L'Encéphale xxx (xxxx) xxx–xxx

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Research article

# Healthcare pathways and practitioners' knowledge about ADHD in children

## *Organisation des soins et connaissances des médecins français sur le TDAH de l'enfant*

suppl. Informations

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ARTICLE INFO

*Article history:*
Received 5 February 2023
Accepted 4 July 2023
Available online xxx

*Keywords:*
ADHD
Medical doctors
Care pathway
Knowledge
Attitudes
Training
France

ABSTRACT

*Introduction.* – Access to care for children and adolescents affected by ADHD in France remains below the levels attained in most industrialised countries. To contribute to improving ADHD care in France, we assessed existing ADHD knowledge among medical doctors (MDs) and described associated care pathways in two large French regions in 2021. We produced tools to evaluate the regional impact of implementing a stepped-care pathway for ADHD.

*Methods.* – A SurveyMonkey® study was sent to professionals from two regions in France accounting for 14 million inhabitants, allowing them to describe their role in child/adolescent ADHD, as well as their representations and knowledge about the disorder.

*Results.* – Around 9.4% of all MDs potentially involved with children took part in the study; 34.9% considered themselves untrained, 40.5% were involved in ADHD care at a first-tier level, and 19.6% at a second-tier level. Access to a second or third-tier service for ADHD was associated with mean waiting times of 5.7 and 8.5 months, respectively. Initiation of stimulant therapy remained mainly restricted to second or third-tier MDs, and adaptation of dosage or change in the galenic formulation was rarely performed by first-tier MDs (27.2% and 18%, respectively). Training in neurodevelopmental disorders and tier-level were the strongest determinants of knowledge, attitudes and self-assessed expertise about ADHD.

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https://doi.org/10.1016/j.encep.2023.07.005


Please cite this article as: Willig T-N, et al, Healthcare pathways and practitioners' knowledge about ADHD in children, Encéphale, https://doi.org/10.1016/j.encep.2023.07.005

*Conclusions.* – This study provides insight into training needs for MDs regarding healthcare pathways in ADHD and should support the implementation of health policies, such as a stepped healthcare access for ADHD. The study design and dissemination have been validated and will be available in France and other countries facing similar obstacles in care pathways for ADHD. Official recommendations on ADHD in children and adults are being updated in France, and our data and the survey design will be a starting point for their implementation.



RÉSUMÉ

*Introduction.* – L'accès aux soins des enfants et des adolescents ayant un TDAH en France reste en deçà du niveau atteint dans la plupart des pays occidentaux. Nous avons évalué les connaissances des médecins et décrit les filières de soins dans deux grandes régions françaises en 2021, et nous proposons une méthodologie et des outils d'évaluation utilisables pour l'implémentation et l'évaluation d'un parcours de soins gradué dans le TDAH.

*Méthodes.* – Une étude a été diffusée via un questionnaire SurveyMonkey® à tous les médecins de deux régions Françaises totalisant une population de 14 millions d'habitants. Nous avons ainsi évalué les connaissances et les représentations des médecins impliqués dans le TDAH de l'enfant et décrit leur rôle dans le TDAH de l'enfant.

*Résultats.* – Notre étude a recensé 9,4 % de médecins potentiellement impliqués dans le TDAH de l'enfant: 34,9 % d'entre eux se considèrent comme non formés, 40,5 % sont déjà impliqués dans un rôle de premier recours, et 19,6 % dans un rôle de second recours. L'accès à un second ou un troisième niveau de recours pour le TDAH s'associe, quand il est possible, à des délais moyens de 5,7 et de 8,5 mois respectivement. La prescription initiale des psychostimulants reste principalement restreinte au médecin de deuxième et de troisième recours dans notre étude, et l'adaptation des doses ou les changements de présentation galénique sont rarement réalisés par les médecins de premier recours (27,2 et 18 % respectivement). La formation sur les troubles du neurodéveloppement et l'organisation en niveaux de recours sont les déterminants les plus importants des connaissances, des pratiques, et de l'auto estimation de leur expertise sur le TDAH par les médecins.

*Conclusions.* – Notre étude souligne l'impact et les besoins de formation des médecins sur le TDAH, et notre enquête contribue à diffuser les politiques de santé tels que des parcours de soins coordonnés pour le TDAH. Le protocole expérimental et son application ont été validés dans notre étude et sont donc à la disposition en France comme dans les pays qui rencontrent des difficultés dans la structuration des parcours de santé pour le TDAH. Les recommandations officielles en cours de rédaction en France sur le TDAH de l'enfant et de l'adulte pourront ainsi s'appuyer sur ces données ainsi que sur le protocole expérimental comme outil d'évaluation de l'impact de ces recommandations.



*Mots clés :*
TDAH
Médecin
Parcours de santé
Connaissances
Attitude
Formation
France

## 1. Abbreviations

| | |
|---|---|
| ADHD | Attention-deficit/hyperactivity disorder |
| MD | Medical doctor |
| ASD | autism spectrum disorder |
| SLD | specific learning disorders |
| AURA | Auvergne Rhône-Alpes |
| ARS | Agence Régionale de Santé |
| URPS-ML | Union Régionale Professionnelles de Santé–Médecins Libéraux |
| VAS | visual analogue scale |
| GP | general practitioner |
| TDAH | trouble déficit de l'attention hyperactivité |

## 2. Objectives

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder affecting around 5–7% of children and adolescents worldwide [1,2], characterised by developmentally inappropriate levels of either inattention or hyperactivity/impulsivity, or a combination of both, associated with impairments in different domains of functioning. Symptoms and related impairments, when untreated, tend to follow a chronic course and may persist into adulthood. People with ADHD are at increased risk of several medical [3] and psychiatric conditions such as diabetes, obesity [4], asthma [5], substance use, mood, anxiety and personality disorders, as well as disruptive behaviour [6]. ADHD also increases the likelihood of adverse outcomes such as low quality of life, accidental injuries, educational underachievement, unemployment, gambling, teenage pregnancy, difficulties socializing, delinquency, suicide, and premature death [6]. The management of ADHD in children is multimodal and includes parent programs, school-based interventions, and psychostimulant or non-stimulant medications [7,8]. Appropriate treatment of ADHD can reduce symptoms, impairment (e.g. school and family functioning), and adverse outcomes [9,10]. Therefore, early detection, diagnosis and access to evidence-based treatment are crucial for reducing the individual and socio-economic burdens of untreated ADHD. However, access to care is not optimal in many countries.

