28 **Sample**

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31 639 male admissions were examined for analysis from the six decades since 1962, with
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33 selection being determined by complete WAIS profiles. Although no explicit exclusion
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35 criteria were applied, any admissions without English as their first language and who did not
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37 receive their education within the UK were not tested with the WAIS and were not included
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39 in the present study. Incomplete WAIS profiles were also not included. Unfortunately, the
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41 number of individuals not formally assessed was not recorded. Whilst data on nationalities of
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43 admissions over the decades was unavailable, qualitative impressions of the main author
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45 based on individuals assessed suggest that the number of individuals born outside of the UK
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47 appears to be increasing. In terms of age at testing, the means, standard deviation and range
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49 of ages for each decade is presented in Table 1. An ANOVA did not reveal any significant
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51 difference between the decades in age at testing ($F(5,633) 2.97, n.s$).
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Table 1. around here

Inconsistencies and omissions in how demographic information was recorded over the years prevented any meaningful comparison on the education and occupational histories of patients. However, qualitative observations of the patient records found that from the 1960s whilst unskilled workers and labours with very little formal education comprised the majority of admissions, there were some skilled admissions including trained engineers and medical professionals. Similar inconsistencies with how information was formally recorded are also present in terms of the offending and diagnostic classifications of patients. Whilst available data suggests that diagnoses could be grouped broadly into ‘mental illness’ (e.g. schizophrenia, psychosis, bipolar disorder, depression), ‘personality disorder’ (e.g. psychopathic personality disorder, schizoid personality disorder, borderline personality disorder), comorbid mental illness and personality disorder and ‘other’ (e.g. delusional jealousy, alcoholism, neurodevelopmental and genetic conditions), there was limited case note information to support diagnostic descriptions. Early admissions also included a number of descriptions that would not meet contemporary diagnostic criteria such as those described as a ‘feeble minded person’, ‘intellectual retardation’, ‘homosexual’ and ‘imbecile with superimposed jealousy’.

Measures

All versions of the Wechsler Adult Intelligence Scale (WAIS) were included in the study, specifically the WAIS (Wechsler, 1955), WAIS R (Wechsler, 1981), WAIS III (Wechsler, 1997) and WAIS IV (Wechsler, 2008). A significant number of the WAIS III tests and all

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3 WAIS IV were administered or supervised by one of the authors. All WAIS versions were
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5 completed as part of a routine admissions clinical assessment.
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11 **Results**

12 **WAIS IV profiles**

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18 105 WAIS IV profiles were examined, with assessments being completed between 2009 and
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20 2019. Using the Lichtenberger and Kaufman (2012) criteria 94 (89.5%) profiles were valid,
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22 i.e. did not have a difference of 1.5 standard deviation between any composite score. Figure
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24 1. shows the percentages of 'qualitative descriptions' of these valid full scale IQs. The
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26 majority of admissions had a full scale IQ falling in the 'borderline' range (i.e. with full scale
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28 IQs falling between 70 and 79), followed closely by those in the 'low average' range (i.e.
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30 with full scale IQs falling between 80 and 89). No individuals had full scale IQs falling in the
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32 'superior' classification. In terms of significant discrepancies between composite scores,
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34 many profiles had significant discrepancies between one or more composite scales. See figure
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38 2. The WAIS IV profiles of all admissions are presented in table 2.
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Full scale IQs over six decades

