

A Study of Comparative Clinical and Socio-Economic Characteristics of School-Age Children Screened for ADHD: Implications for Development of ADHD Clinical Care Pathway

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Abstract: ADHD is the most frequently occurring neurobiological disorder in childhood and is defined by cardinal symptoms of inattention and/or hyperactivity and impulsivity. We evaluated school-age children referred for behaviour problems and screened for ADHD over a 22-month period. We compared the clinical and socio-economic characteristics of the two groups of children: those diagnosed with ADHD and non-ADHD. A total of 63 children were assessed for possible ADHD over the period. There was no statistically significant difference between both groups in relation to several characteristics including sex ratio, mean age at referral and diagnosis, mean number of clinics attended, the time taken to complete the assessment and the socioeconomic status of patients' families. The highest proportion of the ADHD and non-ADHD children lived in the most deprived areas. The main difference between both groups was the high rate of negative teachers' responses. No teacher's rating was positive for any child without a diagnosis. An ideal ADHD care pathway should follow multi-disciplinary approach, and rely on evidence-based feedback from the school, as a more reliable pointer to confirmed diagnosis of ADHD compared to just parental report. This will likely reduce assessment duration and avoid delays in diagnosis confirmation.

Keywords: ADHD, Childhood, Adolescence, Socio-Economic, School-Age, Clinical Care Pathway

1. Introduction

Attention-deficit/hyperactivity disorder (ADHD) is the most frequently occurring neurobiological disorder in childhood and is defined by symptoms of inattention and/or hyperactivity and impulsivity that are excessive when compared with other individuals at the same developmental level. ADHD symptoms can persist into adulthood, causing significant functional impairment and emotional distress. ADHD is regarded as a chronic condition leading to significant impairment in several domains.

ADHD prevalence varies worldwide and figures of 1.5% to 19.8% have been reported. A UK survey estimated the prevalence of ADHD to be 3.62% of boys and 0.85% of girls [1]. A systematic review of prevalence studies by Polanczyk

and colleagues (2007) concluded that there were relatively minor differences in ADHD prevalence worldwide which is around 5.3% [2].

ADHD is as a heterogeneous disorder with the aetiology involving the interplay of multiple genetic and environmental factors including various potential susceptible gene candidates, with up to 75% heritability factors, perinatal and postnatal adverse risk exposure factors, dietary and severe psychosocial adversarial factors. Different ADHD sub-types appear to result from different combinations of risk factors acting together [3].

Socio-economic factors are known to influence the prevalence of chronic childhood disabling conditions including emotional and behavioural disorders like ADHD [4].

ADHD diagnosis is based on a combination of observer feedback on screening tool rating scales, direct clinical

observations and a range of other neuro-psychiatric tests including the computerized continuous performance tests.

Referrals of school-age children for assessment of difficult or challenging behaviour constitute a major case load of Neuro-developmental Paediatricians (designated as Community Paediatricians in the UK).

2. Methods and Design

We aimed to evaluate the characteristics of school-age children screened for ADHD following referral for behaviour problems to the local Community Paediatric unit (CPU) of a large healthcare NHS Foundation Trust over a 22-month period. We compared the characteristics of children diagnosed with ADHD with those not diagnosed following standard comprehensive assessments. This was an audit of the school-age workload in a moderately-sized Community Paediatric centre of a North-West of England Local Authority Borough, UK.

A retrospective review of medical records of all the patients referred to the CPU between Jan 2014 and Oct 2015 was conducted. Standardized demographic and referral information were collected for each patient. Information was also collected on the range of clinical presentation, socio-economic characteristics, assessment duration and schedule of follow-up. The audit was completed as part of the Clinical Governance strategies of the Bridgewater Community Healthcare Foundation Trust. No identifiable patient record was used and no research ethical approval was required.