The first French national recommendations for ADHD published in 2014 focused on general information for physicians involved in the detection and initiation of diagnosis of child ADHD (first-tier medical doctors (MDs)), but the purpose of these recommendations was not to guide treatment and implementation of care [11]. In France, various professionals contribute to the diagnosis and care of children with ADHD, including paediatricians, general practitioners and psychiatrists working in private practice, hospitals, medico-social settings or local networks for learning disorders (LD), but with considerable discrepancies in the level of knowledge and disparities in access to care, despite local initiatives [12,13]. The health care pathway for ADHD in France relies on direct access and choice by parents and patients of the providers, as compared to other countries with specific networks and services, mostly based on

child and adolescent mental health services (CAMHS) like in United Kingdom. Commonly, families are exposed to delays measured in years for a first diagnosis, and access to combined care remains unequal [14]. Consequently, access to pharmacological treatment for ADHD in France remains far below other countries, reaching 0.3 to 0.4% of the annual age group compared to 1.8 to 2% in many countries (annual prevalence of medication use as summarised in reference [15]).

In France, a national initiative was promoted starting in 2018 by the French government to improve healthcare access for children with neurodevelopmental disorders [16,17]. Even though efforts have mainly focused on autism spectrum disorders (ASD), intellectual development disorders and specific learning disorders (SLD), with the creation and extension of related expert centres and national guidelines [18–20], specific platforms are now also available for early detection and intervention for disorders in children aged < 7, including ADHD. An extension for older children between the ages of 6 to 12 years old is currently ongoing.

In the same period, national guidelines were proposed by the French national health authority (HAS) for SLD in 2018 [21]. They recommend a stepped care approach for SLD defined as follows: first-tier practitioners include MDs able to perform screening, symptoms analysis, prescription and interpretation of first-line tests, advice about non-pharmacological treatments: psycho-education, occupational or speech/written language therapy, school accommodations. Second-tier services involve MDs able to analyse complex cases (with symptoms across different fields) with the need for multi-disciplinary assessment to set priorities (comprehensive evaluations by staff trained in developmental disorders). Third-tier services have MDs with expertise in complex cases (e.g., ADHD in the course of genetic disorders, epilepsy, comorbidities with ASD, disruptive behaviour or affective disorders) or for situations requiring second or third-line pharmacological treatment (in France: atomoxetine, clonidine for instance).

To address this issue and foster evidence-based healthcare pathways, the implementation of a regional experimental stepped healthcare access model for children with learning disorders and ADHD started in 2021. Referred to as "*Parcours de Santé TSLA Occitanie*" (*Healthcare pathway for specific language and learning disorders*) in the region Occitanie (South of France) [22,23], this regional initiative aims to facilitate the diagnosis and treatment of children with ADHD or SLD, with direct funding of healthcare professionals for parental behavioural training, occupational therapy and some types of psychotherapy. After the first three years of experimentation, its design and aims will be proposed for a national extension. Informed by French guidelines for learning disorders [21] and international guidelines for ADHD [6,8,24,25], the project is also expected to disseminate evidence-based information about ADHD through professional training workshops.

To precisely assess the knowledge of MDs about ADHD and the organisation of referral pathways, we surveyed MDs, including general practitioners, paediatricians and psychiatrists, with the aims to 1) identify professional roles and referral routes for children with ADHD using a model of stepped care, as it has been recommended in France by the national authorities [21,26]; 2) assess the professionals' experience, role in the stepped care model, their knowledge and any specific pre and postgraduate training on ADHD; 3) investigate which topics or local areas need improvement to alleviate difficulties in healthcare pathways; and 4) determine which obstacles are relevant for guidelines and training content. ADHD may represent a paradigm for designing and evaluating healthcare programmes for neurodevelopmental disorders (NDD) in France, helping to reduce delays and inequities of access to care.

## 3. Methods

We included general practitioners, paediatricians and child/adolescent psychiatrists of two French regions with a combined population of 14 million inhabitants: Auvergne Rhône-Alpes (AURA), and Occitanie where the regional experimentation is on-going ("*Parcours de Santé TSLA Occitanie*") [22,23]. In both regions, the transmission of the survey was endorsed by the regional health agencies "*Agence Régionale de Santé* (ARS)" and by the regional union of healthcare workers for medical doctors "*Unions Régionales Professionnelles de Santé Médecins Libéraux* (URPS-ML)" for the private sector. In France, ARS are in charge of health care organization at the regional level, especially to implement recommendations issued by both the Ministry of Health, and national health agency (HAS), through a five-year regional plan for health planning. Similarly, URPS-ML are composed of elected representants of MDs working in a private practice, through regional elections, with a representative role towards official structures including ARS.

The link was sent through emails between March and May 2021, along with an information letter. The two ARS contacted 1832, and 958 professionals from the public sector, and the two URPS-ML contacted 8117 and 5125 professionals in the private sector, respectively, in AURA and Occitanie (total number: 16,032 MDs). The survey was further relayed to members of the Association Française de Pédiatrie Ambulatoire (AFPA). The whole reference population of MDs in these two regions is estimated to be 20,865 MDs, with 19,126 GPs, 1556 paediatricians, and 183 child and adolescent psychiatrists, including professionals working in a private practice or a public structure as provided by ARS Occitanie and Auvergne Rhône-Alpes.