To examine whether the full scale IQ of admissions to the hospital have changed since 1962 an ANCOVA was performed using the six decades (1960s, 1970s, 1980s, 1990s, 2000s and 2010s) as the independent variable, the Flynn adjusted full scale IQ as the dependent variable and WAIS version (WAIS, WAIS R, WAIS III and WAIS IV) as the covariate. Flynn adjusted full scale IQs were calculated by deducting 0.3 points from the calculated full scale IQ for every year since the test was administered and the respective version of the WAIS comparative data was published as suggested by Flynn (2009). Analysis revealed that whilst there is a significant difference between the six decades in full scale IQ ($F(5, 632) = 8.00, p < 0.001, \eta_p^2 = 0.060$), a modest effect of WAIS version was also found ($F(1, 632) = 4.60, p < 0.05, \eta_p^2 = 0.007$). Post hoc Bonferroni correction tests revealed significant differences between the 1960s and the 1980s ($p < .002, d = 0.53$), 1990s ($p < .001, d = 0.89$), 2000s ($p < .022, d = 0.42$) and 2010s ($p < .001, d = 1.04$). Significant differences were also present between the 1970s and 1990s ($p < .016, d = 0.46$) and 2010s ($p < .001, d = 0.60$), the 1980s and the 2010s ($p < .005, d = 0.60$), the 1990s and 1970s ($p < .016, d = 0.44$), as well as 2000s and 2010s ($p < .001, d = 0.59$). All other comparisons were not significant. See figure 3. for the mean Flynn adjusted full scale IQ of admissions within the six decades, including standard deviations and significant differences. Although the effect of WAIS version was modest, comparison of the adjusted full scale IQ in each WAIS version reveals some post hoc Bonferroni tests with significant differences and that the first version of the WAIS was used for thirty years, as well as associated with the highest average full scale IQ. See table 3. for the mean adjusted full scale IQ of admissions for each version of the WAIS and use of the WAIS version over the six decades.

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16 **Number of admissions with full scale IQs of 70 or below**

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19 Including only 'valid' WAIS IV profiles the number of admissions to the hospital found to
20 have a full scale IQ of 70 or below over the six decades is shown in figure 4. Analysis using a
21 Pearson Chi Square found a significant difference between the number of full scale IQs of 70
22 or below and the decade of admission ($\chi^2 = 36.79, df = 5, p < 0.0001$). Examining each
23 decade shows that compared to all previous decades there has been a significant increase in
24 the number of admissions with full scale IQs of 70 and below since 2010.
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36 **Figure 4. around here**
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Discussion

The finding that the majority of contemporary admissions to HSPC (62%) present with WAIS IV full scale IQs falling in the 'borderline' and 'low average' ranges, along with the 15% whose full scale IQs fall in the 'extremely low' range suggest suboptimal levels of cognitive functioning are typical in the current population. However, the quarter of admissions who present with full scale IQs falling in the 'average' or 'high average' range suggest overt cognitive dysfunction is not true for all (although it is possible that some of these individuals may have also experienced a relative decline from 'premorbid' levels falling in the 'superior' range). Of significance is the application of the Flynn adjustment to full scale IQs which suggests individuals admitted may be less able than WAIS IV manual data suggests. The high number of significance discrepancies between composite scores (verbal comprehension, perceptual reasoning, working memory and processing speed) suggest that heterogeneous cognitive profiles among admissions are also common. Consistent with the literature (e.g. Bechi et al., 2019), the examination of the WAIS IV composite profiles and subtests suggest that processing speed (specifically the subtests of coding and symbol search) is the most compromised compared to other areas of cognitive functioning. However, this finding should be treated with caution as there is some degree of overlap in the standard deviations between the respective scales of the WAIS IV.

The comparison of the full scale IQs of admissions over a fifty-year time period are believed to be unique and to the authors' knowledge no other HSPC facility has routinely administered the WAIS to admissions over such an extended period of time. Repetition of the study may therefore be difficult. As such, the findings might provide a useful barometer of the changing cognitive profiles of admissions to one UK HSPC hospital and possibly HSPC in general. Of

