Research Article

Depressive Disorders in a Clinical Population of Children and Adolescents with High Intellectual Potential

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ABSTRACT

Objectives: To examine extensively the relationships between High Intellectual Potential (HIP) and depression in large samples of children using clear definitions of HIP, different observational sources and specific assessments of depression.

Methods: HIP (N=256, full-Wechsler scale IQ score ≥ 130) and non-HIP (N=676, full-Wechsler scale IQ score<130) groups of children with behavioral, psychological and/or school difficulties were compared using assessments of depression across different observations/settings (psychiatric, parental and child's self-report evaluations).

Results: HIP and non-HIP groups did not differ significantly for depression regardless of observational sources. However, according to parental observation, there were significantly more depressed children with high Verbal Comprehension Index (VCI ≥ 130) than expected. Moreover, based on children's self-evaluation, total Multiscore Depression Inventory for Children (MDI-C) scores were significantly lower in children with high Working Memory Index (WMI ≥ 130) or Processing Speed Index (PSI ≥ 130).

Conclusion: The results highlight the importance of using multiple observational sources and conducting analyses on different dimensions of intellectual functioning (such as memory, verbal language or processing speed), beyond only full-scale IQ scores. The positive association found in this study between depression and VCI suggests that high verbal potential is associated with a greater capacity to express depressive mood. Conversely, depressive mood may lead to defense mechanisms to prevent depressive collapse, through a need to control verbal language with an overinvestment of this domain. Furthermore, the negative associations between total MDI-C scores and WMI or PSI might be explained by bradypsychia (a psychological slow-down frequently observed in depression). Bradypsychia can have deleterious effects on short-term memory measured by WMI and on processing speed measured by PSI. According to these findings, depression should definitively be assessed in children and adolescents with HIP and difficulties. Early detection of depressive symptoms in this population can help provide on time the required therapeutic and educative care to prevent cognitive inhibition and later chronic depressive disorders.

Keywords: High intellectual potential; Gifted; Cognitive profile; Depression; Children; Adolescents; Multiple observational sources

INTRODUCTION

Children with High Intellectual Potential (HIP) have been reported to display depression in several clinical observations. According to Corazza et al., high intellectual potential refers to an individual's exceptional ability to solve complex problems within a well-defined conceptual framework [1]. In this context, goals are clear and the individual uses logical, systematic thinking to reach efficient solutions. High intellectual potential is characterized by a structured, methodical approach to problem-solving, where intelligence plays a dominant role. High levels of intellectual functioning are considered in this article based on the psychometric definition of levels of at least 2 standard deviations above the means in a general population. Regarding the definition of depression, a depressive episode is characterized by at least a low mood or loss of interest or pleasure in normally enjoyable activities by the individual occurring most of the day, nearly every day, for at least two weeks. The national center for assistance to Children and Adolescents with High Potential (CNAHP), established

in a French hospital-university department of child and adolescent psychiatry, provides assessments to identify HIP and adapted care for children and adolescents with HIP and emotional, behavioral and/ or school-related problems. Besides its mission of evaluation and therapeutic care, the CNAHP is also involved in missions of training for professionals (caregivers and schoolteachers) and developing research (the missions of evaluation, therapeutic care) [2]. The children and adolescents are referred to the CNAHP by parents or professionals (mainly schoolteachers) who think that these children and adolescents with psycho-affective and/or school problems may show HIP. At the Center, they benefit from cognitive assessments (intelligence and creativity tests) and psycho-affective evaluations to identify any high potential and understand better their emotional problems. Following the cognitive assessments performed at the CNAHP, some children and adolescents may not be identified with HIP but still benefit from an educative and therapeutic project. They all come from regular school classes.