A previously published research proposed a tool to provide a replicable approach to assess health professionals' knowledge in Ireland [27]. Thus, we adapted this questionnaire to the French setting and had it translated and back-translated by the first author and external translators. This also allowed us to control metric values of the index of knowledge and attitudes through its application in our population study.

The final questionnaire (see supplementary materials: questionnaire) was organised into five sections: 1) general information about the respondent (age, gender, tier-level, medical speciality, setting, and description of medical activity) (11 items); 2) local healthcare organisation and context, including potential referral routes available to the respondent (12 items); 3) level of expertise and training of respondents regarding ADHD (5 items); 4) attitudes about ADHD (7 items), and knowledge about ADHD (5 items about clinical facts, 5 items about treatment) based on a Likert scale ranging from entirely disagree (-2) to fully agree (+2), with reference on the values obtained through the script concordance test completed by a panel of experts (see below); 5) self-assessment of the degree of expertise in ADHD using a visual analogue scale (VAS) with a score ranging from 0 to 100. The estimated time to respond to all 45 questions was 10 minutes. The questionnaire was circulated using SurveyMonkey® software (SurveyMonkey Inc®).

Tier levels were defined according to the national recommendations published by the French Haute Autorité de Santé and described in the questionnaire in appendix [21].

We first performed a script concordance test [28,29] with a panel of 12 ADHD experts to provide a/a "gold standard" of the response of experts for attitudes and knowledge on ADHD, b/reference values to be compared with individual responses to the survey (results in supplementary table* 1). Script concordance tests are assessment tools designed to determine whether respondents' knowledge is

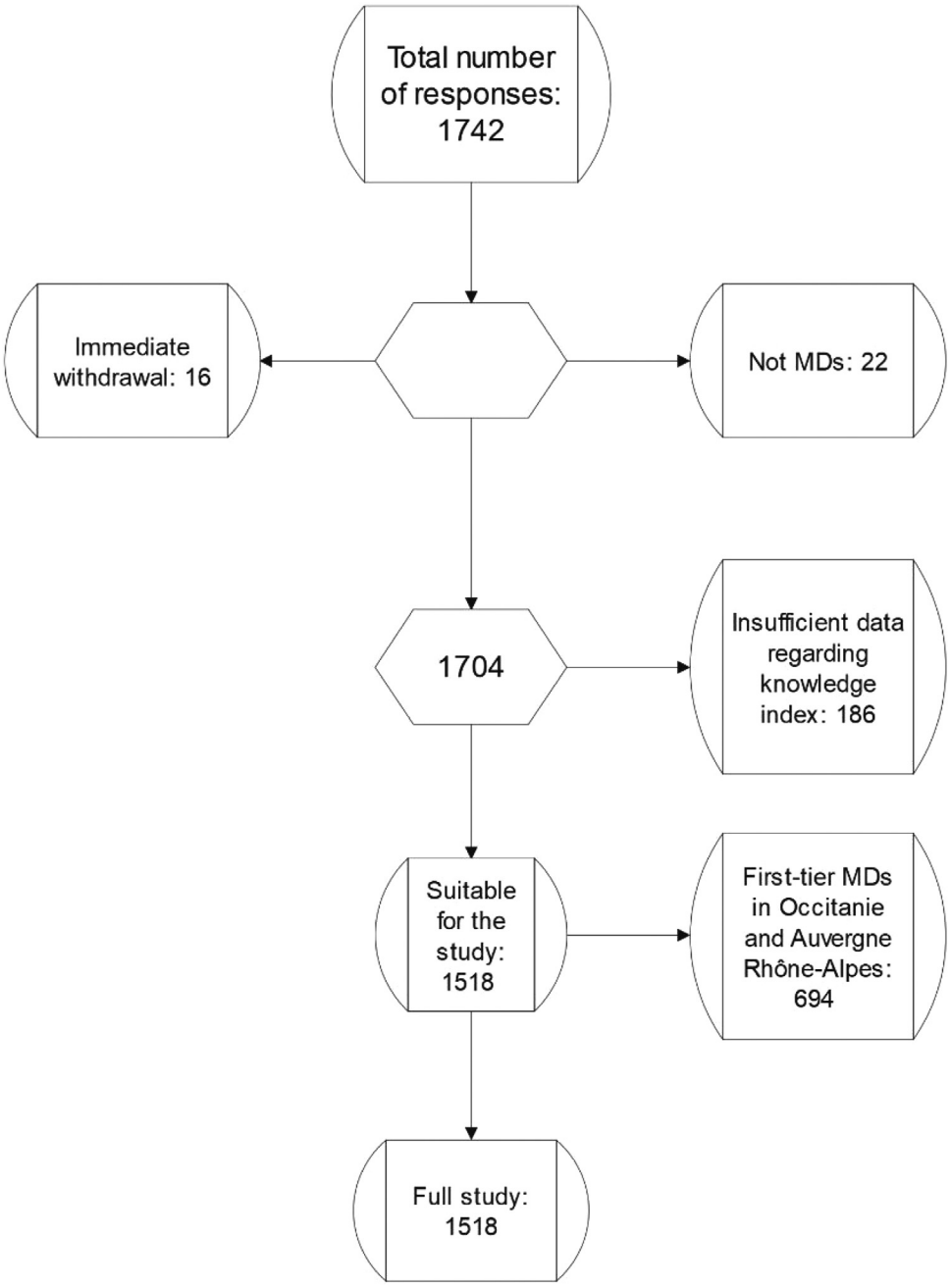


**Fig. 1.** Survey flow chart. MDs: medical doctors.

efficiently organised for clinical actions [29]. Items were aggregated into a single dimension: a composite scale of attitudes and knowledge about ADHD. For this scale, the internal consistency was satisfactory [Cronbach's ($\alpha = 0.70$)].

The composite scale and the VAS of expertise scores were used for the statistical analysis.