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2
3 interest is the observation that the initial WAIS dominated testing in the hospital for almost
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5 thirty years, before being replaced with the WAIS R. Such a slow transfer of the WAIS to the
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7 WAIS R however may not be unusual in the context of the 1960s, 1970s and 1980s where
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9 information on new tests was obtained at a much slower pace and the need to update
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11 'normative' data not fully appreciated. It could therefore be argued that because many of the
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13 initial WAIS assessments were completed using normative data at least thirty years out of
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15 date the application of the Flynn adjustment is bolstered. The presence of significant
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17 differences in the adjusted full scale IQs between some versions of the WAIS may raise
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19 questions around the relative difficulty of each version and changes in test content (Weiss,
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21 Gregoire & Zhu, 2015). Such comparisons however are problematic with three times the
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23 number of initial WAISs compared to other versions, relatively large standard deviations and
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25 the apparent increase in the adjusted mean full scale IQ of the WAIS R and WAIS III not
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27 being consistent with any increase in test difficulty.
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37 Contrary to the observation that full scale IQs appear to have increased in the general
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39 population is the finding that the full scale IQs of the current sample over the six decades has
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41 significantly reduced, with a one standard deviation drop between those admitted during the
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43 1960s and 2010s. This suggests that contemporary admissions present with more cognitive
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45 dysfunction compared to admissions from previous decades. This is also supported by the
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47 significant increase in the number of individuals admitted with full scale IQs of two standard
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49 deviations or below the mean (one of the criteria for individuals to be considered to have an
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51 intellectual disability). Whilst the increasing complexity and demands of each version of the
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53 WAIS test may account for some of the reduction in full scale IQ (with the WAIS IV being
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55 considerably longer to administer and more demanding than the original WAIS) other
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57 contributing factors must also be at work. Of particular significance is the gradual change in
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3 presenting characteristics of admissions into HSPC, notably higher levels of mental disorder,
4 interpersonal risks to others and an associated increase in the level of cognitive disturbance.
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7 Although completed over twenty years ago, some supporting evidence for this trend is
8 provided by Lumsden, Chesterman and Hill (1998) in an examination of 100 consecutive
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10 admissions to HSPC who found that 59% presented with some form of neuropsychological
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12 ‘impairment’, 26% with a history of obstetric complications, 31% with a history of head
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14 injury resulting in a loss of consciousness, 69% with a history of alcohol misuse and 10% to
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16 40% with ‘abnormal’ EEGs and brain scans. With a higher threshold for admission to HSPC
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18 now compared to previous decades, only those individuals with a mental disorder and who
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20 present as a grave and immediate risk of harm to others are admitted. In addition, compared
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22 to the 1960s there has been a gradual increase in the number of alternatives to HSPC such as
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24 low and medium secure units where if available many previous admissions who did not
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26 present as a grave and immediate threat to others may have entered rather than HSPC.
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37 The finding that current admissions to HSPC present with lower levels of ‘intelligence’
38 compared to previous generations is particularly interesting within the context of the wider
39 changes in society where general levels of intellectual functioning in the population are
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41 thought to have increased due to improved early nutrition, education, literacy levels and
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43 general standard of living, as well as perhaps the increased use of technology (Flynn, 2009).
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45 Although speculative, it could be argued that whilst many admissions to HSPC during the
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47 1960s would have experienced considerable social deprivation within the context of a post-
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49 war Britain, current admissions are exposed to other factors that have a detrimental impact on
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51 cognitive development and functioning, notably early and sustained polysubstance misuse by
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53 themselves and possibly by their mothers when pregnant (Singer, Wu, Minnes et al.,2018), as
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55 well as many growing up in urban environments with high levels of air pollution (Suades-
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3 Gonzalez, Gascon, Guxens, & Sunyer, 2015). Whilst the effects of early traumas (including
4 psychological, physical, emotional and sexual) are also more widely recognised by
5 contemporary society including the effects on cognitive development (Majer, Nater, Lin,
6 Capuron, & Reeves, 2010), it is unlikely these were any less present during the 1960s
7 onwards and therefore are a potential experience of all cohorts. Whatever the potential
8 explanations for the reduction in general levels of intellectual functioning, a reverse Flynn
9 effect appears to have occurred in this population. Requiring more detailed examination, it is
10 also possible that this reverse Flynn effect may be particularly stronger at the lower ends of
11 the IQ distribution and that different domains of intelligence may vary with ability levels as
12 has been suggested in the general population (Zhou, Zhu & Weiss, 2010).
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30 **Limitations of present study**