More precisely, of the initial 338 children and adolescents referred to the CNAHP, a significant number showed school problems (78%, including school failure defined as repeating a grade) and the following disorders diagnosed at the CNAHP by the child psychiatrist according to the Diagnostic and Statistical Manual of Mental Disorders DSM-5 and ICD-10 (WHO) diagnostic criteria: Depressive disorders (8%), conduct disorder (9.5%), anxiety disorders (40.5%) and other problems (34.4% including, for example, family problems with sibling conflicts) [3-5]. Depressive disorder appears therefore to be a relatively frequent psychiatric disorder observed in this clinical population [6]. Results regarding anxiety disorders have been presented in detail in a previous article [7].

However, few studies on psychological and emotional issues, such as depression, have been conducted in children with HIP and the findings were inconsistent [8]. Indeed, some studies reported that students with HIP had low scores of depression or were significantly less depressed than their non-HIP peers [9-12].

Moreover, a substantial body of research on education supports the view that children with HIP are as well-adjusted as their non-HIP peers for emotional problems such as depression [13-16]. Several studies showed no significant differences for depression scores between the HIP and non-HIP groups [17-21]. The previous review by Neihart suggested also that the prevalence of depression in children and adolescents with HIP was not any higher or lower than in the general population [22]. Similarly, Martin et al., meta-analysis using a random effect model based on six studies concluded that there was no difference between the HIP and non-HIP groups with regard to depressive symptomatology (effect size=-0.17) [23,24]. More recently, Duplenne et al., conducted a systematic review and meta-analysis and reported similar results based on 15 studies on depression in individuals with HIP [25]. However, it is noteworthy that the effect size was also very small (effect size=-0.14).

Finally, other studies suggest a positive association between HIP and depression in children and adolescents [24,26-28]. It is noteworthy that the Jackson study is a qualitative one and the Messier et al., study was conducted on adolescents with conduct disorders [27,28]. Also, Guenole et al., reported that children with HIP (full-scale IQ ≥ 130, n=143) showed significantly more disorders than their non-HIP peers (n=143) [29]. This was true for all the dimensions covered by the French version of the Child Behavior Checklist (CBCL) which includes the anxiety/depression dimension. Furthermore, they observed significantly more emotional dysregulation (including anxiety/ depression symptoms, attention problems and aggressive behaviors) related to humor regulation impairments in the HIP subgroup with a

Wechsler Intelligence Scale for Children-III (WISC-III) heterogeneous cognitive profile (n=51) resulting from high verbal IQ scores (IQ Verbal score more than 15 points higher than IQ Performance score) compared to the HIP subgroup without this cognitive profile (n=92) [26]. It is noteworthy that humor regulation disorders in childhood have been reported by several authors to be a strong predictor of negative evolution with a risk of developing emotional disorders in adulthood [30,31]. Interestingly, the Simoes et al., study reported a significantly higher frequency of children with HIP showing depression compared to children with average intellectual abilities based on a subjective global parental evaluation whereas there were no more significant group differences based on the parental evaluation using the test Diag-80 [14].

Based on these discrepant results and as suggested also by Tourreix et al., it seems difficult to draw firm conclusions about the relationship between depression and HIP [32]. This can be partially explained by methodological biases, such as different/absent definitions of HIP applied to the recruitment of participants in studies, small sample sizes, small effect sizes even in systematic reviews and meta-analyses, non-validated/adapted/specific tools for assessing depression and the use of a single observational source in the evaluation of depression [23,25]. For example, child self-report questionnaires were mostly used to measure depression even if psychiatric evaluation or parental observation alone was also used [12]. In addition, some studies have raised issues on the specificity of the conclusions regarding high levels of intellectual functioning since they did not compare HIP group and non-HIP groups [14,16,29].

The objective of this prospective and exploratory study was to investigate further the relationships between high intellectual functioning and depression given the inconsistent findings and methodological biases previously mentioned. Therefore, large HIP and non-HIP groups of children with difficulties were compared and clear definitions of HIP were used. Validated, adapted and specific assessment tools of depression were used in this clinical population across a variety of concurrent observational situations, including parental evaluation, child psychiatric evaluation and child self-report evaluation.

