A Profile of Common Neurodevelopmental Disorders Presenting in a Scottish Community Child Health Service –a One Year Audit (2016/2017)

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Abstract:
Community Child Health (CCH) is the branch of Paediatrics that specialises in childhood Neurodevelopmental and Emotional problems (NDEP), such as Attention Deficit Hyperactivity Disorder (ADHD), developmental delays and common emotional issues. A retrospective review of all patients seen in the local outpatient clinics between June 2016 and May 2017 within an NHS Fife region was carried out. No identifiable patient record was used and no research ethical approval was required. A total of 543 patients were seen in 908 clinic sessions, aged between two months and 18 years 6 months (average of 104 months) and 74% males. The largest age group (47%) was school-aged (5-9 years) children while young people (16–19 years) constituted 6% of the clinical caseload. The largest cases (46%) were seen in summer, but new referrals peaked during winter/spring (66%). The greatest proportion of patients (78%) lived in the most deprived 60% (Quintiles 1 to 3) of the community. The commonest NDEPs were difficulties with behaviour (45%), sleep (30%), social communications (27%), coordination (24.5%), sensory processing (22%), LD (19%), ADHD (17%), and speech/language delay (17%). Over 25 other multi-agency professionals were involved, including the OT (33%), SALT (26%), Health Visitors (18%), CAMHS (17%), Educational (16%) and Clinical Psychologists (15%). This study highlights the significant public health importance of childhood Neurodevelopmental disorders requiring high levels of integrated multi-professional involvement. It has implications for CCH training curriculum. The high risk of future mental health problems in adulthood demands a corresponding long-term follow-up and surveillance of children with NDEPs.

Keywords:
Community Child Health, Training, Childhood, Neurodevelopment, Behaviour, Emotional Health, Multi-Professional, Socioeconomic Deprivation, ASD, ADHD, Sleep Disorder

1. Introduction

Community Child Health (CCH) is the branch of Paediatrics that specialises in common childhood developmental, behavioural and emotional problems, such as Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), Tics disorder (TD)/ Tourettes syndrome (TS), Learning Disorders (LD), developmental delay, development coordination disorder (DCD) and common behavioural issues [1]. The Diagnostic and Statistical Manual of Mental Disorders (DSM -5) [2] and ICD-10 [3] have a definitive classification entry for most of these disorders.

Neurodevelopmental and Emotional problems (NDEP) in children and adolescents are being increasingly recognised worldwide but the healthcare services available for addressing them are largely deficient. In the United Kingdom (UK), the Royal College of Paediatrics and Child Health (RCPCH) has recently highlighted the problems of both capacity and high-quality care in CCH [4]. A recent survey of UK CCH services concluded that fewer than half of the proposed number of 4.5 Community Paediatricians per 100,000 children were in post by 2017 [5].

Worldwide prevalence for each of the NDEPs varies widely due to differences in study methodology and definitions used. Epidemiological research has demonstrated an overall prevalence of psychiatric disorders among school aged children and adolescents of 16-18%, including developmental, behavioural, emotional, sleep, feeding and attachment disorders [6]. Co-existence of disorders and sharing of symptoms across disorders (co-morbidity) is the rule rather than the exception for most children presenting with impairments in various domains of general development, communication and language, social interrelatedness, motor coordination, attention, activity, behaviour, mood and sleep [7].

Most children with NDEPs will be seen by a wide range of professionals including Health Visitors, Nurses, Social Workers, Education specialists, Paediatricians, General Practitioners (GP), Speech and Language Therapists (SALT), child Neurologists, child Psychiatrists, Psychologists, Neurophysiologists, Dentists, Clinical Geneticists, Occupational Therapists (OT) and Physiotherapists. There is growing evidence that early onset childhood NDEPs have long-term, often lifetime negative consequences, and that early screening and diagnosis can enhance these conditions' future prognosis [7].

The NDEPs have genetic predispositions interacting with a number of identifiable environmental risk factors. Patients with NDEPs are at a high risk of mental health problems persisting from school age to adolescence and adulthood [8,9]. A cohort study in Australia found that developmental delay predicted adult manic symptoms, while behaviour problems predicted both depressive and psychotic symptoms [10]. However, longitudinal and follow-up studies of childhood NDEPs are fraught with a number of challenges. The co-existence of disorders and the development of one problem into another raise important research questions, such as the possibility of shared aetiologies and risk factors associated with heterogeneous phenotypes [11].