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33 Whilst all current admissions to HSPC have in common an initial view of being considered ‘a
34 grave and immediate risk of harm to others’, as a group they comprise a wide range of
35 primary and comorbid diagnoses, as well as all having diverse histories. Although specific
36 diagnostic groups, including those with a mental illness and a personality disorder were
37 examined by the Flinn et al (2018) study, it is methodologically difficult to carry out
38 meaningful diagnostic group comparisons with the current sample as individuals with a
39 mental illness comprise the vast majority of admissions. Attempting to compare clinical
40 groups or control for co-occurring conditions is extremely difficult, where some individuals
41 may have one or more such factors in their backgrounds. In addition, while a significant
42 number of individuals admitted to HSPC report experiencing head injuries in their past, the
43 frequency, location of injury and severity all vary, as well as only some of those reporting a
44 head injury actually having a brain injury observable in any scan. Attempting to group such a
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3 clinically diverse sample into a single category of HSPC admissions has therefore
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5 questionable validity. A similar issue is the diverse unavailable medication histories of
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7 individuals. Whilst the effects of medications on cognition can be positive and negative, of
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9 significance is the finding that many anti-psychotic medications can exacerbate processing
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11 speed difficulties (Knowles, David & Reichenberg, 2010).
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19 In terms of the administration of the WAIS over the decades, it is also likely that there have
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21 been considerable differences in how the test was completed. For example, initial WAIS tests
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23 appear to have been completed by assistant psychologists rather than qualified, as well as
24
25 there being changes in the test stimuli, availability of composite discrepancy analyses, use of
26
27 confidence intervals and comparative data. As a result, there has been no consistent test
28
29 protocol. The initial WAIS was also significantly shorter and quicker to administer compared
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31 to subsequent versions. Clinical judgement also plays an important part of all
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33 neuropsychological assessments in HSPC where although tests need to be administered
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35 broadly following manual guidelines, there is the need to be flexible in approach and
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37 particularly mindful of an individual's test effort, motivation and mental state (Iverson,
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39 2009). Assessments may therefore require several meetings, including shorter and more
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41 frequent sessions. Whilst as yet there is no research on forensic clinical samples to support
42
43 the need for shorter sessions, research on undergraduate students has suggested that 'low
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45 stake' (assessments without any overt consequences) cognitive ability test sessions that
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47 exceed 25 to 30 minutes may have a detrimental effect on motivation (Gignac, Bartulovich,
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49 & Salleo, 2019). Although in the minority, some individuals may also be familiar with
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51 intelligence testing and the concept of IQ, as well as perhaps having experienced some form
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53 of testing during their childhoods or early adulthood. Practice effects are therefore possible,
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55 as well as deliberate attempts to underperform if they believe it may be in their best interests
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3 to do so (such as when on remand for an offence and seeking a non-custodial sentence).

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5 Indeed, if possible some form of control for symptom exaggeration, poor effort and
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7
8 malingering would have been incorporated in the study consistent with the recommendation
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10 that it should be included in all forensic neuropsychological evaluations (Iverson, 2010).

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12 However, whilst these factors may have been present in some assessments, it could also be
13
14 argued that all were potentially present across all decades of testing and therefore any
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16 influence on the overall results minimal. With regard to test performance, within non-clinical
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18 samples it has also been suggested that low scores in many neuropsychological measures
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20 including the WAIS are common and do not reflect any underlying pathology (Binder,
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22 Iverson & Brooks, 2009). However, as yet there is no manual data on the amount of
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24 variability in tests in the general population or base rates on the prevalence of false positives.
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26 Excluding poor effort as an explanation, low scores in assessments are therefore assumed to
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28 reflect some form of cognitive dysfunction rather than just a reflection of the typical variation
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30 in the population.
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39 **Future research and clinical implications**

