

Thiago de Oliveira Pires¹

Cosme Marcelo Furtado Passos da Silva^{II}

Simone Gonçalves de Assis^I

Family environment and attention-deficit hyperactivity disorder

ABSTRACT

OBJECTIVE: To analyze factors associated with attention-deficit and hyperactivity disorder in children.

METHODS: This is a longitudinal study about behavior problems in schoolchildren that was carried out in the city of São Gonçalo (Southeastern Brazil) in 2005. A total of 479 students from public schools was analyzed, selected through three-stage cluster sampling. The Child Behavior Checklist was used to measure the outcome. A questionnaire was administered to parents/guardians concerning the exposure factors, which were: child's and family's profile, family relationship variables, physical and psychological violence. The log-binomial regression model with a hierarchical approach was employed in the analysis.

RESULTS: Higher intelligence quotient was inversely associated with the frequency of the disorder (PR = 0.980 [95%CI 0.963;0.998]). The prevalence of the disorder in the children was higher when there was family dysfunction than among families with a better way of relating (PR = 2.538 [95%CI 1.572; 4.099]). Children who suffered verbal abuse from the mother had a prevalence 3.7 times higher than the ones not exposed to this situation in the last year (PR = 4.7 [95%CI 1.254;17.636]).

CONCLUSIONS: Negative family relationships are associated with symptoms of Attention-Deficit and Hyperactivity Disorder. Its association with the intelligence quotient reiterates the importance of the genetic and environmental basis at the origin of the disorder.

DESCRIPTORS: Attention Deficit Disorder with Hyperactivity, epidemiology. Risk Factors. Socioeconomic Factors. Family Relations. Domestic Violence.

^I Centro Latino-Americano de Estudos sobre Violência e Saúde. Escola Nacional de Saúde Pública Sérgio Arouca (ENSP). Fundação Oswaldo Cruz (Fiocruz). Rio de Janeiro, RJ, Brasil

^{II} Departamento de Epidemiologia e Métodos Quantitativos em Saúde. ENSP-Fiocruz. Rio de Janeiro, RJ, Brasil

Correspondence:

Thiago de Oliveira Pires
Av. Brasil, 4036 – sala 700
Manguinhos
21040-361 Rio de Janeiro, RJ, Brasil
E-mail: thop100@hotmail.com

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INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD) is one of the most common child psychiatric disorders: it occurs in 3% to 7% of schoolchildren, according to the classification criterion of the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, revised text (DSM-IV-TR). Higher prevalences have been found in screening studies carried out with parents and teachers, and range between 2.3% and 19.8% in other countries.²¹ There is wide variation in the prevalence of the disorder, depending on the child's or adolescent's age, on the diagnostic criterion that is used (psychiatric interviews, screening or diagnostic scales) and on the source of information that is employed (usually parents, teachers and the adolescent him/herself).

Research conducted with schoolchildren aged six to 12 years estimated 5% of ADHD cases in a sample of 1,898 children in the city of Florianópolis (Southern

Brazil).²⁴ Fleitlich & Goodman¹² (2004) observed that 1.8% among 1,251 children from public and private schools suffered from the disorder in the city of Taubaté (Southeastern Brazil). Vitolo et al³⁵ (2005) observed symptoms in borderline and clinical levels in 31.1% of the 454 children from public and private schools in the same city. Rodhe (1999)²⁵ estimated a prevalence of 5.8% among 1,022 schoolchildren from the city of Porto Alegre (Southern Brazil).

Prevalences differ in relation to sex and age. ADHD is more common in male children and prevalence decreases as age advances.²⁸ Another investigated aspect is the cognitive impairment of children with ADHD, with association between low intelligence quotient (IQ) and the disorder.¹⁸

The genetic and biological component of ADHD has been emphasized in the literature and debates about the psychosocial contribution of the environment in which the child develops have been growing.²⁸ Among the broad set of environmental factors related to psychological disorders and ADHD, severe marital fights between parents/guardians have considerable relevance. Sociodemographic factors associated with ADHD (low income, parents' low level of schooling and large families²⁹) have been investigated, as well as aspects related to the family environment (parenting style, parents-children attachment, parental psychology and family functioning^{4,27,29}). Living within dysfunctional families may predict the emergence of ADHD.²⁹

Schroeder & Kelley³⁰ (2009) have shown that children with ADHD lived within a family environment that was less organized and had more family conflicts than that of the control group. Johnston & Mash¹⁶ (2001), in a review paper, have suggested that the presence of the disorder in children is associated with various degrees of problems in the family and in the marital functioning.

