

ORIGINAL ARTICLE

Evaluation of psychomotricity and visual attention disorders among preschool children in the city of Khemisset, Morocco

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Submitted: 2022-12-24 *Accepted:* 2023-02-15 *Published online:* 2023-02-15

Key words: **Psychomotricity; Visual attention; Preschool; Motor rhythms; Hemineglect**

Act Nerv Super Rediviva 2023; 65(1): 8–15

ANSR65123A03

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Abstract

The evaluation of the state of psychomotricity and visual attention at an early age is essential to prevent psychomotor and attentional disorders with the aim of ensuring normal school and health development of the child.

The objective of this work is to evaluate this state and to detect possible disorders at the level of psychomotricity and visual attention in Moroccan preschool children of the city of Khemisset. This study was carried out on a population of 117 children from four preschools whose age varies from 3 to 6 years.

The results obtained showed remarkable differences in neuropsychological, cognitive and behavioral performance, as well as in psychomotor rhythms.

Generally, the study showed that visual attention and precision of motor rhythms become more efficient with age. At the same time, these results revealed a high percentage (17%) of hemineglect children, the coefficient of variation evaluating the regularity of rhythms in these children is high (15%, 18%), which means a low regularity of slow rhythms and fast.

The results of the F.C.R correlates with the results of the finger-tapping; Indeed, children with high attentional performances (percentile>75%) have low coefficients of variation (between 8% and 10%), therefore better regularity and precision of rhythms. We observe a correlation between the Bell test and the F.C.R; Indeed, children with heminegligence have very low percentiles (between 10% and 16%), which means severe attention deficit.

INTRODUCTION

The concept of psychomotricity is one of the most recent concepts in the educational and therapeutic sphere. It was part of a vision of being that had just moved from body-mind dualism to the notion of globality, of the uniqueness of being (Ajuriaguerra *et al.* 2009). Research at the level of neurocognitive

sciences which has highlighted, from the observation of the functioning of the brain, the obligatory passage through experience and bodily and emotional integration, during the emergence and development of intelligence have influenced the development of the notion of psychomotricity (Le camus 1988). Finally, it relied

on the recognition of the spontaneous and creative movement of the Human Being and particularly of the child, which at the beginning was above all intuitive and reactive to lead today to “conscious spontaneous movement”.

The early detection of psychomotor disorders is of extreme importance, given the impact of these disorders on the quality of life of the individual and especially of the child at preschool or school age; these disorders can affect his course of schooling and its health development (Vaivre-douret 1997). The evaluation of the psychomotor state of the individual is done through neurocognitive tests to assess and detect possible psychomotricity disorders (Ajuriaguerra 1959; Vaivre-Douret 2006).

The remediation of psychomotor disorders is mainly done through rehabilitation techniques that allow the individual to regain their motor skills and improve their quality of life (Ajuriaguerra 1959).

Visual attention is a neurocognitive function at the base of many of our behaviors. It allows the smooth running of other functions such as memory or reasoning, hence its importance. It offers, among other things, the ability to voluntarily select a stimulus and to pursue the direction it implies over time (Vaivre-douret 1997).

Attention disorders are more or less heavy on development in general, and can influence the mental and relational health of the individual. These disorders are identified using a battery of tests of the child's neuropsychological functions (Allport 1989).

The objective of this work is to evaluate the state of psychomotricity and visual attention in preschool children in order to diagnose possible disorders and prevent problems in their schooling and health.

MATERIAL AND METHODS

Study population

Our sample is composed of 117 children aged 3 to 6 from four preschools in Khemisset, Morocco. Their distribution by age and sex is given in the table below. The relatively small number of children in the age group [3 years; 4 years] is due to a high number of refusals. The children come from average socio-cultural backgrounds.

These children have passed the bell test. Among these 117, 72 passed the test of the rhythms (Finger

Tapping) using the impeller and the test of the Rey Complex Figure simplified form (RCF). The table below illustrates the distribution by age and sex of the 72 children.