MATERIALS AND METHODS

Participants

The sample consisted of 932 children (mean age: 10.33 years, Standard Deviation (SD)=3.11), ranging from 6 to 16.1 years old, including 256 children with HIP (full-scale IQ score ≥ 130, 210 boys and 46 girls, mean age: 10.63 years, SD=2.99) and 676 non-HIP pears (full-scale IQ score<130, 560 boys and 116 girls, mean age: 10.61 years, SD=2.77). They were all referred to the CNAHP given their difficulties (behavioral issues, emotional disturbances and/or school problems). The CNAHP offers to this clinical population a comprehensive psychological assessment using many instruments, such as cognitive, behavioral and socioemotional evaluations. Clinical data were collected as part of the systematic evaluation performed at and by the CNAHP. Following the guidelines of the ethics committee of Rennes University Hospital based on the ethical principles of the declaration of Helsinki, all participants and their legal guardians were informed that these data could be used in the anonymized database for research perspective and gave their consent.

Assessment of intellectual functioning

A psychologist evaluated children and adolescent's intellectual

functioning using the Wechsler Intelligence Scale adapted to the age, which was validated in children and adolescents between the ages of 6 and 16 years, 11 months. The WISC-IV scale has excellent validity and reliability [33]. The Verbal Comprehension Index (VCI), the Perceptual Reasoning Index (PRI), the Working Memory Index (WMI) and the Processing Speed Index (PSI) were used to create four composite scores. Children were excluded from the research if their previous WISC-IV assessment was completed less than a year earlier since the validity of the results obtained when the WISC-IV is freshly readministered can be questioned.

Evaluation of depression

Depression was assessed according to three different observational sources: Parents, child psychiatrist and child.

Parental evaluation: When parents called to have an appointment for their child at the CNAHP, the same trained secretary performed a semi-structured phone interview (parental observation) using a parental questionnaire including questions concerning education, behavioral and/or emotional problems, such as depression issues. The questions, including qualitative responses (yes or no) related to depressive symptoms (sadness, disengagement of the child from previous activities that were usually important for him or her, loss of pleasure in activities usually enjoyed by the child, loss of self-esteem), were therefore asked consistently in the same way by the same professional for all parents. This interview includes questions about depressive symptoms but also about school, behavioral and/or emotional difficulties.

Child psychiatric evaluation: Based on a direct psychiatric clinical observation of the child or adolescent, the child psychiatric examination of the DSM and ICD diagnostic criteria for depressive disorders provides a clinical psychiatric judgement [4,34]. The child psychiatric evaluation is conducted by the child psychiatrist at the center, at the end of the evaluations of the children and adolescents received at the CNAHP.

Child's self-report evaluation: The MDI-C is a self-report inventory for children from 8 to 17 years old and it is used to assess the level and nature of depression in children and adolescents [17]. It is a questionnaire of 79 items, including 78 items assigned to the following scales: Anxiety (somatic and cognitive aspects of anxiety), self-esteem (perceptions and evaluations that children have of themselves), sad mood (the individual's current affective state), helplessness (the child's perception of his own ability to manage social situations in order to obtain common benefits), introversion (tendency withdrawal from social situations or social contacts), low energy (the child's cognitive intensity and somatic vigor), pessimism (the child's vision of his future and the extent of his discouragement) and defiance (behavioral problem and irritability). The item 45 is an indicator of suicide risk. The child responds by circling T (true) or F (false) for each item. To

obtain raw scores, it is necessary to count the items for which the score points in the direction of depression. The manual provides the conversion of raw scores into standardized scores and into percentiles, as well as the norms established in France, according to sex and age (8-10 years, 11-13 years, 14-17 years) [17]. A high total score represents a greater intensity of depressive symptomatology. Standard scores below 56 correspond to no depression, scores between 56 and 65 indicate levels of symptomatology related to mild to moderate depression, scores between 66 and 75 indicate moderate to severe symptoms of depression and scores higher than 76 indicate severe depression. Regarding the evaluation process, the child or adolescent filled out the MDI-C self-report inventory at the CNAHP with the possible assistance of a psychologist who was available to respond to any queries the child might address. Given the possible emotional nature of some of the questions, it was important that the child completed the MDI-C neither alone in a room nor at home where the parents could influence the child's responses.