Family violence is a psychosocial factor that has been recently introduced in the literature about ADHD, with indications that parents of hyperactive children are more likely to use physical methods to discipline them.²⁸ Parents of children with ADHD in Iran used corporal violence more commonly than parents of children without the disorder.³

Brazilian investigations have indicated a similar picture. Abramovitch¹ (2008) verified that children with ADHD and disruptive behavior had three times higher odds of having suffered physical abuse. Fleitlich & Goodman¹¹ (2001) noticed that children whose parents/caregivers used belts for spanking presented a higher proportion of hyperactivity (45%) when compared to children who did not suffer this kind of aggression (29,7%).

Besides being direct victims of family violence, children are emotionally affected when they witness

violence within the family. Children in this situation tend to present externalizing and internalizing behaviors more commonly.⁷ A study with schoolchildren in the city of Rio de Janeiro (Southeastern Brazil) found that children with ADHD had higher odds of having witnessed fights between their parents.³³

The present paper aimed to analyze factors associated with ADHD in children.

METHODS

Observational, fixed cohort study involving 479 schoolchildren from the municipality of São Gonçalo (Southeastern Brazil) in 2005. The study was developed by the *Centro Latino-Americano de Estudos de Violência Jorge Careli (Claves/Fiocruz)*, and its design includes two or more contiguous follow-up periods (repeated measures study). The exposure factor and the status of the disease were examined in 2005, 2006 and 2008. This paper presents the results of the first wave (2005).

The sampling plan was based on the record of public schools, classes and average number of students per class, provided by the Education Department of the Municipality of São Gonçalo in 2005 (6,589 students enrolled in the 2nd grade). Three-stage cluster sampling was employed (schools, 2nd grade classes and students). The random selection of the 25 schools was performed through systematic sampling with probability proportional to size (PPS); two classes were randomly drawn in each school and ten students were drawn in each class, totaling 500 students. Two attempts were made concerning the mother's/guardian's attendance of the interview at the school. If she failed to attend it or if the student no longer studied at the school, a new interview was scheduled according to a previous draw.

One per cent of the recruited individuals refused to participate in the study and approximately 35% of the students who had been originally selected were substituted, mainly because of mistakes in the gradebook. Of the total sample, 479 children were analyzed. Overall, 21 children with $IQ \leq 69$ were excluded because it is difficult to measure ADHD in children with low intellectual level.

A multidimensional questionnaire was administered to the children's guardians (mainly mothers).

The scale Child Behavior Checklist (CBCL) was used to measure behavior problems of children aged six to 18 years in the last six months, based on the information provided by their parents.² The guardians answered ten items related to inattentive and hyperactive behavior, with questions like: the child is agitated and restless; impulsive, acts without thinking; does not finish the things he/she has begun; distracted, he/she cannot focus

his/her attention for long periods of time. The answer options varied from false to very true (0 to 2 points). The items were added and standardized so that they had a mean of 50 and standard-deviation of 10, enabling to categorize results as: normal (< 65) and borderline/clinical (≥ 65).

ADHD assessment by the CBCL presented a significant Pearson's correlation (0.35; $p < 0.001$) between the two instruments. CBCL presented sensitivity of 50% and specificity of 79% in relation to the Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children – Present and Lifetime (KSADS-PL – diagnostic scale used in psychiatry),^a when applied to a sub-sample of 45 students.

The CBCL version administered to the population of São Gonçalo was translated, adapted and validated by Bordin et al⁵ (1995) for Brazil.

The Wechsler Intelligence Scale for Children (WISC-III),²⁰ constituted of 13 subtests that compose the total IQ, subdivided, enabled to assess verbal IQ (related to verbal comprehension) and executive IQ (perceptual organization and visual processing, planning capacity, non-verbal learning and skills to think and manipulate visual stimuli with speed and quickness). The complete test was administered to 26 children and the reduced version, to 473 (there was one refusal). The reduced version was composed of two subtests³² (vocabulary and cubes). Pearson's correlation coefficient was 0.85 between the reduced test and total IQ (close to the minimum value of 0.90 suggested by Kaufman¹⁷ as the ideal one). For verbal and executive IQ, it was 0.88 and 0.83, respectively.