Univariate statistical analysis was used to compare groups of respondents according to demographic variables and professional status regarding the composite scale and VAS. Non-parametric tests were used when the sample did not follow a normal distribution. We also used regression models using the composite scale and VAS as response variables to identify predictors that could be relevant for future professional training. All statistical analyses were conducted with IBM SPSS 25 and Jamovi 1.8.1. Figs. 2 and 3 were designed using *JMP®, Version 17. SAS Institute Inc., Cary, NC, 1989–2023*. Descriptive analyses included frequency distributions, percentages, and mean and standard deviations. The significance level was set at $P < 0.01$ for this analysis, as several statistical analyses were performed.

To identify the socio-demographic and professional variables predictive of knowledge and expertise in ADHD in our sample, we ran a bivariate analysis using the composite scale and the VAS, allowing us to extract factors which specific training policies might target.

## 4. Results

We obtained 1742 responses to the survey, and the final sample consisted of 1518 surveys (see Fig. 1) with a final response rate of 9.4%. We excluded questionnaires filled out by

**Table 1**
Main socio-demographic characteristics of respondents.

| | | |
|---|---|---|
| Gender ($n = 1513$) | Male | 21.6% |
| | Female | 78.1% |
| Speciality ($n = 1515$) | General practitioners | 40.6% |
| | Paediatricians | 36% |
| | Neuropaediatricians | 4.6% |
| | Psychiatrists (adult and child/adolescent) | 11.1% |
| | Other | 7.7% |
| Age range ($n = 1506$) | <35 years old | 13% |
| | 35 to 49 years old | 39.1% |
| | 50 to 65 years old | 38.5% |
| | >65 years old | 8.6% |
| Population area ($n = 1486$) | <5,000 inhabitants | 10% |
| | 5,001 to 20,000 | 19.4% |
| | 20,001 to 100,000 | 28.9% |
| | >100,000 inhabitants including Paris | 41.7% |
| Type of professional practice ($n = 1518$) | Exclusively private practice | 52.8% |
| | Both private and employed practice | 29.3% |
| | Exclusively employed practice | 17.9% |
| Region ($n = 1510$) | Auvergne Rhône Alpes | 37.2% |
| | Occitanie | 37% |
| | Other regions | 24.8% |

**Table 2**
Activity of responding MDs and referral networks for ADHD.

| | | |
|---|---|---|
| Alarm signs for ADHD in the responding MDs' population ($n = 1518$) | Disruptive behaviour at school | 84.8% |
| | Learning difficulties | 61.5% |
| | Disruptive behaviour at home | 43.4% |
| | Emotional disorders | 20.2% |
| | Exclusion from school | 7.2% |
| | Substance use | 7.2% |
| | Rule breaking behaviour | 4.7% |
| Self-assessment of level of training and expertise by responding MDs ($n = 1518$) | Untrained | 34.9% |
| | First-tier | 40.5% |
| | Second-tier | 19.6% |
| | Third-tier | 5.4% |
| Number of new ADHD diagnoses/month ($n = 1502$) | 0 to 1 | 70.2% |
| | 2 to 5 | 21.8% |
| | 6 to 10 | 5% |
| | >10 | 2.9% |
| In regard to treatment with stimulants (pharmacological treatment): | I initiate the first prescription | 14% |
| | I do prescription refills every 28 days | 56.4% |
| | I handle dose adjustments | 27.2% |
| | I change the galenic formulation when needed | 18% |
| | I do not prescribe because I do not feel qualified | 33.4% |
| | I am opposed to pharmacological treatment | 2% |
| What is your second-tier referral option? ($n = 1134$) [a] | Neuropaediatrician | 52.5% |
| | Paediatrician | 12.1% |
| | Psychiatrist | 44.1% |
| | General practitioner | 0.3% |
| | Other specialist | 9.3% |
| | No referral possible | 8.5% |
| | In the same "département" | 82% |
| | In another "département" | 9.5% |
| | Mean delay: months (SD) | 5.8 (4.1) |
| What is your third-tier referral option? ($n = 1431$) [b] | Reference centre for language and learning disorders (CRTLA) | 39.8% |
| | University department of psychiatry | 26.3% |
| | Network structure | 9.1% |
| | Private practitioner | 7.6% |
| | In the same "département" | 52.7% |
| | In another "département" | 16.6% |
| | Mean delay: months (SD) | 8.5 (5.3) |

[a] For second-tier referral: the assessment was extracted based on the respondents, either untrained or at the first tier
[b] For the third-tier referral, the assessment was made on all respondents except the third-tier respondents themselves

professionals other than MDs or with incomplete responses on the attitudes/knowledge items. The socio-demographic characteristics of respondents are shown in Table 1. The majority of respondents were women (78%), mainly GPs (40.6%) and paediatricians (36%), followed by psychiatrists (11.1%) and neuropaediatricians (4.6%). Most of the respondents were aged 35 to 49 (39.1%) or 50 to 65 (38.5%), working in large cities (over 100,000 inhabitants: 41.7%), medium-size towns (20,000 to 100,000 inhabitants: 28.9%), or in rural areas (below 5,000 inhabitants) or small towns (5,000 to 20,000 inhabitants) (10% and 19.4% respectively). More than half of the sample was exclusively working in private practice. About 46% of the sample defined themselves as first-tier medical professionals, while 19.3% as second-tier and 5.4% as third-tier (Table 2). In the meantime, 34.9% of the respondents describe themselves as untrained. Diagnosis activity remains occasional for most MDs (0 to 5/months for 92% of the respondents (Table 2)).