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42 It would be useful for this study of intellectual functioning to be repeated in other forensic
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44 psychiatric samples to examine if the findings are specific to one HSPC or reflect a wider
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46 change in these populations over time. The presence of high levels of cognitive dysfunction
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48 among admissions to HSPC as reflected by low levels of general intellectual functioning and
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50 notably processing speed difficulties suggest the consideration of an individual's cognitive
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52 functioning remains important. As well as all clinical staff making reasonable adjustments
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54 and adaptations to everyday procedures to minimise the effects of any cognitive dysfunction,
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56 specific application and evaluation of cognitive remediation interventions for those who
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3 might benefit from targeting cognitive problems is required, especially those directed at
4 processing speed (Mogami, 2018). Many of the conventional interventions and risk
5 management protocols offered in HSPC and beyond may also require specific adaptations to
6 either compensate for or develop processing speed difficulties. Including cognitive
7 dysfunction awareness in staff training on mental illness is also essential as clinical
8 impressions suggest such knowledge is lacking in many staff.
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21 In terms of clinical assessments and interventions, full scale IQ continues to be requested for
22 many individuals to inform future clinical pathways notably to intellectual disability services
23 and is often associated with requests for repeat IQ testing. Such situations can create much
24 debate as to an individual's level of difficulties and ignores research evidence suggesting
25 repeat IQ testing in forensic intellectual disabilities is associated with significant
26 inconsistency between scores (Habets, Jeandarme, Uziebo, et al., 2015) and where IQ may
27 not be a reliable indication of an individual's level of functioning (Siegel, 1989; Whitaker,
28 2010; Webb & Whitaker, 2012). In other clinical groups, IQ is also misleading with regard to
29 an individual's specific difficulties. For example, many individuals with an autism spectrum
30 condition can have a full scale IQ in the 'average' range or above and yet have significant