There are many established rating scales and clinical instruments to assess NDEPs. A comprehensive screening tool has recently been designed and piloted among a large cohort of Swedish children. It is available free online (http://gillbergcentre.gu.se/english/research/screening-questionnaires/a-tac). The Autism-Tics, ADHD, and other Co-morbidities (A-TAC) inventory is reported to have a good to excellent sensitivity and specificity, with values of the area under the

receiver operating characteristics (ROC) curves ranging from 0.77 (AD/HD) to 0.91 (ASD) [11].

2. Materials and Methods

We aimed to evaluate the spectrum of various Neurodevelopmental and Emotional problems (NDEP) among children and young people attending two outpatient clinics of a local Community Child Health (CCH) service within Scottish NHS Fife Trust over a 12-month period between June 2016 and May 2017. A retrospective review of clinical records of all patients referred and seen over this period was carried out. This was an audit of the CCH workload completed as part of the Clinical Governance strategies of the NHS Fife. No identifiable patient record was used and no research ethical approval was required.

Standardized demographic and referral information were collected for each patient, including the range of clinical presentation, socio-economic characteristics, assessment duration and follow-up schedule.

2.1. Clinical Diagnostic Procedures

ADHD was diagnosed using the validated Swanson, Nolan, and Pelham–IV Questionnaire (SNAP-IV) (26-item is a freely available resource online at myadhd.com). ASD was diagnosed by a multidisciplinary approach involving detailed assessment individually by the Educational Psychologist, Clinical Psychologist, Speech and Language therapist (SALT) and the Community (Developmental) Paediatrician (CDP), using the ICD-10 checklist criteria to confirm or refute a diagnosis. All borderline cases on which the four professionals could not agree about the diagnosis were referred to a tertiary multi-disciplinary team for further assessments which included a formal cognitive assessment and use of Autistic Diagnostic Observation Schedule (ADOS-2).

Social Communication concerns were used for classification of all the patients who presented with significant symptoms of social interaction, social communication, rigidity of thoughts and other autistic traits, which were insufficient for a confirmed diagnosis of ASD.

Developmental Coordination disorder (DCD) or Dyspraxia was diagnosed by collaboration between the CDP and the Occupational Therapists (OT), who performed a series of specialised assessment tests including the Motor Assessment Battery for Children 2nd edition (MABC-2).

Sensory processing difficulties were diagnosed based on history of significant functional impairment arising from altered processing of sound, light, smell, proprioceptive, touch and other sensory inputs during clinical assessment. Other conditions were diagnosed based on detailed clinical history, clinical examination and exclusion of other physical disorders through laboratory investigations and radiological imaging where necessary.

2.2. Distribution of Socioeconomic Deprivation

The socio-economic status (SES) of each child was determined using the latest version of Scottish Index of Multiple Deprivation (SIMD) 2016, identifying the data zone for each patient using their residential postcodes. Details of SIMD2016 and the

distribution of data zones by Quintiles, Deciles and Vigintiles have been previously described [12].

2.3 Statistical Analysis

Spearman's rank correlation coefficient (http://www.socscistatistics.com/tests/spearman/default2.aspx) was used to determine the relationship between the prevalence of various NDEPs in different socio-economic groups. Other descriptive statistics used was chi square (with Yates correction when relevant) for comparison of proportions among groups of patients (http://www.socscistatistics.com/tests/chisquare2/Default2.aspx) and t-test for comparison of two means (https://www.medcalc.org/calc/comparison_of_means.php). Analysis of variance (ANOVA) was used when testing for differences between three or more means (http://statpages.info/anova1sm.html). Statistical significance is accepted at the p value of <0.05.

3. Results and Discussion

3.1. Description of Local Services

NHS Fife is one of the fourteen Regional Boards of NHS Scotland. Its services consist of two main hospitals supported by a network of Community and Day Hospitals. The primary care services provision within the three Community Health Partnerships (CHPs) and other subdivisions within Fife local Authority have been described elsewhere [12]. This audit mainly covers the Glenrothes and North east (NE) Fife CHP.