Alarm signs are predominantly behaviour problems in school (85%) or at home (43%), while learning problems accounted for 61%

**Table 3**
Comparison of ADHD knowledge through the composite index and the VAS according to sociodemographic and professional characteristics of MDs.

| Item | | Composite Index of Knowledge Mean (SD) | *P*-value Effect size $\varepsilon^2$ | VAS of Expertise Mean (SD) | *P*-value Effect size $\varepsilon^2$ |
|---|---|---|---|---|---|
| Gender ($n = 1513$) | Male | 15.87 (7.85) | <0.001 | 43.74 (26.67) | 0.811 |
| | Female | 18.02 (6.37) | low | 43.91 (24.73) | negligible |
| Speciality ($n = 1515$) | General practitioner | 15.92 (6.3) | <0.001 | 33.41 (21.62) | <0.001 |
| | | | low | | moderate |
| | Paediatrician | 18.54 (6.02) | | 45.51 (22.88) | |
| | Neuropaediatrician | 23.16 (5.01) | | 74.09 (18.86) | |
| | Psychiatrist | 18.23 (9.26) | | 62.99 (23.38) | |
| | Other | 17.24 (6.42) | | 44.69 (25.16) | |
| Age range ($n = 1506$) | <35 years | 18.08 (5.99) | <0.001 negligible | 37.09 (23.25) | <0.001 low |
| | 35 to 49 years | 17.76 (6.16) | | 40.53 (24.96) | |
| | 50 to 65 years | 17.96 (7.06) | | 48.82 (25.15) | |
| | >65 years | 14.29 (8.49) | | 47.32 (24.19) | |
| Population area ($n = 1486$) | <5,000 inhabitants (inhab.) | 15.6 (2.3) | <0.001 low | 29.9 (20.97) | <0.001 low |
| | 5,001 to 20,000 inhab. | 17.04 6.72) | | 39.4 (23.34) | |
| | 20,001 to 100,000 inhab. | 17.2 (6.92) | | 45.1(24.62) | |
| | >100,000 inhab. | 18.59 (6.92) | | 48.9 (26.06) | |
| Type of professional practice ($n = 1518$) | Exclusively private practice | 16.51 (6.69) | <0.001 low | 37.92 (23.59) | <0.001 low |
| | Both private and employed practice | 17.43 (7.21) | | 47.16 (47.16) | |
| | Exclusively employed | 19.51 (6.19) | | 52.54 (52.54) | |
| Region ($n = 1510$) | Auvergne Rhône Alpes | 17.98 (7.16) | 0.022 negligible | 44.38 (25.89) | <0.001 negligible |
| | Occitanie | 16.99 (6.94) | | 41.06 (25.26) | |
| Tier level | Untrained | 14.5 (6.2) | <0.001 moderate | 21.6 (14.1) | <0.001 large |
| | 1° level | 45.9 (18.6) | | 18.05 (6.0) | |
| | 2° level | 67.9 (16.4) | | 20.74 (6.4) | |
| | 3° level | 79.5 (15.9) | | 21.87 (7.75) | |

of the MDs (Table 2). We thus investigated whether alarm signs for ADHD, handling of medication and referral routes differed based on the professional tier levels in a stepped care approach, the different medical specialities, and the geographical setting (e.g. rural versus urban). Details of these analyses are shown in supplementary material table* 2. The results show that warning signs for ADHD vary based on speciality, with a high proportion of children with emotional and conduct disorders in patients seen by psychiatrists. In contrast, learning disorders and disruptive behaviour at home were more frequently encountered in patients of neuropaediatricians.

Psychiatrists predominantly handled initiation, titration, and changes in the galenic formulation (respectively: 50, 70, and 50%) along with neuropaediatricians (respectively: 81, 93 and 81%) working in second/third-tier settings in urban areas. Renewal of prescriptions was done by general practitioners (60%), paediatricians (64.3%) and psychiatrists (58%). More than a third of first-tier professionals (mainly general practitioners and paediatricians) stated that they lacked competence in diagnosing and treating children and adolescents with ADHD. This was also claimed by 15% of psychiatrists. Psychiatrists were significantly more likely not to endorse the use of ADHD medication than practitioners from other specialities (5.4% vs. 2.6% general practitioners and 0.7% paediatricians).

As regards referral routes, second-tier services are led mainly by neuropaediatricians (52.5%) or psychiatrists (44%) (Table 2) in public services (supplementary table* 2). This second-tier service is usually available within the same geographical area (French département) (87%), with a mean waiting time for patient uptake of 5.6 months, while neuropaediatricians report a higher proportion of patients on waiting lists above six months (supplementary table* 2). Patients referred by paediatricians and psychiatrists are more likely to obtain a second-tier uptake within less than five months (20.7 and 28.4%, respectively) than those referred by general practitioners (11.4%) (supplementary table* 2).

Third-tier services are networks, psychiatrists or neuropaediatricians in university hospitals, available within the same geographical area in only a third of cases. The mean waiting time for uptake was about eight months (Table 2), with a third of referrals having to wait more than one year. Practitioners from low-density/rural settings were less likely than those from urban areas to access third-tier services in a close geographic area and within five months or less ($P < 0.0001$). More than half of practitioners from low-density areas and 44.7% of the global sample general practitioners declared not to be aware of this level (supplementary table* 2).

The composite knowledge index showed higher levels for neuropaediatricians, women, and MDs working at a second or third-tier level and in larger cities. Conversely, older practitioners, especially among untrained or working at a first-tier level or in rural areas, exhibited lower knowledge or attitudes toward ADHD (Table 3).

Detailed results of the composite knowledge and representation index from the expert panel and study population are shown in Figs. 2 and 3. The composite knowledge and representation index in ADHD significantly correlated with VAS (Spearman's correlation rho = 0.411, $P < 0.001$).

A stepwise multivariate analysis revealed eight independent predictive variables for the composite index on ADHD: being trained in neurodevelopmental or learning disorders, tier-level, age (younger MDs < other groups), having a diploma in neurodevelopmental or learning disorders, gender (female > male), number of ADHD diagnoses/month, type of professional practice and density of population (large cities > rural areas) (Table 4). The strongest positive association is shown for previous training in neurodevelopmental or learning disorders ($\beta = 0{,}173$; $t = 6{,}553$; $P < 0{,}001$). These eight variables explain 21% of the variance of the composite index scores ($R^2 = 0{,}213$), and the model was significant ($F = 47.475$; $P < 0{,}001$).