Each patient was assessed using multiple-source feedback including evidence-based rating scale screening tools, detailed developmental history and direct clinical assessment. The patients were assessed using the Swanson, Nolan, and Pelham –IV Questionnaire (SNAP-IV) (26-item freely available resource online at myadhd.com). A few patients were also assessed using the short version of the Revised Conners' Parent and Teacher Rating Scales. Each patient was assessed and followed up by a Consultant Paediatrician or a senior Community Paediatric doctor.

Using the residential postcodes, we identified the Lower-Layer Super Output Areas (LSOA) for each patient. LSOAs are small neighborhood areas based on the 2011 Census, designed to be of a similar population size with an average of 1,500 residents each. The socio-economic status of each child was determined using the Index of Multiple Deprivation (IMD) 2015 scores and ranking order out of all the 32,844 LSOAs in England [5]. The ranked LSOAs were analysed as groups of 5 (Quintiles) or groups of ten (Deciles). Deciles are calculated by ranking the 32,844 small areas in England from most deprived to least deprived and dividing them into 10 equal groups while Quintiles are calculated by dividing them into 5 equal groups.

Spearman's rank correlation coefficient was used to determine the relationship between the prevalence of ADHD in different socioeconomic groups. Other descriptive statistics used was chi square (with Yates correction when relevant) for comparison of proportions among groups of patients.

3. Results

3.1. Local Population and Service Description

Halton is a local borough district in North West England administered by a unitary authority. The borough consists of the towns of Runcorn and Widnes and the civil parishes of Hale, Daresbury, Moore, Preston Brook, Halebank and Sandymoor. The estimated school age childhood population of Halton local district between 5 and 19 years is 16,432, which is 13% of total population of 126,400 (mid 2014 estimate) with an annual birth rate of 1,522.

Halton is the 19th of the 20 English local authority districts with the highest proportion of their neighbourhoods (21 out of 80) in the most deprived 10 per cent of neighbourhoods nationally on the Index of Multiple Deprivation 2015 [5].

The Community Paediatric Unit (CPU) is the secondary referral centre for the local council Authority, providing secondary level community-based Paediatric care for all children from 0 to 19 years with any neuro-developmental or behavioural problems. The CPU accepts referrals from a wide variety of primary care practitioners including the General Practitioners (GP), Health Visitors, para-medical healthcare professionals and therapists, school or nursery staff and school nurses.

The CPU has a direct link with the local two local District General Hospitals (DGH) in Warrington and Whiston for access to laboratory pathology and radiological investigation services and to a tertiary children's hospital in Liverpool for specialist expertise.

3.2. Clinical Characteristics

A total of 63 children were assessed for possible ADHD over a period of 22 months, corresponding to 2 patients per 1000 of the total school age population per year. Table 1 displays the main characteristics of the two groups (ADHD and non-ADHD) of children.

There was a significantly higher male predominance in those diagnosed with ADHD (6:1) compared to 2:1 among those negative for ADHD diagnosis.

Mean age at referral and mean age at diagnosis were similar: 100 [Standard Deviation (SD) = 34] months and 110 (SD = 32) months vs 107 (SD = 38) months and 114 (SD = 37) months for ADHD and non-ADHD patients respectively. The mean duration for the assessment of all patients from the time of referral to time of diagnosis was 8.5 months but it was twice as long for the positively diagnosed cases (12 months vs 6 months) compared to the non-diagnosed cases. The average number of clinics attended before diagnosis confirmation was statistically similar between both groups (3 vs 2 clinics).

The main difference between both groups was the high rate of negative school teachers' feedback on the screening questionnaires (SNAP-IV or Conners Teachers Rating Scale). Only 2 out of 30 teacher's symptom ratings were positive among the children without a clinical diagnosis of ADHD confirmed.

Table 1. The main characteristics of the two groups of children (ADHD and non-ADHD).