Fife has a population of 370,330 [13], 6.9% of Scotland's population, including over 64,305 children aged 0-15 years (17.4%), with 36% of its 174,427 households living in fuel poverty, on £340 median weekly income (after housing) and 19.4% of the children live in low income households [14]. The 0-15 year childhood 2016 mid-year population estimates for Glenrothes and NE Fife (Table 1) is 19,304 (9941 males and 9363 females), which is 15.7% of the total population of 122,960. The total population of children and young persons (CYP) 0-19 years is 25,843 [15].

Table 1. *Showing the childhood population estimates of Glenrothes and North East (NE) Fife compared to whole Fife and Scotland (mid-2016).*

	Glenrothes and NE Fife	**Fife**	**Scotland**
Aged 0-4 (2016)	5727	19806	287238
Aged 5-9 (2016)	6290	21308	298862
Aged 10-15 (2016)	7287	23258	329817
Aged 16-19 (2016)	6539	17181	243221
Total Population	122,960	370,330	5,404,700
Child Population (0-15)	19304	64372	915917
Male Child Population	9941	33050	468396
Female Child Population	9363	31322	447521
Proportion 0-15 yrs child population (%)	15.7	17.4	16.9

Sources:

KnowFife Dataset website (http://knowfife.fife.gov.uk/advanceddataviews/view) (Last accessed December 2017) [15]

National Records of Scotland. Mid-Year Population Estimates Scotland, Mid-2016. 27 April 2017; https://www.nrscotland.gov.uk/files//statistics/population-estimates/mid-year-2016/16mype-cahb.pdf (Last accessed December 2017) [16].

National Records of Scotland. Fife Council Area - Demographic Factsheet. July 2016. Available online: https://www.nrscotland.gov.uk/files/statistics/council-area-data-sheets/fife-factsheet.pdf (Last accessed December 2017) [17].

3.2. Epidemiology

A total of 543 patients were seen within the one-year period, corresponding to 2.1% of CYP's (0-19 years) population, consisting of 402 (74%) males and 141 females (ratio 3:1 M/F). Age range was between 2 months and 18 years 6 months (average of 8 years, 8 months). Each patient had on average 2 additional professionals involved in their care and 3 distinctly diagnosed NDEPs (ranging from 1 to 8). 199 (37%) of them (10 per 1000 of childhood population) were new referrals with an average age of 7 years and 4 months (88 months), who were significantly younger than the other follow-up patients with average age of 9.5 years (Table 2).

The largest age groups of the patients (47%) were school-aged (5-9 years) children while young people (16 – 19 years) constituted 6% of the clinical caseload (Table 3). There was a clear relationship between the age of the patients and the number of professionals involved in their care (3.2 vs 1.25 for the youngest and oldest groups respectively).

Table 2. *Comparing the characteristics of new referrals with the other follow-up patients.*

Patient's status	**No_Pts**	**Avg_Prof**	**Avg_Clin**	**Avg_Diag**	**Avg_Age**	**Avg_DNA**
New_Referrals	199	2.0 ±1.3	1.6 ±0.9	3.1 ±1.7	88 ±44	1.3 ±0.5
FU_Patients	344	2.1 ±1.7	1.7 ±0.8	3.4 ±1.6	113.5 ±43	1.2 ±0.4
Total	**543**	**2.0 ±1.6**	**1.7 ±0.9**	**3.3 ±1.7**	**104 ±45**	**1.2 ±0.5**
T test		0.717	0.67	2.06	6.69	-2.56
P value		0.47	0.5	0.04**	<0.001**	0.01**

Legend:

FU - Follow-up; Pts – Patients; Avg – Average; Clin – number of clinics attended; DNA – "Did Not Attend"; Diag – number of diagnosed NDEPs

Table 3. *Showing the age distribution of all patients*

Age_Band	**No_Pts**	**%**	**Prevalence[β]**	**Avg Prof[£]**	**Avg_Diag[a]**	**Gender Ratio (M/F)**	**Avg_Clinics[b]**
0–4 yrs	61	11	11	3.2 ±1.6	2.7 ±1.5	37/24(1.5:1)	1.5 ±0.8
5–9 yrs	257	47	41	2.2 ±1.6	3.4 ±1.7	198/59(3.4:1)	1.7 ±0.9
10–15 yrs	193	36	26.5	1.6 ±1.4	3.5 ±1.7	147/46(3.2:1)	1.6 ±0.8
16–19 yrs	32	6	5	1.25 ±1.0	2.8 ±1.2	20/12(1.6:1)	1.5 ±0.7
Total	**543**		**21**	**2 ±1.6**	**3.3 ±1.7**	**2.9:1**	**1.7 ±0.9**
rho[&]/F score		-0.4[&]	-0.4[&]	21.56	4.87	0.2[&]	1.41
P value		0.6	0.6	<0.001**	0.002**	0.8	0.24