Statistical analysis

When comparing the HIP group (IQ scores ≥ 130) with the non-HIP group (IQ scores<130), the relationships between depression (parental observation or child psychiatric diagnosis) and intellectual functioning (full-scale IQ score and WISC indices) were examined using t-tests or χ^2-tests. When comparing the HIP group (IQ scores ≥ 130) to the non-HIP group (IQ scores<130), the relationships between the MDI-C depression scores (child's self-report rating) and levels of intellectual functioning (full-scale IQ score and WISC indices) were examined using t-tests. Furthermore, the comparison of the 3 observational scores (child, parents, psychiatrist) to assess depression was studied using concordance analysis based on Bravais-Pearson correlation analyses. Finally, in order not to multiply statistical analyses, we followed the hierarchical strategy of Cohen by first analyzing the total score of depression on the MDI-C [35]. The sub-scores (sub-dimensions) on the MDI-C were only analyzed if the analyses related to the total score gave significant results. Additionally, in order to assess more precisely intellectual functioning based on the CNAHP evaluation of cognitive profile not reduced to the total IQ composite score, the analyses were conducted not only on the Full-Scale Intelligence Quotient (FSIQ) [36].

RESULTS

Descriptive analysis

The WISC-IV scores for each participant in the whole sample as well as the HIP and non-HIP groups are provided in Table 1 to characterize better the individuals' intellectual functioning. It is noteworthy that the VCI is the highest index in the HIP group and is also notably high for the non-HIP group and the whole sample.

Table 1: Descriptive analysis of WISC-IV scores for the High Intellectual Potential (HIP) group (n=256), the non-HIP group (n=676) and all the participants (N=932).

WISC-IV	All participants		Non-HIP group		HIP group	
	Mean	SD	Mean	SD	Mean	SD
Full-scale IQ score	119.7	16.7	112.3	13.0	139.3	6.6
Verbal comprehension index	127.1	17.8	121.6	16.7	141.7	11.4
Perceptual reasoning index	113.9	16.6	108.4	14.5	129.2	11.0
Working memory index	106.4	16.9	100.8	14.6	121.9	11.6
Processing speed index	103.9	16.6	100.1	15.1	114.7	15.5

Note: WISC: Wechsler Intelligence Scale for Children; SD: Standard Deviation.

The child psychiatric evaluation was conducted for 475 out of 932 children given that only children living near the CNAHP area were systematically addressed to the child psychiatrist at the CNAHP for possible therapeutic follow-up. The child's self-report evaluation was performed for 710 out of 932 children given that the MDI-C is a self-report questionnaire for children from 8 to 17 years old (children from 6 to 7 years old did not therefore fill out the MDI-C questionnaire). The parental evaluation was obtained from all parents (N=932).

Based on psychiatric evaluation, depressive disorders were observed in 41/475 (8.6%) of children attending the CNAHP according to DSM (DSM-5 and DSM-5-TR) and ICD (ICD-10 and ICD-11) diagnostic criteria. Based on parental evaluation, the frequency of individuals with depression in the whole sample was 159/932 (17.1%). Based on the child's self-report questionnaire Multiscore Depression Inventory for Children (MDI-C) depression was found in 272/710 (38.3%) of children. However, when focusing on severe depression (MDI-C total score ≥ 76) regarding its clinical importance at the CNAHP, it is noteworthy that only 5 children out of 710 showed severe depression (MDI-C total score ≥ 76), including 3 children with high intellectual potential (full-scale IQ ≥ 130) and 2 children with high verbal comprehension performance (VCI ≥ 130) but with full-scale IQ<130. The frequency of children on each MDI-C subscale is not given regarding the small number of children (n=5) showing severe depression.