Characteristics	All Patients	ADHD	Non-ADHD	Chi sq, p value
Total No of Pts	63	33	30	--
Sex ratio	49:14 (3.5:1)	28:5 (5.6:1)	21:9 (2.3:1)	1.3;0.25
Mean Age at Referral (mo)	102 (SD 38)	100 (SD 34)	107 (SD 38)	0.07;0.8
Mean Age at Diagnosis (mo)	111 (SD 35)	110 (SD 32)	114 (SD 37)	0.07;0.8
Mean no. of clinics attended	2.2	2.6	2	0.1;0.75
No. living in the most deprived Quintile of society	42 (67%)	24 (75%)	18 (60%)	1.2;0.3
No. living in the most deprived Decile of society	28 (44%)	17 (52%)	11 (37%)	0.9;0.3
Positive Parent ratings	57 (90%)	32 (97%)	25 (83%)	3;0.08
Positive Teacher ratings	33 (52%)	31 (94%)	2 (7%)	47; <0.01**
Mean screen duration (mo)	8.5	11.6	5.8	0.8;0.4
Mean co-morbidities	1.6	1.6	1.6	0.8;0.4

Legend:

** Clinically significant

3.3. Socioeconomic Characteristics

The largest proportion of the children (both ADHD and non-ADHD) lived in the most deprived areas of the community (Tables 2 and 3), with 44% living in the most deprived 10% (1st Decile), Spearman Rank Correlation (R) = -0.7; p=0.04. This represents 6 children per 1000 school-age population.

67% of all the referrals came from the most deprived (1st Quintile) section of the local authority. There was no statistically significant difference between the distribution among the ADHD-positive and non-ADHD groups (for Decile distribution: Yates chi square = 3.5, p = 0.9 and for Quintile distribution: Yates chi square = 3.1, p = 0.54).

Table 2. The distribution of patients based on their Socioeconomic locations (in Deciles).

IMD Decile (1 is most deprived)	Est Total Population	Sch-Age Population	ALL Patients (% ¹⁰⁰ [§])	ADHD Positive (% ¹⁰⁰ [§])	Non-ADHD (% ¹⁰⁰ [§])
1	32017	4808	28 (5.8)	17 (3.5)	11 (2.3)
2	28854	3704	14 (3.8)	7 (1.9)	7 (1.9)
3	9664	1280	4 (3.1)	0	4 (3.1)
4	6614	811	3 (3.7)	1 (1.2)	2 (2.5)
5	5985	724	3 (4.1)	1 (1.4)	2 (2.8)
6	8997	953	1 (1)	1 (1)	0
7	9031	911	3 (3.3)	1 (1.1)	2 (2.2)
8	12457	1381	2 (1.4)	2 (1.4)	0
9	12782	1888	5 (2.6)	3 (0.6)	2 (1.1)
Total	126400	16459	63 (3.8)	33 (2)	30 (1.8)
Spearman Rank Correlation			R = -0.7 p=0.04	R = -0.5; p = 0.2	R = -0.55; p = 0.12

Legend:

[§]Prevalence (per 1000 School-age population)

R = Spearman Rank Correlation

Table 3. The distribution of patients based on their Socioeconomic locations (Quintiles).

IMD Quintile (1 is most deprived)	Est Total Population	Sch-Age Population	ALL Patients (% ¹⁰⁰ [§])	ADHD Positive (% ¹⁰⁰ [§])	Non-ADHD (% ¹⁰⁰ [§])
1	60871	8512	42 (4.9)	24 (2.8)	18 (2.1)
2	16278	2091	7 (3.3)	1 (0.5)	6 (2.9)
3	14982	1677	4 (2.4)	2 (1.2)	2 (1.2)
4	21488	2292	5 (2.2)	3 (1.3)	2 (0.9)
5	12782	1888	5 (2.6)	3 (1.6)	2 (1.1)
Total	126400	16459	63 (3.8)	33 (2)	30 (1.8)
Spearman Rank Correlation			R = -0.7 p=0.23	R = 0; p = 1	R = -0.8; p = 0.13

Legend:

[§]Prevalence (per 1000 School-age population)

R = Spearman Rank Correlation

3.4. Sources of Referral

Nine different sources of referral were identified (Table 4). There was no statistical significance between those diagnosed with ADHD and those undiagnosed. It was interesting to know that all the patients referred by Educational professionals including the Educational Psychologist (2), Special Educational Needs Coordinators (SENCo) (1) and Educational Welfare Officer (1), as well as those referred by the Speech and Language Therapist (SALT) and the Autistic pathway multi-professional team (ASC Pathway) were positively diagnosed with ADHD. On the other hand, 72% of the children referred by their GP did not

meet the criteria for ADHD diagnosis.