Legend:

Pts – Patients; Avg – Average; Clin – number of clinics attended; DNA – "Did Not Attend"; Diag – number of diagnosed NDEPs

[β] Estimated prevalence per 1000 of children and young people population(0-19yrs) in Glenrothes and NE Fife (Total of 25843, mid 2016 estimate)

[&] Spearman Rank Correlation

[£] Mean ±Standard Deviation

[a] Mean ±Standard Deviation

[b] Mean ±Standard Deviation

3.3. Seasonal Variations

The largest caseload of patients (46%) was seen in summer (June to August) and the minimum was seen in winter (13%) (Table 4). Higher proportion of new referrals were received during the winter and spring (66%) compared to summer and autumn months (25%) ($p<0.001$). This probably reflected the predominance of referrals being triggered by concerns identified by teachers at school during term sessions.

The average age of children seen in the winter and spring was 17 months younger (92 months) compared to those seen in summer and autumn ($p < 0.001$).

Table 4. *Showing the seasonal variation among the children with NDEPs.*

Year Period	All Pts	% (n=543)	Avg_ Prof	Avg Diag	Avg Age[b]	Avg Age[a]	New Pts	% New
Summer (Jun-Aug)	250	46.0	2.1	3.4	108.1	9.3	60	24 (n=250)
Autumn (Sep-Nov)	138	25.4	2.0	3.3	110.7	9.5	36	26 (n=138)
Winter (Dec-Feb)	73	13.4	2.1	3.0	89.5	7.7	46	63 (n=73)
Spring(Mar-May)	82	15.1	1.8	3.3	93.7	8.0	57	69.5 (n=82)
F score/ Chi square		-0.8	1.156	1.141	5.92	6.22	9.3487[¥]	34.9
P value		0.33	0.33	0.33	<0.001**	<0.001**	<0.001**	<0.01**

Legend:

Avg_Prof – Average number of other Professionals per patient

Avg_Diag – Average number of NDEPs diagnosed per patient

Avg Age - Average age of each patient ([a] in years; [b] in months)

[¥] Chi Square test for seasonal distribution of new and follow-up patients

*** Statistically significant*

3.4. Clinical Outcomes and "Did Not Attended" (DNA) Rates

A total of 908 clinic appointments were offered to the 543 patients (average of 1.7 clinics per patient per year), out of which 232 (26%) were recorded as "Did Not Attended" (DNA). Clinic DNA rate for new referrals was 80 out of 327 (24%) and 152 out of 581 (26%) for follow up appointments.

54% of patients were offered a single clinic appointment, 27% had two clinics and 17% were offered 3 and up to 5 clinic appointments. 159 (29%) patients missed one

clinic, 29 (5%) missed 2 and 5 (1%) missed 3 or more clinics. 63 (32%) of new referrals compared to 130 (38%) of follow-up patients missed one or more clinics.

There was a statistically significant association between patients who attended the highest number of clinics and male preponderance, high morbidities and increased number of additional professionals required (Table 5).

143 patients (26%) who were discharged had on average one fewer diagnosed problems, slightly less clinic appointments and fewer additional healthcare professionals compared to the remaining patients. They were on average 18 months older than other patients (117 vs 99 months). All the differences between the discharged and the remaining patients were statistically significant (Table 6). The proportion of the new referrals (41 patients) that were discharged (21%) was less than the rate among follow-up (n = 102) patients (30%).