The general functioning of the family (General Functioning Scale of the McMaster Family Assessment Device)⁹ was assessed by the following questions: it is difficult to plan family activities because there are disagreements; in times of crisis, it is possible to turn to each other for support; it is not possible to talk in the family about the sadness they feel; each person in the family is accepted for what he/she is; discussing concerns or fears is avoided; feelings are expressed to each other; having bad feelings within the family; feeling accepted for what one is; difficulty in making decisions within the family; being capable of making decisions; not having a good relationship when they are together; confiding in each other. There were five answer options (1 to 5 points), ranging from I fully agree to I fully disagree, with higher values meaning a better general functioning of the family. In this paper, precarious family functioning was considered as results in the standard-deviation range below the mean, and regular or good functioning, above this level. The

scale was cross-culturally adapted following the steps proposed by Herdman et al¹⁴ (1998) (non-published data). Cronbach's alpha was 0.81.

Physical and verbal violence witnessed by the child was assessed by the Conflict Tactics Scale – CTS. It was developed by Straus³¹ (1979) and adapted to Portuguese by Hasselmann & Reichenheim¹³ (2003). Tactics used in moments of conflict between the parents in the last year were analyzed: a) verbal aggression between parents, assessed by acts like insulting, getting sulky, crying, doing things to irritate the other, destroying, hitting or kicking objects; b) violence, assessed by throwing objects at the other, pushing, slapping or hitting; c) severe violence, identified by punches, kicking, hitting or trying to hit the other with objects, spanking, threatening to use or really using firearms or knives. One positive item in each of the sub-scales was considered one case.

Physical and verbal violence suffered by the child was also assessed by the CTS, including the same items of verbal aggression, violence and severe violence perpetrated by the parents against the child.

Sibling violence was assessed by the presence of physical or verbal aggressions between the child and his/her siblings throughout the child's life. One positive answer to physical or verbal violence characterized the presence of sibling violence; no positive answer, absence.

The following were analyzed: a) child's profile; sex; age (in years); IQ; b) family's socioeconomic profile: level of schooling of the guardian that had the largest number of years of study: up to incomplete elementary education (which includes those who cannot read or write) and complete elementary and higher education (high school and college/university course); *per capita* family income (in reais): salary and other forms of earnings, like pensions and allowances; number of people in the household; c) family functioning and violence.

Simple frequencies of profile and sociodemographic variables were estimated, and prevalence was calculated according to each explanatory variable. The association of continuous variables with ADHD was verified by Somers' D correlation, using the program Stata version 10, and applying the adjustment to the sampling plan.

The explanatory variables were analyzed with generalized linear models of the binomial family and log link function to estimate prevalence ratios. The modeling variables were selected based on the results of the bivariate analysis, considering $\alpha = 10\%$. Ten variables were selected for the multiple regression, organized in a hierarchized way: distal level (information on the

^a Assis SG, Avanci JQ, Pesce RP, Oliveira RVC, Furtado LX. A violência familiar produzindo reversos: problemas de comportamento em crianças escolares [relatório de pesquisa]. Rio de Janeiro: CLAVES/FIOCRUZ; 2007.

child's and family's profile); intermediate level (verbal aggression and physical violence witnessed by the child between his/her parents); proximal level (physical violence directly suffered by the child).³⁴

The hierarchized model has been used in the study of behavioral factors related to ADHD; for example, Leech et al¹⁹ (1999) investigated the effect of children's exposure to substances such as alcohol on the occurrence of attention problems and impulsivity. These authors highlight the following block of variables: maternal characteristics, environmental characteristics, current and prenatal use of substances.

The hierarchical levels were based on the presupposition that the child's and family's profile exerts primary influence on the child's development. Violence witnessed in the family environment was considered a risk factor¹⁵ for violence suffered by the child in the family environment and relevant to the emergence of mental health problems in children. Violence directly suffered by the child was the last block investigated in the model and could be affected by the previous levels.

In the selection of variables within each block (theoretically considered equally relevant), the variable that presented, comparatively, the effect with the lowest *p* was sequentially removed from the model, up to the point in which all the effects present in the model were statistically significant at the level of 0.05.