3.5. Clinical Outcome

14 patients (22%) were either immediately discharged or failed to attend clinic appointments during the study period. This included 5 with ADHD (15%) and 7 (23%) non-ADHD patients.

14 patients (36%) among those diagnosed with ADHD were either not on any treatment or waiting for medications to be commenced. 3 of the remaining 19 patients were on Atomoxetine while the others were on various Methylphenidate preparations.

Table 4. List of referral sources and ADHD Positivity Rate.

	All Patients	Proportion (%)	ADHD	Non-ADHD	Positivity Rate (%)
Gen. Practitioner	42	67	19	23	45
School Nurse	7	11	4	3	57
CAMHS	7	11	4	3	57
Educ Psychologist	2	3	2	0	100
Behaviour MDT	1	1.6	0	1	100
SENCo	1	1.6	1	0	100
ASC Pathway	1	1.6	1	0	100
SALT	1	1.6	1	0	100
Educ WO	1	1.6	1	0	100
Total	63	100	33	30	52

Legend:

CAMHS: Child and Adolescent Mental Health Service

SENCo: Special Educational Needs Coordinator

MDT: Multidisciplinary Team

ASC: Autism/Social Communication

WO: Welfare Officer

3.6. Associated Co-morbidities

The associated co-morbidities were common and similar in both groups (Table 5). Each patient had on average 1.6 co-morbid problems. Only eleven children (17%) did not have any other identified disorders. 19 children (30%) had one co-morbid problem, 22 (35%) had two conditions while seven (11%) and four (6%) children had 3 and 4 co-morbidities respectively (Yates' chi-square = 0.211, p value = 0.96)

The commonest associated problems in both groups were sleep difficulties (33%), learning/ educational difficulties (22%), Developmental Coordination Disorder (11%), Social Communication concerns (11%) and Speech/ Language delay (8%). Social problems were also common including family disruptions (19%), abuse or exposure to domestic violence (5%) and local council custody/adoption (11%).

Table 5. List of associated co-morbid problems.

Problems	Total No	Total Percent	ADHD Pos	Non-ADHD	Chi sq, p value
Sleep problems	21	33.3	12	9	0.286; 0.59
Learning/Educational Diff	14	22.2	8	6	0.164; 0.68
Family-separation	12	19.0	7	5	0.211; 0.65
DCD	7	11.1	2	5	0.877; 0.35
LAC/Adopted	7	11.1	2	5	0.877; 0.35
SC concerns	7	11.1	3	4	0.018; 0.89
Speech/ Language delay	5	7.9	4	1	0.676; 0.41
CD/ODD	4	6.3	1	3	0.379; 0.53
Tics	4	6.3	3	1	0.175; 0.67
FH ADHD	3	4.8	1	2	0.007; 0.93
Social - DV, abuse	3	4.8	2	1	0.007; 0.93
ASD	2	3.2	0	2	0.621; 0.43
Sensory integration Diff	2	3.2	2	0	0.424; 0.51

Problems	Total No	Total Percent	ADHD Pos	Non-ADHD	Chi sq, p value
Cardiac symptoms/CHD	2	3.2	2	0	0.424; 0.51
Smoker-sub abuse	2	3.2	0	2	0.621; 0.43
Developmental Delay	1	1.6	0	1	0.002; 0.96
Microcephaly	1	1.6	1	0	0.002; 0.96
NF1	1	1.6	1	0	0.002; 0.96
Emotional Diff	1	1.6	0	1	0.002; 0.96
Foetal Alcohol Syndrome	1	1.6	1	0	0.002; 0.96
Attachment Diff	1	1.6	0	1	0.002; 0.96
None	11		5	6	0.256; 0.61