Table 5. *Showing the relationship between number of clinics offered and sex ratio, morbidities and number of additional professionals involved.*

No_Clinics	No_Pts	%(n=543)	M:F Ratio	Avg_DNA	Avg_Age	Avg_Prof	Avg_Diag
1	294	54%	2.6	1.0 ±0.1	103.4 ±46.4	1.7 ±1.4	2.9 ±1.6
2	157	29%	2.6	1.1 ±0.3	106.6 ±45.4	2.4 ±1.8	3.7 ±1.7
3	71	13%	4.5	1.3 ±0.5	104 ±38.4	2.4 ±1.7	3.9 ±1.6
4	18	3.3%	5	1.8 ±0.7	93.1 ±34	2.6 ±1.6	4.5 ±1.3
5	3	0.6%	2	3 ±0	105.7 ±44.1	1.7 ±1.2	3.7 ±2.1
Total	543		2.9	1.2 ±0.5	104.1 ±44.7	2 ±1.6	3.3 ±1.7
Rho[&]/Fscore	-1[&]	-1[&]	-0.05[&]	75.86	0.413	7.025	11.76
Pvalue	0.02**	0.02**	0.93	<0.001**	0.80	<0.001**	<0.001**

Legend:
Avg_Prof – Average number of other Professionals per patient
Avg_Diag – Average number of NDPs diagnosed per patient
Avg_Age – Average age of each patient ([a] in years; [b] in months)
[¥] *Chi Square test for seasonal distribution of new and follow-up patients*
** *Statistically significant*
[&] *Spearman Rank Correlation*

Table 6. *Comparing the characteristics of patients discharged with the others.*

Pts Status	No Pts	% (n=543)	Avg_Prof	Avg-No_Clin	Avg_Diag	Avg_Age[a]
Discharged	143	26	1.6 ±1.3	1.4 ±0.7	2.6 ±1.5	117 ±45.5
Remaining	400	74	2.2 ±1.6	1.8 ±0.9	3.6 ±1.7	99 ±43.5
T test			4.03	4.82	6.22	-4.2
P value			<0.001**	<0.001**	<0.001**	<0.001**

Legend:
[a] *Average age per patient (in months)*
Avg_Prof –; Average number of other Professionals per patient
Avg_Diag – Average number of NDEPs diagnosed per patient

3.5. Socioeconomic Distribution

The greatest proportion of patients lived in the most deprived 60% (Quintiles 1 to 3) of the community data zones (78%) and a smaller proportion (22%) were from the most affluent 40% data zones (Quintiles 4 and 5). There were no statistically significant differences in the gender ratio, average age, number of NDEPs, or number of professions per patient in the distribution of patients among the 5 Quintiles (Table 7).

Table 7. *Showing the distribution of the patients according to their socioeconomic status distribution.*

Quintile	No Pts	% (n=543)	Prevalence[β]	M:F Ratio	Avg_Prof	Avg_Diag	Avg_Age
Q1	162	29.8	27.7	3.2:1	2±1.8	3.3±1.6	103±48
Q2	117	21.5	23.2	2.9:1	1.7±1.4	3.2±1.8	108±45.4
Q3	144	26.5	30	2.7:1	2.2±1.6	3.3±1.6	99±41.7
Q4	74	13.6	15.6	2.5:1	2.3±1.6	3.5±1.7	104±43.6
Q5	46	8.5	8.5	2.8:1	2±1.5	3.5±1.7	111±41.6
Total	543	100	21	2.9:1	2±1.6	3.3±1.7	104±44.7
Rho[&]/ F score		-0.9[&]	-0.7[&]	-0.7[&]	2.16	0.51	0.93
P value		0.083	0.23	0.23	0.073	0.73	0.45

Legend:
Q1 (Most deprived areas); Q5 (Least deprived areas);
[β] Estimated prevalence per 1000 of children & young person's population (0-19 yrs) in Glenrothes and NE Fife (Total of 25843, mid 2016 estimate)
[&] Spearman Rank Correlation

3.6. Diagnostic Categories

Over 30 different categories of Neurodevelopmental, Behavioural, and Emotional problems (NDEP) were diagnosed. The commonest were difficulties with behaviour (45%), (including challenging, oppositional-defiant (ODD), aggressive and conduct disorders), sleep (29%), social communications (27%), Developmental Coordination Disorder (DCD) (24.5%), sensory processing (22%), Learning Difficulties (19%), ADHD (17%), and Speech/Language (SAL) delay (17%). 13% of the patients presented with emotional problems including Anxiety and Depression (Table 8). Global Developmental Delay (GDD, involving 2 or more domains) accounted for (12%) and Autism Spectrum Disorder (ASD) was 13%. Each patient had a range of one to 8 different NDEPs (average of 3) diagnosed.