Regarding the VAS, the stepwise multivariate analysis revealed five independent predictive variables: tier-level, number of ADHD diagnoses/month, diploma or training in neurodevelopmental or learning disorders, and age (Table 5). The strongest positive association was shown for the tier level ($\beta = 0{,}539$; $t = 21{,}485$; $P < 0.001$). These five variables explain 60% of the variance of the VAS ($R^2 = 0{,}597$), and the model is significant ($F = 412.106$; $P < 0{,}001$). Detailed results are shown in Table 5.

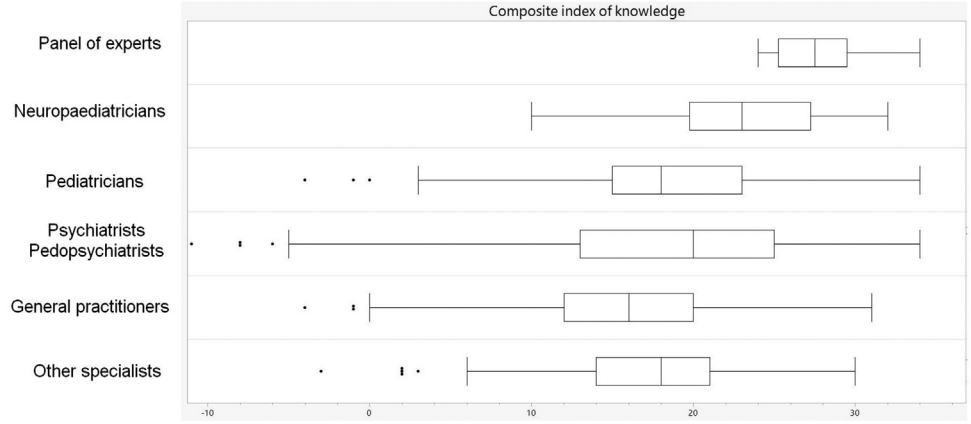


**Fig. 2.** Results of the composite index from the panel of experts and survey sample.

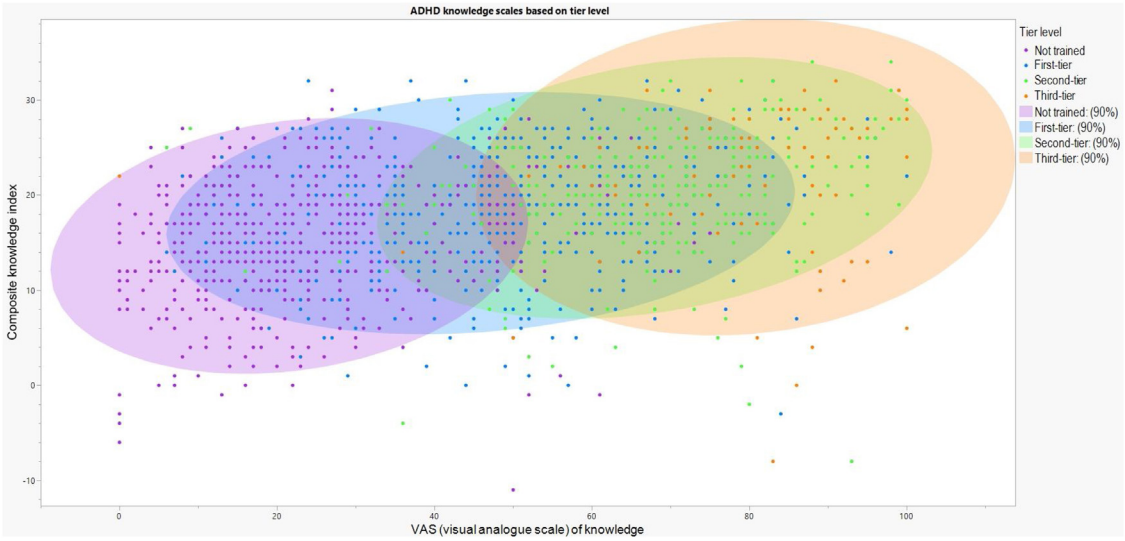


**Fig. 3.** Distribution of the composite index of knowledge and the VAS of knowledge, according to the tier level of the respondents.

**Table 4**
Stepwise regression model for the composite ADHD representation and knowledge index.

| Predictive variables | β | t | *P* |
|---|---|---|---|
| Having followed a training on ADHD: yes/no | 0.173 | 6.553 | 0.000 |
| Tier-level: untrained/1/2/3 | 0.161 | 4.573 | 0.000 |
| Age | −0.143 | −5.777 | 0.000 |
| Having a diploma on NDD: yes/no | 0.140 | 4.599 | 0.000 |
| Gender | 0.094 | 3.836 | 0.000 |
| Number of ADHD diagnoses/month | 0.074 | 2.524 | 0.012 |
| Type of practice | −0.071 | −2.937 | 0.003 |
| Density of population | 0.048 | 1.965 | 0.050 |

**Table 5**
Stepwise regression model for the VAS on ADHD expertise.

| Predictive variables | β | t | *P* |
|---|---|---|---|
| Tier-level | 0.539 | 21.485 | 0.000 |
| Number of ADHD diagnoses/month | 0.135 | 6.428 | 0.000 |
| Having a diploma on NDD: yes/no | 0.123 | 5.561 | 0.000 |
| Having followed a training on ADHD: yes/no | 0.114 | 6.071 | 0.000 |
| Age | 0.061 | 3.493 | 0.000 |

Further analysis of pairwise comparisons revealed significant differences regarding knowledge based on speciality, helping to differentiate three groups according to the results of the composite index of knowledge, [general practitioners] = [other specialities] «< [paediatricians] = [psychiatrists] «< [neuropaediatricians] with a significance level of difference expressed as .000 1 (expressed as « < ) or .001 (expressed as «) or .01 (expressed as <) or non-significant or at level.05 (defined as =) as detailed in Table 6.