Information referring to sampling design was considered in the entire analysis (model adjustments and association tests) to correct precision measures and weights were incorporated in order to correct point estimation.²³ Program R version 2.11.1 was used to adjust the models, through library survey. The complex sample module of the program SPSS version 15 was employed for the association measures.

The project was approved by the Ethics Committee of the *Escola Nacional de Saúde Pública* (process no.: 0051.0.031.000-04, 2005). The schools' principals and the parents signed a consent document.

RESULTS

The children were aged between six and 13 years (mean = 7.9 and sd = 1.1); 51% were boys and 49%, girls; 32.7% were identified by their guardians as having white skin color, 66.7% as having black/mixed-ethnicity skin color and 0.6% as having yellow/indigenous skin color; 53.3% of the children lived with both parents, 24.8% with only one, 18.1% with father and stepmother/mother and stepfather and 3.8% with other relatives. The children lived in families with precarious socioeconomic condition, characterized by high number of people per household (mean = 4.7 and sd = 1.4); parents' low level of schooling (51.2% of

the guardians had as their highest level of schooling incomplete elementary school); and low family income (5.7% of the families had monthly *per capita* income higher than the minimum salary – R\$ 300.00 in 2005 – and 69% had *per capita* income up to half a minimum salary) (Table 1).

The prevalence of ADHD was 10.7% (5% borderline and 5.7% clinical), slightly higher among the boys (12.7% versus 8.5% in the girls), but with no statistical significance (Table 2).

The prevalence of the disorder increased with age, with borderline statistical significance: one more year of age resulted in an increase of approximately 27% in the prevalence of the disorder.

The mean IQ value was 92.1 (sd = 13.0). For the increase of each point in the IQ score, there was a decrease of 2.1% in the ADHD prevalence. The same association was shown by Somers' D correlation (Table 2).

Low income and the number of people living together were not associated with ADHD. Parents' level of

Table 1. Schoolchildren's profile and sociodemographic characteristics. São Gonçalo, RJ, 2005. (N = 479)

Variable	% (95%CI)
Sex	
Male	51.0 (47.9;54.1)
Female	49.0 (45.9;52.1)
Skin color	
White	32.7 (29.0;36.7)
Black/mixed-ethnicity	66.7 (62.6;70.5)
Yellow/indigenous	0.6 (0.2;2.0)
Family structure in which the child lives	
Both parents	53.3 (48.4;58.2)
Only one of the parents	24.8 (21.1;28.8)
Presence of stepmother/stepfather	18.1 (15.0;21.6)
Other relatives	3.8 (2.2;6.4)
Guardian's highest level of schooling	
Up to incomplete elementary education	51.2 (44.9;57.5)
Complete elementary education and higher education	48.8 (42.5;55.1)
Per capita income	
Lower than R\$ 150.00	69.0 (63.8;73.8)
From R\$ 150.00 to R\$ 300.00	25.3 (21.8;29.2)
Higher than R\$ 300.00	5.7 (3.6;8.9)
	Mean (standard deviation)
Age	7.9 (1.1)
People per household	4.7 (1.4)

Table 2. Prevalence ratios and univariate analysis of the regression models of the log-binomial family. São Gonçalo, RJ, 2005.