Table 8. *Showing prevalence of various diagnosed NDEPs.*

Diagnosis	No_Pts	Percent (n=543)	Population Prev[$]	Avg_Prof	Avg_Age (Months)
Behaviour_Diff	243	44.75	12.6	1.8	110
Sleep_Diff	162	29.8	8.2	1.9	110
SC_Concern	149	27.44	7.7	2.3	100
DCD	133	24.49	6.9	2.5	104
Sensory	120	22.1	6.2	2.6	87
LD	103	18.97	5.3	2.4	127
ADHD	93	17.13	4.8	1.4	133
SALD	93	17.13	4.8	2.9	77
LAC_Adoption	71	13.08	3.7	2.1	95
Emotional(Anx/Dep)	69	12.71	3.6	2.1	124
ASD	69	12.71	3.6	1.5	113
GDD	67	12.34	3.5	3.2	86
Hypermobile_Joints	64	11.79	3.3	2.9	85
Dyslexia	46	8.47	2.4	2.0	134
Visual_Impairment	36	6.63	1.9	3.2	94
Constipation	29	5.34	1.5	2.5	104

Overweight	29	5.34	1.5	2.6	100
Geneticsyndromes	21	3.87	1.1	4.2	103
Enuresis	21	3.87	1.1	2.0	108
Ortho_Problems	19	3.5	1	3.6	109
Hypotonia	17	3.13	0.9	2.9	83
Motor_Delay	16	2.95	0.8	2.25	103
Tics_Tourettes	15	2.76	0.8	2.3	120
Ex_Preterm	14	2.58	0.7	2.9	100
Epilepsy	10	1.84	0.5	3.9	102
CerebralPalsy	10	1.84	0.5	4.5	104
Hearing_Impairment	9	1.66	0.5	3.7	111
Drooling	5	0.92	0.3	2	112
Selective_Mutism	4	0.74	0.2	2.75	124
Down'sSyndrome	2	0.37	0.1	1.5	165
Cong_Heart_Dx	4	0.74	0.2	3.5	104
Others	58	10.61	3	3.1	102

Legend:
[$] Population prevalence per 1000 of childhood population

Diff – difficulties; SC – Social Communication; DCD – Developmental Coordination Disorder; LD – Learning Difficulties; ADHD – Attention Deficit Hyperactivity Disorder; SALD – Speech & Language Disorder; LAC – Looked After Child; ASD – Autism Spectrum Disorder; GDD Global Developmental Delay; Ortho – Orthopaedic

Genetic Syndromes include Angelman's syndrome, Brachio-Otic Syndrome, NF1, Chromosomal copy number variants

Congenital defects including Corpus Callosum Dysgenesis, Pachygyria, Scaphocephaly, Hydrocephalus, Arnold Chiari malformation

Orthopaedic problems include Scoliosis, Pes cavus, Hip dysplasia

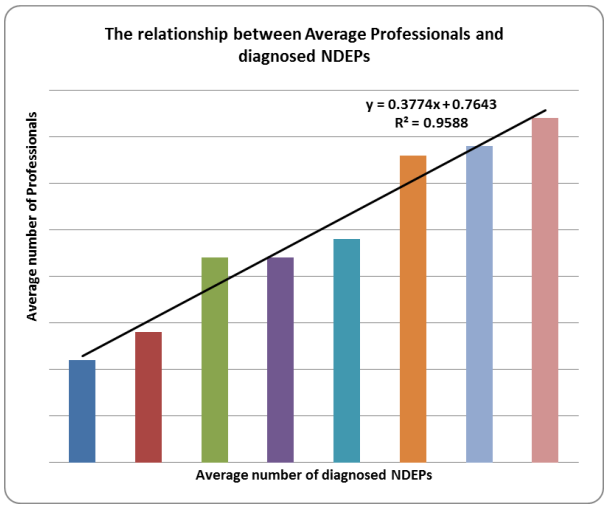
Others: Miscellaneous conditions including Asthma, Attachment Disorder, Small Stature/Failure to thrive, Dairy/Gluten Intolerance, Eczema, FASD, Iron Deficiency, Feeding Diff, GOR, Hypothyroidism, Microcephaly, Micrognathia, Mild Dysmorphism, Motor Mannerisms, Ocular Albinism

3.7. Multidisciplinary Professionals Involvement

There was a statistically significant relationship between the number of diagnosed NDEPs and the number of professionals involved in the management of each patient (Figure 1). The youngest children (0 – 4 years) required the largest number of professionals involved in their care ($p < 0.001$) (Table 3).