According to the children's self-report evaluations, the distribution in the whole sample (N=710) of the MDI-C total score and the eight different MDI-C subscales scores were as follows: Total depression mean score=54.3 (SD=8.8), anxiety mean score=52.6 (SD=10.1), self-esteem mean score=53.3 (SD=8.9), sad mood mean score=53.6 (SD=8.7), helplessness mean score=53.0 (SD=9.5), introversion mean score= 52.9 (SD=10.2), low energy mean score=52.8 (SD=10.2), pessimism mean score=51.2 (SD=9.2) and defiance mean score=52.5 (SD=10.4).

Intellectual functioning and depression

The relationships between intellectual functioning and depression according to the child's self-evaluation, child psychiatric evaluation and parental evaluation are presented in Tables 2-4.

According to parental observation, there is a significant relationship between verbal comprehension assessed using the WISC-IV and depression observed by the parents (χ^2 (2)=6.11, p=0.013). As shown in Table 2, there are significantly more depressed children than would be expected in the high VCI group (VCI>130), while there are significantly less depressed children than would be expected in the non-high VCI group (VCI<130). Moreover, there is no significant relationship between depression observed by the parents and the other WISC-IV scores (FSIQ, PRI, WMI or PSI).

Concerning the evaluation conducted by the child psychiatrist, no significant relationship could be observed between the diagnosis of depressive disorder according to the ICD or the DSM diagnostic criteria and the levels of intellectual functioning assessed on the Full-Scale IQ (FSIQ) score or on the four dimensions of the WISC-IV (VCI, PRI, WMI or PSI) (Table 3).

There is no significant relationship between the total depression score on the MDI-C and the FSIQ score on the WISC-IV but the results trend towards significance (the total MDI-C scores are lower in the HIP group than in the non-HIP group, p=0.083). There is no significant relationship between the total depression score on the MDI-C and the VCI and PRI scores. However, there is a significant relationship between the total depression score of the MDI-C and the WMI or PSI scores. The total MDI-C scores were lower in the high WMI group (WMI>130) or PSI group (PSI>130) than in the non-high groups for WMI (WMI<130) or PSI (PSI<130) (Table 4).

There were no significant relationships between depression and intellectual functioning according to the child's self-report evaluation, when children were grouped with respect to the 130 cut-offs of intellectual giftedness for the VCI and PRI indices. Therefore, only FSIQ, WMI and PSI scores are presented in Table 4.

Comparison of observational sources

The concordance analyses show significant results between the three observational sources of depression (parental observation, child psychiatric diagnosis and child self-report questionnaire based on the MDI-C) regardless of the levels of intellectual functioning (p<0.05). The results are presented in Table 5. However, these significant correlations remain weak and the shared variances are under 7%.

Table 2: Relationships between depression (parental observation) and intellectual functioning based on the WISC-IV indices and the Full-Scale IQ (FSIQ) score in the whole sample (N=932).

WISC-IV		Depression					Fisher exact test
Indices	N	Yes			No		p-value
FSIQ							
IQ ≥ 130	256	48	19%	208		81%	p=0.393
IQ<130	676	111	16%	566		84%	
VCI							
VCI ≥ 130	436	88	20%	348		80%	p=0.013
VCI<130	503	71	14%	432		86%	
PRI							
PRI ≥ 130	176	28	16%	148		84%	p=0.693
PRI<130	764	131	17%	633		83%	
WMI							

WMI ≥ 130	91	16	18%	75	82%	p=0.858
WMI<130	849	143	17%	706	83%	
		PSI			
PSI ≥ 130	68	16	24%	52	76%	p=0.131
PSI<130	872	143	16%	729	84%	

Note: PSI: Processing Speed Index; WMI: Working Memory Index; FSIQ: Full-Scale Intelligence Quotient; PRI: Perceptual Reasoning Index; VCI: Verbal Comprehension Index.