Variables of the child's and family's profile		% (95%CI)	PR	95%CI
Sex	Male (n = 244)	12.7 (8.8;18.0)	1.492	0.860; 2.589
Parents' level of schooling	Up to incomplete elementary school (n = 242)	12.0 (8.2;17.3)	1.378	0.968; 1.960
Family functioning	Precarious (n = 66)	24.2 (15.3;36.1)	2.742	1.673; 4.496
		Somers' D ^a (95%CI)	PR	95%CI
Age	-	0.060 (0.003;0.117)	1.269 ^b	0.996;1.617 ^c
Intelligence Quotient	-	-0.026 (-0.049;-0.004)	0.979 ^b	0.965;0.993 ^c
Per capita income	-	-0.009 (-0.048;0.029)	1.000 ^b	0.996;1.003
Number of people in the household	-	0.017 (-0.031;0.066)	1.085 ^b	0.891;1.322
Witnessed Violence		% (95%CI)	PR	95%CI
Verbal aggression of the mother against the father	Presence (n = 295)	14.2 (9.9;20.0)	3.179	1.060;9.537 ^c
Verbal aggression of the father against the mother	Presence (n = 287)	13.2 (8.9;19.3)	2.289	0.801;6.539
Physical violence of the mother against the father	Presence (n = 84)	15.5 (7.8;28.4)	1.457	0.636;3.338
Physical violence of the father against the mother	Presence (n = 97)	19.6 (11.3;31.9)	1.963	0.991;3.887 ^c
Severe physical violence of the father against the mother	Presence (n = 57)	22.8 (13.5;35.9)	2.194	1.293;3.725 ^c
Severe physical violence of the mother against the father	Presence (n = 50)	16.0 (7.7;30.2)	1.471	0.687;3.146
Suffered Violence		% (IC95%)	RP	IC95%
Mother's verbal aggression	Presence (n = 367)	12.8 (9.3;17.3)	5.632	1.465;21.654 ^c
Father's verbal aggression	Presence (n = 259)	13.1 (8.9;18.9)	1.738	0.932;3.24 ^c
Mother's physical violence	Presence (n = 333)	10.8 (7.5;15.3)	0.933	0.562;1.550
Father's physical violence	Presence (n = 162)	11.8 (7.9;17.2)	1.055	0.665;1.672
Mother's severe physical violence	Presence (n = 250)	12.0 (8.1;17.3)	1.363	0.793;2.345
Father's severe physical violence	Presence (n = 97)	13.4 (7.3;23.2)	1.298	0.634;2.655
Sibling violence	Presence (n = 219)	15.5 (10.7;21.9)	2.379	1.239;4.567 ^c

^a Somers' D correlation

^b Except for the continuous variables, whose result represents the Exponential of the parameter - Exp(β)

^c Variables included in the multiple model

schooling proved to be more relevant, with children of parents with up to incomplete elementary education presenting prevalence 37.8% higher than those whose parents had a higher level of schooling, close to the 5% statistical significance.

Family functioning, the last variable evaluated in the block of child's and family's profile, proved to be strongly associated with ADHD: families with more dysfunctional strategies had 2.7 times more children with the disorder than those with better functioning.

Verbal aggression of the mother against the father (PR = 3.179 [95%CI 1.060;9.537]) and severe physical violence practiced by the father against the mother (PR = 2.194 [95%CI 1.293;3.725]) were associated with ADHD. Although not statistically significant, the father's physical violence against the mother deserves attention.

The mother's verbal aggression and physical or verbal fights between the child and the siblings were associated with ADHD. The father's verbal aggression was more frequent among children with the disorder, close to the level of statistical significance.

In the multiple model, the statistically significant variables were IQ and family functioning. The introduction of the variables of the second block (violence witnessed in the family) did not contribute to the model (their effects were not statistically significant); thus, the previous model remained. The introduction of the variables that measured the suffered violence pointed that the mother's verbal aggression against the child was aggregated to IQ and to the type of family functioning to explain the occurrence of ADHD in the sample (Table 3).

Table 3. Hierarchized multiple model, prevalence ratios and significance. São Gonçalo, RJ, 2005.

Model	Levels	PR (95%CI)
Perfil da criança e da família		
Intelligence Quotient	-	0.980 ^a (0.962;0.997)
Family functioning	Precarious	2.643 (1.589;4.396)
+ Witnessed Violence		
Intelligence Quotient	-	0.980 ^a (0.962;0.997)
Family functioning	Precarious	2.643 (1.589;4.396)
+ Suffered Violence		
Intelligence Quotient	-	0.980 ^a (0.963;0.998)
Family functioning	Precarious	2.538 (1.572;4.099)
Mother's verbal aggression	Presence	4.703 (1.254;17.636)

^a Except for the variable intelligence quotient - because it is continuous, it presents the Exponential of the parameter - $\text{Exp}(\beta)$.

IQ level was inversely associated with occurrence of ADHD (PR = 0.980; 95%CI 0.963;0.998) and there was more possibility of occurring ADHD in children whose families had precarious functioning when compared to families with a better way of relating. The greatest difficulties pointed in the family relationship of the children with ADHD (PR = 2.539; 95%CI 1.572;4.099) were: planning of joint activities, confiding in others, decision-making, acceptance of the way of being of each member of the family, presence of bad feelings in the family and having a poor relationship when the family is together (Table 3).