Legend:

Diff: Difficulties

DCD: Developmental CD

LAC: Looked After Child (by Local Authority)

SC: Social Communication

CD/ODD

FH: Family History

DV: Domestic violence

ASD: Autistic Spectrum Disorder

CHD: Congenital Heart Diseases

NF: Neurofibromatosis

4. Discussion

4.1. Use of Validated Screening Tools and Observer Feedback

Both assessment screening tools used: Swanson, Nolan, and Pelham –IV Questionnaire (SNAP-IV) (26-item freely available resource online at myadhd.com) and the short version of the Revised Conners' Parent and Teacher Rating Scales are very common and have been validated in several studies [6-8]. In comparison with direct overt questioning or use of broad-band mental health questionnaires, narrow-band instruments like the SNAP-IV has been reported to be more reliable to obtain information on ADHD symptoms at school from teachers [9]. It has been reported to show 'good' concordance with the Paediatricians' clinical impression of ADHD [10]. Both SNAP-IV and Conners' Revised Questionnaires have inter-rater agreement weighted kappa scores ranging from .30 ("fair") to .77 ("good") across symptoms [11]. Good Inter-rater validity is one of the hallmarks of reliable screening tools.

Disagreement between parents on ADHD assessment rating scales have been reported [12], depending on their levels of education. The agreement is reported to be especially good for symptoms of hyperactive-impulsivity. Mothers tend to report more symptoms than fathers. The agreement of parents' questioning responses with the teachers is essential for achieving a reliable diagnosis of ADHD. Previous studies suggest that reliability of the parents responses are significantly improved by providing them with appropriate instructions and guidance on how to rate children's ADHD symptoms [13].

4.2. Socioeconomic Factors

A recent comprehensive review of over 160 studies have proven that childhood disabling chronic conditions including

ADHD in high-income countries are associated with social disadvantage. There is currently limited evidence to explain the causality of the observed consistent association across different countries [4]. This study confirms a relatively high prevalence of children at high risk of developing ADHD and other behavioural or developmental co-morbidities living in the least affluent areas of the community.

Poverty is considered the single biggest threat to child well being and efforts directed at reducing socioeconomic inequalities that begin in childhood are urgently needed [14]. Children living in poor socio-economic neighbourhoods are reported to be at higher risk of school drop-out, imprisonment, negative emotional states and more health-related problems when compared to their peers in more affluent settings. The children are exposed to high levels of environmental risk factors including chronic stress due to high levels of crime, discord and other threatening and uncontrollable events [15, 16].

Other indicators for the poor socioeconomic background of the children presenting with behavioural difficulties suspected to be ADHD is the high prevalence of social problems in this study found among the patients including family disruptions (19%), local council custody/adoption (11%), abuse or exposure to domestic violence (5%).

4.3. Clinical Factors

36% of the diagnosed patients were not on any medications and 15% were already self-discharged during the study period. High rates of treatment non-compliance and self-discharge have been reported in other similar studies among children and adolescents with ADHD. ADHD patients often face challenges of managing self-regulatory impulses, which may affect their compliance with treatment [17]. A high level of stigma attached to ADHD diagnosis in some local settings may also discourage patients from actively seeking or complying with treatment regimens.

Other neuro-developmental, behavioural, educational and emotional co-morbidities are highly prevalent among ADHD patients. The commonest co-morbidities in this study are sleep difficulties (33%), learning/ educational difficulties (22%), dyspraxia (11%), social communication concerns (11%) and speech delay (8%). A recent similar study has reported high prevalence of comparable pattern of comorbid/alternative diagnoses among those with ADHD and those not diagnosed with ADHD, thereby emphasizing the importance of evaluating all childhood behaviour referrals for comorbid disorders regardless of the primary diagnosis [18]. This underlines the need for a multidisciplinary and multiagency approach to the management of ADHD.