Table 3: Relationships between depression (child psychiatric diagnosis according to DSM and ICD criteria) and intellectual functioning based on the WISC-IV indices and the Full- Scale IQ (FSIQ) score in the total sample examined by the child psychiatrist (n=475).

WISC-IV		Depression				Fisher exact test
Indices	N	Yes		No		p-value
		FSIQ				
IQ ≥ 130	144	12	8%	132	92%	p=0.929
IQ<130	331	29	9%	302	91%	
		VCI				
VCI ≥ 130	244	24	10%	220	90%	p=0.337
VCI<130	231	17	7%	214	93%	
		PRI				
PRI ≥ 130	127	4	3%	123	97%	p=0.103
PRI<130	348	37	11%	311	89%	
		WMI				
WMI ≥ 130	54	5	9%	49	91%	p=0.861
WMI<130	421	36	9%	385	91%	
		PSI				
PSI ≥ 130	38	2	5%	36	95%	p=0.441
PSI<130	437	39	9%	398	91%	

Note: PSI: Processing Speed Index; WMI: Working Memory Index; FSIQ: Full-Scale Intelligence Quotient; PRI: Perceptual Reasoning Index; VCI: Verbal Comprehension Index.

Table 4: MDI-C depression scores (child's self-report evaluation) in the total sample assessed (n=710) grouped with respect to the 130 cut-offs of intellectual giftedness for the Full- Scale IQ score (FSIQ), Working Memory Index (WMI) or Processing Speed Index (PSI).

MDI-C								WISC-IV			
	FSIQ ≥ 130 m ± SD	FSIQ<130 m ± SD	T-test t-value	p-value	WMI ≥ 130 m ± SD	WMI<130 m ± SD	T-test t-value	p-value	PSI ≥ 130 m ± SD	PSI<130 m ± SD	T-test t-value	p-value
MDI-C total score	53.2 ± 9.2	54.7 ± 8.5	174%	p=0.083	51.1 ± 8.8	54.5 ± 8.7	2.581	p=0.01	49.9 ± 7.6	54.5 ± 8.8	3.001	p=0.003
MDI-C subscales scores												
Anxiety	51.5 ± 10.0	53.0 ± 9.7	1.5	p=0.134	50.3 ± 9.3	52.8 ± 9.9	1.655	p=0.098	49.3 ± 8.8	52.8 ± 9.9	2.026	p=0.043
Self-esteem	52.6 ± 9.0	53.6 ± 8.9	119%	p=0.233	50.0 ± 8.9	53.6 ± 8.8	2.726	p=0.007	49.5 ± 6.7	53.6 ± 9.0	2.638	p=0.009
Sad mood	53.5 ± 8.7	53.5 ± 8.7	5%	p=0.958	52.7 ± 8.4	53.6 ± 8.7	0.659	p=0.51	52.0 ± 7.1	53.6 ± 8.8	1.038	p=0.3
Helplessness	52.2 ± 9.8	53.4 ± 9.3	1.239	p=0.216	51.2 ± 8.1	53.2 ± 9.6	1.391	p=0.165	50.1 ± 8.8	53.2 ± 9.5	1.892	p=0.059
Introversion	51.8 ± 10.6	53.3 ± 9.9	157%	p=0.117	50.8 ± 9.0	53.1 ± 10.2	1.495	p=0.135	48.2 ± 7.4	53.2 ± 10.2	2.821	p=0.005
Low energy	51.8 ± 11.2	53.0 ± 9.6	119%	p=0.236	51.9 ± 9.7	52.7 ± 10.2	0.0534	p=0.594	50.0 ± 7.8	52.8 ± 10.3	1.588	p=0.113
Pessimism	50.1 ± 8.9	51.9 ± 9.3	2.036	p=0.042	47.0 ± 8.2	51.7 ± 9.2	3.42	p<.001	48.4 ± 7.3	51.5 ± 9.3	1.932	p=0.054
Defiance	52.2 ± 10.2	53.1 ± 9.7	95%	p=0.344	51.6 ± 10.1	53.0 ± 9.8	0.965	p=0.335	51.3 ± 9.6	53.0 ± 9.8	0.969	p=0.333