Children who suffer verbal aggression from the mother had prevalence of ADHD 4.7 times higher than the prevalence of those who were not exposed to this situation in the last year. There was reduction from crude PR to adjusted PR, indicating that IQ and family functioning explained part of the emergence of ADHD, which previously derived exclusively from family aggression (Table 3).

DISCUSSION

The presence of the mother's verbal aggression against the child, manifested through acts like insults, the child's irritation and destruction of objects, is a fundamental aspect to the occurrence of ADHD. Also important are in what way the family interacts and the child's IQ.

The association between low IQ and ADHD is in line with the results that have been found in many countries, which reiterates the importance of the genetic and environmental basis in the origin of the disorder.¹⁸ On the other hand, intelligence tests are influenced by cultural and linguistic differences and are susceptible to distraction, anxiety, and refusal to cooperate with the examiner, among other conditions. Lower intellectual functioning in children with the disorder oscillates within normal intelligence standards but, nevertheless,

it may facilitate the emergence of learning problems and lower academic competence.²⁶

The more precarious functioning of the family of children with ADHD has also been pointed by other authors. Parents of children with ADHD live with greater stress due to the feeling of incapacity and to more frequent domestic fights than parents of children without ADHD.^{1,3} Scahill et al²⁹ found greater severity of children's symptoms associated with high levels of family dysfunction (OR = 2.20; 95%CI 1.26;3.87). Edwards et al⁸ argue that it is not certain whether family dysfunction is the cause or an effect of the disorder, as a child with ADHD in the family can contribute to hamper the family atmosphere and vice-versa.

Verbal aggression practiced by the mother against the child was associated with ADHD in the adjusted results. In the crude results, other two forms of witnessing violence in the family were statistically significant to explain ADHD (mother's verbal aggression against the father and father's severe physical violence against the mother), as well as psychological and physical violence among siblings. These forms of violence witnessed and suffered directly by the children should be investigated in future studies, especially sibling violence, which has received little scientific attention and which is culturally considered a normal practice in the fraternal relationship.

Verbal aggression is a type of psychological violence that can cause more damage to the child's development than the use of physical force as a disciplinary norm.⁶ In this paper, mothers who practice psychological violence with their children are more frequent in the group of children with ADHD. Ouyang et al,²² in a study with 14,322 North-American children who were followed longitudinally, found more comprehensive results: physical, sexual violence and negligence practiced by the parents against their children were related to the highest prevalence of ADHD.

The 10.7% prevalence of ADHD obtained through the information provided by the parents/guardians is close to the one found in national and international screening studies.^{21,35} The absence of a statistically significant difference between sexes and the increase in ADHD with age are not frequently found in the literature. Authors have shown that the type of informant (parents would tend to overvalue the hyperactive behavior of girls) and the subtypes of ADHD (parents tend to point more symptoms of hyperactivity-impulsivity in younger children) influence gender differences, and can be responsible for the wide variety of results.^{10,28}

The exposure and the outcome were measured simultaneously in a cross-sectional study, which suggests caution in the interpretation of the results: the apparent exposure can be a consequence of ADHD and not the cause (reverse causality). As for verbal aggression and family functioning, this lack of definition in the temporality is a relevant aspect, as ADHD in the child might facilitate the instability of the home, enabling the occurrence of violence and a precarious family functioning.²⁶ Another limitation is the impossibility to differentiate the types of ADHD (hyperactivity and

attention deficit), as the scale that was used does not enable this categorization, hindering the detailed study of the disorder. The fact that the instruments were answered by the guardians, especially mothers, prevents the knowledge of the prevalences when other actors evaluate the symptoms (for example, psychiatrists, teachers and the children/adolescents themselves). The presence of information on ADHD comorbidities would also facilitate the better understanding of the disorder. The sample was composed of children who studied at public schools (low income population), which may have interfered in the effects of the socioeconomic conditions on the outcome.

Psychosocial interventions should be targeted at the child's family (guidance for them to deal with the child who has the disorder in his/her own environment) and be associated with the use of medication (in the recommended cases).

These screening instruments are fundamental to map possible cases at the population level (for example, schools) to be subsequently referred to diagnosis in clinical care.

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