Certain groups of patients with the highest degree of multiple disabilities required exceptionally higher than average number of multidisciplinary professionals caring for them, including patients with Hydrocephalus (8), Congenital Defects such as cleft lip/ palate, talipes, and micrognathia (5), Cerebral Palsy (4.5), Epilepsy (4), Genetic syndromes (4), Congenital Heart diseases such as pulmonary atresia, VSD, and Tetralogy of Fallot (3.5), and hearing impairment (3.7).

Figure 1. *Showing the relationship between the average NDEPs diagnosed per patient and the average number of additional professionals per patient.*



Legend:
Spearman's rank correlation coefficient (rho) 0.99, 2-tailed p value<0.0001

3.8. Classification of Professional Teams

Over 25 different multi-agency professionals from the primary, secondary and tertiary levels of health care were involved in the care of the patients. They included various allied healthcare therapists, medical specialists, educational and social care professionals. The commonest professionals involved included the Occupational Therapists - OT (33%), Speech and Language Therapists - SALT (26%), Health Visitors (18%), Child and Adolescent Mental Health Services – CAMHS (17%), Clinical (15%) and Educational Psychologists (16%) and General Paediatricians (13%). Others included Social Workers, Surgeons and Educational specialists.

The Allied Healthcare Therapists (OT, Physiotherapists, SALT) were the most commonly involved professionals (average of 22% of the patients), followed by the Mental Health practitioners (16%) and Primary Care workers (7.5%). The tertiary professionals (2%) were least involved in the care of the patients (Table 9).

Table 9. *Showing the classification of other professionals involved.*

Healthcare level/ Categories	**Average Involvement**	**Professionals**
Allied Healthcare Therapists	22%	OT, SALT, Physiotherapist
Mental Health	16%	CAMHS teams, Clinical Psychologists
Primary Care	7.5%	Health Visitors/ Community Nurses, Social Workers, School Nurses, Family Support Workers, Continence Services
Educational Sector	6.2%	Educational Psychologists, EY_SEN, Specialist Teachers
Secondary Care	5.2%	General Paediatricians, Ophthalmologists, Orthoptists, Audiologists, Dietitians, Specialist Nurses, Orthopaedic & ENT surgeons
Tertiary Care	2%	Neurologists, Cardiologists, Clinical Geneticists, Neurosurgeons

Legend:
EY_SEN – Early Years Special Educational Needs practitioners
ENT – Ear-Nose-Throat surgeons

3.9. Discussion

The UK 2016 survey of CCH services estimated that there were average of 1940 referrals per 100,000 children aged 0-19 (509 referrals per 100,000 total population). "Was not brought/did not attend" (WNB/DNA) rates nationwide are 10.8% for new appointments and 12.8% for follow up appointments respectively [5]. This compares with our referral rate of 770 per 100,000 of childhood population (or 162 per 100,000 total population). Our DNA rates were more than double the UK average, which were 24% and 26% for the new and follow up appointments respectively.

Our data highlighted significant burden of behavioural and sleep problems among the childhood population. Behaviour difficulties included various complaints like uncontrollable anger, temper tantrums, aggression and violence, oppositional, defiance and conduct behaviours. The prevalence of parent-defined problems affecting various aspects of sleep in children has been reported to vary from 3.7% to 15%, and up to 37% may have significant sleep problems among school aged children [18]. Though epidemiological studies have reported a prevalence of 16-18% for childhood developmental, behavioural, emotional, sleep, feeding and attachment disorders [6], only the most severely affected children are likely to be referred to a CCH clinic, in the absence of any systematic screening for these conditions.

The published population prevalence of several childhood NDEPs are understandably higher than the findings from this clinical cohort study. For example, the childhood prevalence was around 0.5% for each of ADHD, SALD and LD in this study. This significantly underestimates the true population prevalence for these disorders.

This study has huge implications for CCH training curriculum in the UK, to ensure that future qualified Community Paediatricians are exposed to appropriate range of common childhood NDEPs that they are going to encounter frequently in their regular clinical practices. Training in Behavioural and Sleep disorders are not routinely emphasized in the current CCH curriculum (http://www.communitychildhealth.co.uk/cch/).