4.4. Clinical Care Pathways

A number of national and regional guidelines have been produced to help streamline and standardize the assessment and management of ADHD in children and adolescents [3, 19-23]. There is still a wide range of variation in adherence of clinical practice to available guidelines among various healthcare paediatric professionals involved in managing children with ADHD and across various locations [24-26]. There are clear indications and scope for improvement of clinicians' adherence to existing guidelines [27].

The different national and regional guidelines are evidence-based and reflect similarities and differences of healthcare systems. ADHD diagnosis throughout the lifespan should be based on a detailed clinical history incorporated within a clearly defined clinical care pathway. An ideal clinical care pathway specifies the sources of referral, the triage process to ensure a high quality of adequate information is provided, multi-professional approach for assessment and diagnosis, follow-up procedures and transitional processes for smooth transfer of care to adult services [28].

Many other mental health clinical conditions such as post-traumatic stress disorder, mood and anxiety disorders and many socio-economic adverse experiences in children such as maltreatment histories and attachment difficulties, may present with or be associated with behavioural and attentional regulation difficulties. Many other neuro-developmental and neuro-behavioural disorders such as autism, developmental speech, motor, coordination and cognitive delays, sleep or sensory integration disorders, each requiring prompt assessment and management may also present as co-morbidities or with overlapping ADHD-like symptoms. ADHD diagnosis should therefore be conducted within a multidisciplinary team and the practice guidelines should prompt healthcare providers to explore all the various social, mental health, genetic, developmental, perinatal and educational factors affecting the diagnosis [29, 30].

Appropriate sources and quality of information available for clinical decisions are very critical in ensuring prompt and effective care for children, adolescents and their families. Clinical decision about each referral may include acceptance, signposting to other appropriate professionals and healthcare services or deferral until a future date.

This study confirmed that educational and other multi-disciplinary allied healthcare professionals are better at making appropriate referrals compared to the General Practitioners. Positivity rates were 100% for educational professionals (Special Educational Needs Coordinators-SENCo - and Educational Welfare Officers), allied professionals (Speech and Language Therapists - SALT) and multi-professional teams (Autism Pathway) compared to 28% for the GP (usually instigated by parental self-referral). A similar Australian study of 190 children referred for ADHD evaluation concluded that teacher-reported ADHD symptom severity and learning difficulties were the strongest predictors of ADHD diagnosis [18].

This suggests that high quality feedback from the school setting and other multi-disciplinary allied healthcare professionals available at the time of referral to the secondary healthcare service will enhance a more rapid and accurate rate of correct diagnosis of ADHD. It will minimize undue delay in commencement of appropriate treatment and subsequently improve outcomes for the patients and their families.

4.5. Limitations

A limitation of this study is that the data is based on retrospective diagnosis made by a multidisciplinary team in a single centre. Similar studies need to be conducted in multiple centres to determine the validity of the findings and exclude possible bias based on local culture and institutional practices. This bias is however partly mitigated by use of a validated and internationally accepted screening tool of the Swanson, Nolan, and Pelham –IV Questionnaire (SNAP-IV) and the Revised Conners' Parent and Teacher Rating Scales. Moreover, our findings are not dissimilar to another study using a similar methodology in a different country [18].

5. Conclusion

The highest proportion of ADHD and non-ADHD children came from the most socio-economically deprived areas of the local authority. This suggests that an improved environment may significantly improve the overall outcome of childhood ADHD and other behavioural disorders.

There are several reasons accounting for high rates of non-treatment, self-discharge or non-compliance with treatment that are common among children and adolescents with ADHD. The high prevalence of co-morbidities/ alternative diagnoses in children and adolescents with suspected ADHD highlights the importance of systematically evaluating for the presence of co-morbid conditions when assessing children for ADHD, so that interventions can be offered for identified problems.

An ideal care pathway should be conducted within a multi-disciplinary team, and rely on availability of evidence-based feedback from the school setting and other relevant allied healthcare or multi-disciplinary professionals, who are able to provide a more reliable pointer to confirmed diagnosis of ADHD compared to parental- or self-referrals through the

GP. This is likely to reduce the assessment duration and avoid undue delays in providing optimal treatment required.

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