**Table 6**
Pairwise analysis of the composite index of knowledge according to the population of the territories and the speciality. Knowledge according to the speciality of MDs.

| Specialty of MDs | GP | Paediatricians | Neuropaediatricians | Psychiatrists | Others |
|---|---|---|---|---|---|
| Mean (SD) | 15.92 (6.3) | 18.54 (6.02) | 23.16 (5.01) | 18.23 (9.26) | 17.24 (6.42) |
| GP | | | | | |
| Pediatricians | <0.001 | | | | |
| Neuropediatricians | <0.001 | <0.001 | | | |
| Psychiatrists | <0.001 | 0.578 | 0.002 | | |
| Others | 0.178 | 0.477 | <0.001 | 0.157 | |

Pairwise analysis of composite index knowledge according to the territory population

| Population size of MDs | <5.000 inh. | 5.000 to 20.000 inh | 20.000 to 100.000 inh. | >100.000 inh. |
|---|---|---|---|---|
| Mean (SD) | 15.6 (5.49) | 17.04 (6.72) | 17.20 (6.92) | 18.59 (6.92) |
| <5.000 inh. | | | | |
| 5.000 to 20.000 inh. | 0.057 | | | |
| 20.000 to 100.000 inh. | 0.012 | 0.994 | | |
| >100.000 inh. | 0.001 | 0.017 | 0.018 | |

GP: general practitioners; Inh.: inhabitants.

Similarly, pairwise comparisons highlighted differences in the knowledge about childhood ADHD according to the population density of the workplace of the MDs, with large cities offering MDs with a higher level of knowledge than all other groups of cities: [under 5,000 inhabit.] = [5,000 to 20,000 inhabit.] = [20,000-100,000 inhabit.] < [over 100;000 inhabit.], as summarized in Table 6.

## 5. Discussion

Our work is a unique study in France to offer a reproducible strategy of assessment of knowledge and representation in MDs involved in child ADHD and an evaluation of the current access to care in two regions covering 14 million inhabitants. These regions were chosen as healthcare networks on SLD have reached a complete territorial deployment and may serve as a model of a steady state situation in healthcare organisation. The response rate (9.4%) might represent an overall estimation of the percentage of MDs potentially involved in child ADHD, as the survey was officially endorsed and extensively disseminated by both regional health agencies and unions of MDs. Our work provides baseline data previous national recommendations about childhood ADHD in France in 2023 [30] and prior to the conclusions of a regional experimentation about a structured stepped care model [21,22].

The composition of our sample was suitable for assessing basic knowledge about ADHD in general practitioners, paediatricians and psychiatrists and for investigating the current organisation of referral pathways. We expect that organising a stepped approach to diagnosis and treatment, including relevant training workshops and webinars, will reduce these delays, especially for families living in low-density areas.

Regarding access to pharmacological treatment, comparative analyses according to medical speciality and other professional characteristics showed that not only initiation of medication but also titration and changes in galenic formulations were generally handled by second/third-tier services in the public sector. From the present survey, general practitioners and paediatricians in private practice renewed prescriptions but with a limited engagement in treatment dose adjustment (12.5 and 26.7%, respectively) as a historical consequence of the French legal restrictions about methylphenidate initial and annual prescription, which, until recently, was limited to hospital neurologists, paediatricians and psychiatrists. Although drug titration and change of galenic formulation were not prohibited for MDs working in the private sector, our results suggest some form of self-censorship in prescribing ADHD medications. Since September 2021, methylphenidate's initial prescription has been authorised for paediatricians, neurologists, and psychiatrists in private practice and hospital settings, but it remains impossible for GPs.

The composite index of attitudes and knowledge of ADHD showed a gradient with the highest scores in ADHD experts (who took part in the concordance script stage), followed by neuropaediatricians, psychiatrists, and paediatricians without significant differences between these and GPs. Apart from those of the ADHD experts and the neuropaediatricians, scores showed considerable variability, particularly among psychiatrists. This indicates that training in ADHD during pre-graduate medical studies has probably been insufficient in the currently active generations, together with heterogeneity in knowledge among paediatricians and psychiatrists. Notably, some respondents in our survey were at an expert level in knowledge about ADHD in all specialities, including among general practitioners [31,32].

Self-assessed experience in ADHD correlated moderately with the composite index of knowledge and attitudes; overall, the distribution was in line with tier levels.

Comparisons based on sample characteristics showed that women scored higher than men in the composite knowledge and representation index while there were no gender differences in self-assessed expertise (Table 3): this higher figure in female MDs might be related to a gender bias in self-assessment. Similarly, the composite index shows a progression in awareness of child ADHD with age, probably due to acquired experience and post-university training, but with a sharp decline in older MDs (over age 65). Conversely, their self-assessed expertise does not reflect this figure, which remains questionable (Table 2). Overall, younger professionals seemed to underestimate their knowledge, while the opposite was noted for professionals over 65.

Based on the factors identified by the multivariate analyses: having a diploma and/or having followed training in neurodevelopmental or learning disorders as well as the tier level and the frequency of diagnosis, is associated with increased expertise and knowledge. A specific action designed to improve such expertise could be conducted towards general practitioners working in areas with a low specific medical offer and knowledge, such as rural or low-population-density areas. This could help MDs get involved, increase their self-confidence in caring for ADHD patients, and eventually move to a higher level of practice. The training of MDs to move to a first-tier level and the invitation to increase the frequency of conducting a diagnostic procedure could, in the future, help families to access an MD aware of ADHD, as we showed through the knowledge index. Similarly, specific training programmes intended for MDs working exclusively in private practice could help to close the knowledge gap compared to those working in employed practice.

Regarding attitudes, knowledge, and self-declared expertise, our survey results emphasise the usefulness of postgraduate diploma courses, less formal training opportunities, and the expertise acquired with field practice (i.e. the number of diagnoses/months). A second objective of training in France should aim to develop further second-tier professionals in the private or mixed private-public sector now that initiation of psychostimulant treatment is allowed for all psychiatrists, neurologists and paediatricians, since September 2021.