Table 5: Concordance study between the three observational sources of depression based on Bravais-Pearson correlations analyses.

MDI-C	Parental observation	Psychiatric diagnosis
Total score	r=0.19 p=0.008	r=0.21 p<0.0001
Anxiety	r=0.24 p=0.001	r=0.12 p=0.030
Self-esteem	r=0.11 p=0.130	r=0.20 p=0.0002
Sad mood	r=0.22 p=0.003	r=0.26 p<0.0001
Helplessness	r=0.05 p=0.472	r=0.11 p=0.040
Introversion	r=0.13 p=0.077	r=0.03 p=0.581
Low energy	r=0.12 p=0.0955	r=0.14 p=0.009
Pessimism	r=0.15 p=0.0376	r=0.15 p=0.006
Defiance	r=.06 p=.4087	r=0.05 p=0.393

DISCUSSION

Parental evaluation

The parental observation showed a significant relationship between a high verbal potential (VCI>130) and the existence of depression reported by the parents for their children. High verbal potential may be associated with a greater capacity to express depressive mood. Indeed, high VCI levels reflect a good ability in children to accede to verbal representations of their emotions. Their concerns and emotions, including negative ones, could then be expressed more easily to the parents, while children without high verbal potential (VCI<130) could be just as concerned by depressive symptoms but less able to express them. Conversely, depressive mood could lead in young people to defense mechanisms to prevent a depressive collapse, creating a need to control verbal language with an overinvestment in this domain. It is noteworthy that similar relationships were observed between anxiety and VCI levels [8].

Self-assessment by the child Multiscore Depression Inventory for Children (MDI-C)

The child's self-assessment MDI-C shows significant and negative associations between the total MDI-C depression score and the levels of intellectual functioning based on the WMI and PSI indices of the WISC-IV. Symptoms of depression often manifest by a psychological slow-down, a bradypsychia. This slow-down can have a deleterious effect on the memory capacities of the individual, particularly on the short-term memory capacities measured by the WMI. Bradypsychia is often associated with general and psychomotor asthenia. It can therefore also negatively impact activities that solicit both thought and motor skills as measured by the PSI.

Conversely, the VCI and PRI indices rather rely on previous acquisitions, less sensitive to the emotional state of the individual during the cognitive evaluation with the WISC-IV, which could explain the absence of a significant relationship between the total MDI-C depression score and the levels of VCI and PRI.

Furthermore, significant negative associations were found between certain MDI-C sub-domains (pessimism, anxiety and low self-esteem) and certain indices of intellectual functioning (WMI and PSI). The inhibiting effect of pessimism appears here to have a major effect on the ability to memorize current information, as assessed by WMI (p<0.001), to the point of impacting the level of full-scale IQ (it should be noted that pessimism is the only sub-dimension of the MDI-C scale to be significantly and negatively associated with the level of intellectual functioning based on the full-scale IQ score; t=2.036, p=0.042). Moreover, pessimism could lead to difficulties in integrating information from the present and therefore using it in the future. This relationship to temporality might reflect in children and adolescents, a difficulty in projecting themselves into the future. It would be as if the future blocked and obscured by pessimism could not be invested and the individual would be in the instantaneity of the present. It is of interest to observe that pessimism has less impact on PSI, which reflects the expression of information processing capacity in the present time and not in the future. In addition, anxiety impacts, in this study, more the PSI than the WMI. Indeed, anxiety can create a context of insecurity that slows down the children and adolescents in their speed of execution. Concerning self-esteem, the hypothesis can be made that low self-esteem inhibits the performance of the children and adolescents when taking the WMI and PSI tests which require immediate abilities. Inversely, high self-esteem can stimulate their performance at the WMI and PSI tests.