31 difficulties with social cognition and tendency towards literal thinking which in turn may
32 impact on everyday functioning (Hoekstra, Happé, Baron-Cohen & Ronald, 2010). The same
33 may also be true for psychosis. Murphy (2007) in an examination of 30 individuals with a
34 psychosis admitted to HSPC found that it was performance in the revised eyes task (a test of
35 social perceptual theory of mind) rather than full scale IQ that was significantly associated
36 with risk and clinical need ratings three years later. In terms of direct interventions with
37 forensic psychiatric populations, Darmedru and colleagues (2017) also highlight both specific
38 and non-specific cognitive remediation programmes directed at individuals with
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3 schizophrenia who display violence as having a positive impact on reducing both aggressive
4 attitudes and the number of physical assaults on others.
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11 It could be argued that the results also support the continued need for routine
12 neuropsychological assessments of admissions into HSPC. Not only do such assessments
13 provide useful clinical information regarding an individual's functioning and specific needs,
14 they assist with monitoring the changing clinical presentation of the population. With the
15 eventual introduction of the WAIS V into assessments and the move into a new decade,
16 future research will examine how admissions perform in this version of the WAIS and other
17 cognitive tests. There is also the issue of changing demographics of admissions to HSPC.
18 Compared to previous decades qualitative impressions of recent admissions suggest an
19 increase in those who do not have English as their first language and who were educated
20 outside the UK. Indeed, at the time of writing the first languages of individuals admitted
21 include Arabic, Persian, Russian, as well as numerous European and African languages.
22 Attempting to obtain a reliable estimate of general levels of intellectual function of these
23 individuals using conventional Western and English language based neuropsychological
24 measures presents many challenges in terms of language, test stimuli and appropriate
25 comparative data (Nell, 2000; Fagan & Holland, 2007). If such trends continue, the question
26 arises of whether it will be useful to continue with the formal provision of a conventional IQ
27 or whether it should be abandoned for cognitive assessments based on the level of individual
28 need and the support required.
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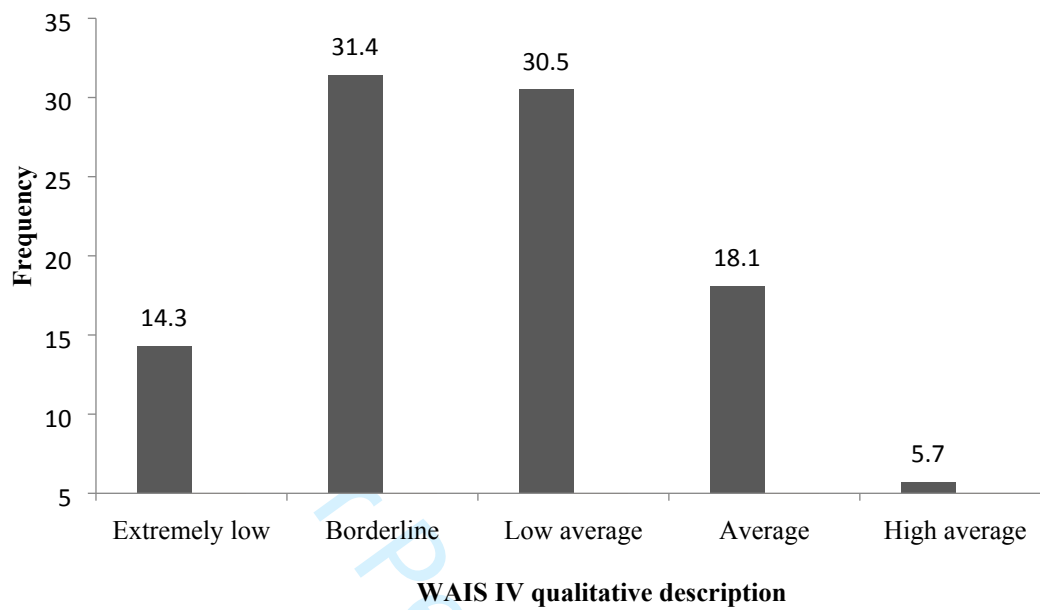
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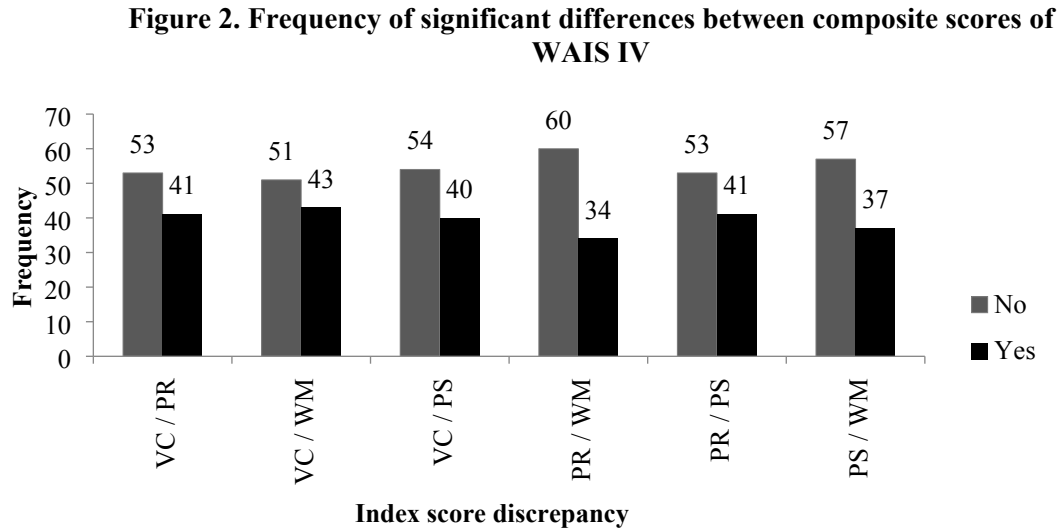
Table 1. Mean age of admissions at testing over six decades