ADHD is the commonest childhood neuro-behavioural disorder, affecting 5% to 12% of all school-age children. Analysis of various studied have estimated that about 1% of children meet the criteria for an ASD, 1.5% have LD, and 1% have a Tic Disorder (TD) [7]. The prevalence of DCD ranges from 1.5% to 20% depending on how it is defined (the high prevalence figures reflect the number of children who fail a standardized test of motor coordination) [19].

Suspected Developmental Delay (SDD) is highly prevalent in infancy and preschool age. Children with developmental delay constitute between 5% and 16% of the general paediatric population worldwide [20,21]. Developmental problems in a child's acquisition of speech, language and/or communication are common difficulties with up to 15% of toddlers being 'late talkers' and 7% of children entering school with persisting impairments of their language development. Socioeconomic adversity is known to be correlated with delayed language development [22,23].

Maternal smoking during pregnancy is one of the most important modifiable risk behaviours that contribute to a variety of long lasting behavioural and neurodevelopmental impairments including poor language development and reduction in cognitive functioning [24,25,26].

Children with early onset NDEPs have increased risk of future mental health disorders and would require longer term surveillance and follow-up [6,8,9]. Data from a UK longitudinal survey showed that adolescents with DCD had an increased risk of mental health difficulties than their peers (odds ratio 1.78, 95% confidence interval 1.12-2.83), after adjusting for socio-economic status and IQ, particularly among the girls. This was, in part, mediated through poor social communication skills and low self-esteem [27]. Preschool symptoms of hyperactivity have also been linked to increased risks of ADHD, Conduct Disorder, Mood Disorder, Anxiety and Autism, as well as functional impairment in adolescence/ young adulthood [28].

3.10. Limitations of the study

This was a retrospective analysis of Neurodevelopmental, Behavioural and Emotional problems (NDEP) presenting in a Scottish regional CCH unit, and may not be representative of the entire country and other regions nationwide. Validated diagnostic tools were available for only a small proportion of the different NDEPs. Diagnosis was based on clinical assessments by experienced Developmental Paediatricians, but no independent verification of the clinical diagnoses could be done.

This clinic-based study is likely to under-estimate the population prevalence of various NDEPs, as only the most severe spectrum of the disorders are likely to be referred to the clinicians.

There is an urgent need for longitudinal follow-up studies of representative samples of children in the wider community, that take a comprehensive view of the spectrum of NDEPs [11].

The strengths of the study include a detailed description of the seasonal variation in services usage, levels of local health inequality and high demand for multidisciplinary local healthcare professionals' involvement. It provides a glimpse of the current health status of the local childhood population and demand for CCH services. It will help to provide a benchmark for evaluating the cost-effectiveness of future planning and reconfiguration of CCH services to suit the local needs. There is need for the National and local Government authorities to continue implementing planned strategies to reduce the level of existing health-related inequalities among the local population. The findings are also relevant for ongoing evaluation and reconfiguration of CCH training curriculum to ensure they continue to reflect the current and future needs of the community served by the qualified Paediatricians.

4. Conclusions

This study provides an overview of the range and distribution of common childhood Neurodevelopmental and Emotional problems (NDEP) within a moderately-sized Scottish region. Significant NDEPs represent a public health priority as they affect more than 2% of the childhood population. The commonest NDEPs include Emotional and Behaviour disorders, Sleep difficulties, Social communication problems, Developmental delay of speech/language, coordination and Learning Difficulties. This highlights the need to plan and provide adequately resourced Primary Care supportive services that appropriately address these problems, with involvement of children, young people and families in strategic planning. Primary Care support services such as parenting programmes and sleep clinics are very cost-effective and can avoid more expensive Secondary and Tertiary Care referrals, which

become inevitable if the problems are not identified and managed early in the community [29].

The study further highlights the multidisciplinary nature of managing common childhood NDEPs, because of high level of symptoms sharing and co-morbidity across various disorders. It is imperative for various agencies and professionals to work together within integrated and coordinated care pathways to provide an optimal outcome to every child and appropriate support for their carers and families. It also has valid implications for reviewing and planning future CCH training curriculum in the UK.

The high risk of future mental health problems in adulthood demands a corresponding long-term follow-up and surveillance of children with NDEPs.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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