Child psychiatrist's evaluation

Depressive disorders were diagnosed for 8.6% of children seen by the child psychiatrist at the CNAHP which is in line with the prevalence of 8% previously reported in 2016 for the clinical population received at this Centre [6]. However, unlike the parental evaluation and the child's self-evaluation, it is noteworthy that no significant relationship was found between the diagnosis of major depressive disorder and levels of intellectual functioning of the WISC-IV (measured by the full-scale IQ score and the four indices of the WISC-IV also). It might be difficult indeed to assess, during a psychiatric interview, certain dimensions of depression (such as introversion and defiance measured

by the MDI-C subscales), which could explain the absence of significant relationships between the child psychiatrist's evaluation of depression and the MDI-C sub-scores of introversion and defiance (Table 5). In addition, the significant correlations observed between the other MDI-C sub-scores and the child psychiatrist's evaluation of depression remain weak and the shared variances are under 7% highlighting the need to use several observational sources to complete thoughtfully this evaluation of depression. Taken together, these results suggest that the previously observed relationships between depression and intellectual functioning are situation dependent.

CONCLUSION

The present study revealed that depression in children and adolescents with HIP and difficulties is a common parental concern (17.1%) that prompts parents to bring their children to a care centre. Enhancing comprehension of the challenges and issues faced by children with HIP, such as depressive disorders, can help us to propose adapted care and in turn help them to develop and express their cognitive potential. According to the study's findings, depression should definitively be assessed in children and adolescents with HIP and behavioral, psychological and/or school difficulties. Early detection of depressive symptoms in this population can help to provide on time the required therapeutic and educative care to prevent cognitive inhibition and later chronic depressive disorders.

Furthermore, this study emphasizes the interest and importance of using several observational sources to complete thoughtfully the evaluation of depression, as already suggested in previous work. Indeed, according to parental observation, there were significantly more children and adolescents with depression than expected in the high verbal potential group (VCI>130). In addition, based on the child self-evaluation, significant negative associations were found between MDI-C depression scores/sub-scores (especially for the pessimism, anxiety and self- esteem sub-dimensions of the MDI-C) and working memory or processing speed.

These latter results highlight the need to use not only different observational sources/settings but also to assess several dimensions of cognitive functioning, such as working memory, processing speed and verbal dimensions, rather than focusing just on global intellectual performance, such as full-scale IQ scores. To understand better the relationships between high intellectual functioning and depressive disorders, further studies are required.

LIMITATIONS

Some limitations of the study should be acknowledged. First, the phone parental evaluation of children's depression was based on parental observation. This parental evaluation was consequently subject to the subjectivity of the observers, just like any other observation-based assessment. Although every child and adolescent coming to the CNAHP for evaluation goes through the same standardized interview grid, this assessment has not been validated in clinical research. It might, therefore, be useful to supplement parental assessments with a validated instrument such as the child behaviour checklist. It is noteworthy that subjectivity cannot be ruled out either from the child psychiatrist's or child's evaluation. All observational sources are subject to subjectivity and should be therefore multiple to limit this bias. Second, there was a bias of recruitment concerning the children in the non-HIP control group given that they are part of a clinical population due to psychological, behavioural, emotional or academic issues. Therefore, there did not represent the general population between the ages of six and sixteen. Thus, it would be useful to compare children with HIP who have difficulties received at the CNAHP with a sample of 6 year to16 year olds drawn from the general population. In line with this limitation, conclusions cannot be extended from this clinical population (including the HIP and non-HIP groups) to the general population.

CONFLICTING INTERESTS

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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