In France, the healthcare structure regarding ADHD (and learning disorders) is based upon a three-levelled practice and expertise [21]. The experiment, "*Parcours de Santé TSLA Occitanie*" (*Healthcare pathway for specific language and developmental disorder*) in the region Occitanie (South of France) [22,23], is a regional application of these recommendations. As several studies have emphasised the difficulty in involving GPs as first-contact gatekeepers on ADHD (for a comprehensive review and meta-analysis [33]), the underlying rationale of the project is to rely on first-tier MDs specifically trained to screen, start diagnosis for simple cases, and to rely on second-tier MDs working together with a multidisciplinary team to initiate both pharmacological and non-pharmacological treatments for ADHD or to assess the more complex situations. In our experimental regional project, we intend to set up a panel of first-tier MDs involving about 10% of the GPs and 50% of the paediatricians working in private practice, with training programs on screening based on a 10-hour format to qualify as first-tier professionals, thus implementing a network of MDs with a particular interest in ADHD [34]. We chose to rely on MDs who have either followed a university diploma or equivalent and are working in a multidisciplinary setting for a second-tier level of care. Comparing our findings to those of similar studies in other countries is helpful. Thus, shortly, we expect the development of second-tier competencies in the private sector, as it is likely that the possibility of active participation in the treatment of ADHD will increase the input from the private sector. We also expect positive changes in professionals' knowledge and involvement in ADHD treatment after implementing the experimental stepped healthcare access model for children with learning disorders and ADHD in the Occitanie region.

Overall, our research provides detailed insights into the healthcare pathway of ADHD in children and adolescents and can be used for healthcare planning and medical education. Based on our findings, we propose reference values for the knowledge index as a basis for regional or national comparisons, together with the identification of referral pathways and mean delays in accessing second-tier or third-tier expertise.

The main limitation of our work relies on the schema used, as the response rate remains low as a common pitfall of all surveys based on a voluntary response.

However, the response rate (9.4%) aligns with the expected involvement of MDs in ADHD. We can hypothesise that the participation reflects the overall interest of non-specialized MDs in ADHD. Thus, our results are to be used for regional and national comparisons.

This survey will thus contribute to the forthcoming sets of new good practice recommendations by the French health authorities (Haute Autorité de Santé) on child and adult ADHD and the methodology for their regional implementation.

## Ethical approval

This work did not need any ethical committee agreement as no personal data of responders were collected. The proposal to participate in the study was directly sent by regional health authorities (ARS) and unions of medical doctors (URPS) in respect of their obligations to comply with the general data protection regulation of the UE (GDPR). Responders were not asked for any information involved by the GDPR.

## Informed consent

Not applicable

## Consent for publication

All authors gave full consent for publication.

## Availability of data and material

A database containing anonymous responses and statistical analysis is available upon request to the first author.

## Disclosure of interests

Dr Willig has no interest to declare. He is president of the association Occitadys and the primary project holder of the *Parcours de Santé TSLA Occitanie*, funded by the ARS Occitanie and the Caisse Nationale d'Assurance Maladie.

Dr Dajon has no interest to declare.

Dr Assathiany has no interest to declare

Dr Brun has no interest to declare

Pr Fourneret reports declared honoraria from HAC Pharma and Tadeka for educational talks or scientific advisor.

Dr Masse has no interest to declare

Dr Monge has no interest to declare

Dr Piollet has no interest to declare

Mrs Thiollier has no interest to declare

Prof Cortese has received honoraria from non-profit associations (British Association of Psychopharmacology (BAP), Association for Child and Adolescent Mental Health (ACAMH), and Canadian ADHD Resource Alliance, CADDRA) for educational talks on ADHD.

Prof Diane Purper-Ouakil reports non-financial support from HAC Pharma and Lundbeck, honoraria and non-financial support from Medice in the last three years. She also collaborated on FP7 projects and a Horizon 2020 SME trial with Mensia without financial interests.

## Funding

This study did not require external funding, but the authors' involvement and the different structures contributed to the distribution of the survey. Statistical analysis was kindly provided by the GIS-BECo, as a result of the participation of Occitadys in its scientific committee.

## Authors' contributions

All authors were involved in the design, the implementation, the analysis of the data and the manuscript. Marie Dajon realised statistical analysis as the result of the involvement of Occitadys in the scientific committee of Gis Beco.

## Acknowledgements

We gratefully acknowledge Nadine Rémy, Nathalie Burdo, Dr Ivan Théis, Catherine Choma (ARS Occitanie), Fabienne Righetti (ARS Auvergne Rhône Alpes) for their support in the diffusion of the survey to hospitals, medico-social institutions of their regions. Similarly, we are indebted to Dr Maurice Bensoussan and Laetitia Habouch (URPS ML Occitanie), to Martine Ranc, Dr Jean Stagnara, Dr Pierre-Jean Ternamian, Dr Vincent Rébeillé-Borgella (URPS ML

AURA) for the distribution to MDs working in private practice in both regions, and to Dr Fabienne Kochert and Valérie Manable (Association Française de Pédiatrie Ambulatoire: AFPA) for the participation of ambulatory paediatricians.

Further support was also provided by Dr Hubert Daudé (Fédération Occitanie des CAMSP), Dr Valérie Cicchelero (Rectorat de Toulouse), Dr Béatrice Sénemaud (Rectorat de Montpellier), professional correspondents from healthcare networks from the two regions: Dys 42, Récital 63, Dys/10, réseau Anais, Occitadys, from the PMI of region Occitanie and Auvergne-Rhône-Alpes

We are also grateful to Christine Gétin (HyperSuper TDAH France) for her valuable input in the past few years, with a common goal of improving care for people with ADHD. Finally, Emeline and Vincent Yau for the back translation of the survey's tools and their help in the English version of this article.

## Online Supplement. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.encep.2023.07.005.

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