Decade	N	Mean age	SD	Range
1960s	100	35.7	11.2	16 & 76
1970s	100	32.0	10.9	17 & 66
1980s	109	33.9	10.5	18 & 66
1990s	101	31.6	8.9	18 & 62
2000s	106	35.4	11.5	18 & 63
2010s	123	32.5	9.3	19 & 59

Table 2. Valid WAIS IV profiles of composite and subscales for total admission sample ($n = 94$).

Composite score & subtest (age scaled score)	Mean	SD	Min / Max
Flynn adjusted Full scale IQ	77.65	13.39	52.2 & 114
Unadjusted FIQ	84.95	13.29	54 & 117
Verbal Comprehension	84.95	12.87	63 & 118
Perceptual Reasoning	85.510	12.93	56 & 117
Working Memory	84.45	13.53	60 & 117
Processing Speed	77.96	14.68	50 & 120
Block design	7.71	2.34	3 & 13
Similarities	6.72	2.53	2 & 16
Digit Span	7.37	2.66	2 & 14
Matrix Reasoning	7.28	3.00	1 & 15
Vocabulary	7.23	2.50	3 & 15
Arithmetic	7.03	2.52	1 & 15
Symbol search	5.99	2.99	1 & 15
Visual puzzles	7.60	2.54	1 & 14
Information	7.99	3.11	3 & 16
Coding	5.88	2.95	1 & 14

Figure 1. Frequency of qualitative descriptions for WAIS IV (%)



Key

VC – verbal comprehension

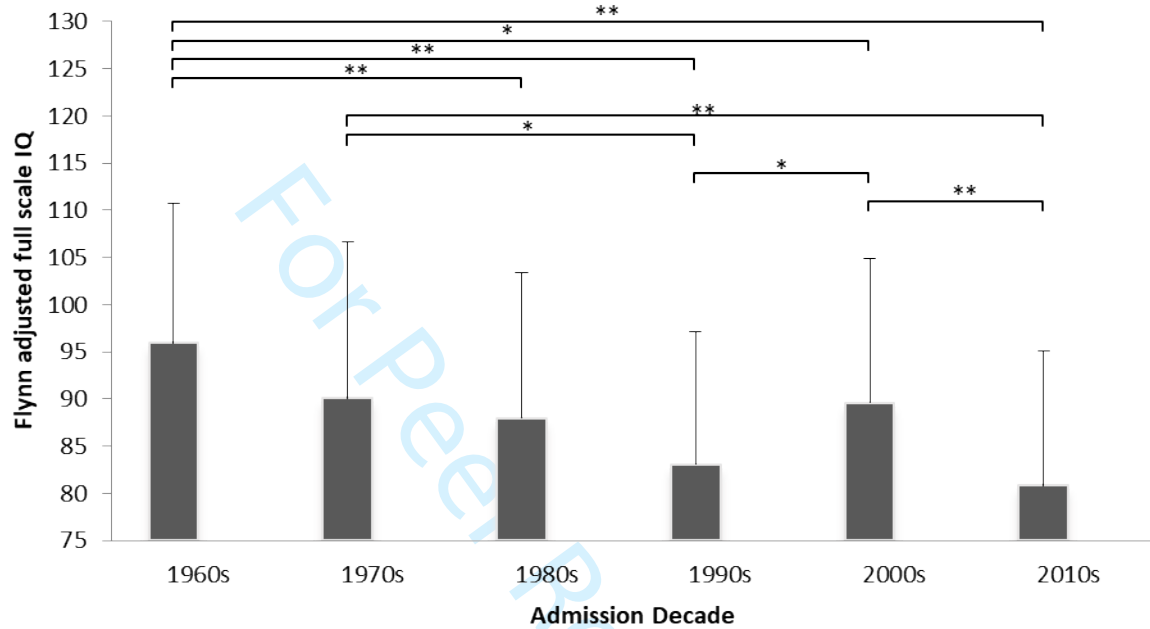
PR – perceptual reasoning

WM – working memory

PS – processing speed

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Figure 3. Mean (SD) Flynn adjusted WAIS FIQ of admissions over six decades with significance bars



Significance bars key

*significant at 0.05

**significant at 0.001

Table 3. Mean adjusted full scale IQ and distribution of WAIS version over six decades

	WAIS ¹	WAIS R ²	WAIS III ³	WAIS IV ⁴	<i>n</i>
1960s	100	0	0	0	100
1970s	100	0	0	0	100
1980s	109	0	0	0	109
1990s	8	93	0	0	101
2000s	0	1	105	0	106
2010s	0	0	18	105	123
<i>n</i>	317	94	123	105	639
Mean (<i>SD</i>)	91.3 (15.7) ^{2,4}	82.3 (14.2) ^{1,3}	89.2 (14.7) ^{2,4}	79.9 (14.7) ^{1,3}	87.7 (15.8)

Superscript numbers in bottom cells indicate a difference in mean adjusted FSIQ at a significant level ($p < .05$)

Figure 4. Number of admissions to hospital in each decade with Flynn Adjusted FIQ of 70 & below