Tab. 2. Numbers of the different age groups (rhythm test and FCR)

Age range	Boys	Girls	Total
[3years; 4years]	3	3	6
[4years; 5years]	12	18	30
[5years; 6years]	21	15	36
Total	36	36	72

METHODS

1. Bell test

The bell test (El Azmy *et al.* 2014) was designed to assess attentional abilities and visual hemineglect (Gauthier *et al.* 1989; Vanier *et al.* 1990). This is a sheet that contains 315 small drawings including 35 bells. The participant is asked to circle all the bells on the sheet without wasting time.

During the bells test, the patient is asked to circle in pen the 35 bells contained on an A4 sheet. All miniatures are in black (Halligan & Marshall 1989; Bergego *et al.* 1995). This sheet is placed in front of the patient.

In this test, three main variables were treated: the total omissions (left, right and central), the difference of left and right omissions (OG – OD) and the administration time.

2. Complex Rey figure

This test was designed to assess visual-constructive skills and visual episodic memory (Eloirdi *et al.* 2021). The procedure consists of presenting the participant with a figure comprising numerous details which he must copy as exactly as possible (Wallon & Messmin 2009). Then, the examinee must reproduce from memory the figure he has just copied. The examinee is not warned in advance that the drawing will have to be done from memory, which makes it possible to evaluate incidental learning.

3. Finger tapping test

The impeller is a device designed to standardize the taps of the finger, performed on its sensitive metal surface, into identical pulses which it transmits to a computer (Graff & El Methni 2011). It also has an input compatible with TTL signals (Transistor-transistor logic) or with a standard switch (open/closed circuit).

The computer to which the impeller is connected contains specialized “Jade” software. On the one hand, this software allows you to capture the rhythm in a classic raw format used for recording sound (.WAV file format). Jade also makes it possible to reduce the rhythm of the pulses produced to a series of intervals between successive pulses. The duration of the

Tab. 1. Numbers of the different age groups (bell test)

Age range	Boys	Girls	Total
[3years; 4years]	9	9	18
[4years; 5years]	21	27	48
[5years; 6years]	27	24	51
Total	57	60	117

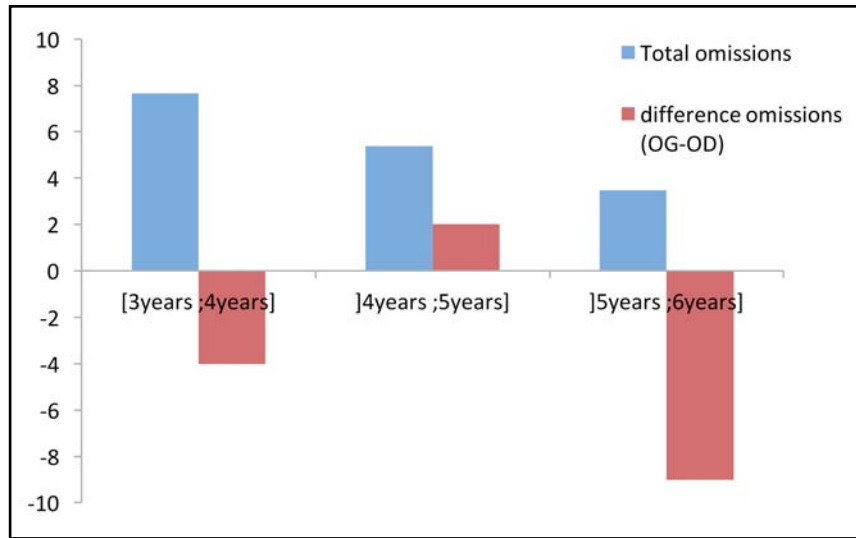


Fig. 1. Average of total omissions and differences in omissions according to age groups

inter-pulse intervals (or IPI for Inter-Pulse Interval), measured in milliseconds, is digitized and can be saved in a particular format (File.DAT) (Graff *et al.* 2009).

RESULTS

Bell test

In general; The percentage of children suspected of having heminegligence is thus 17.9%, or 21/117;

The children having forgotten bells on the left present a right heminegligence, the children having forgotten bells on the right present a left heminegligence;

63/117 children studied obtained a negative score during the OG-OD calculation. The omissions being discreetly more important on the right;

Results by age groups

The graph below illustrates the variation in the average of total omissions according to age groups.

This figure shows an influence of age on the total omissions of bells; the number of omissions decreases

with age. This result can be explained by a relative immaturity which recovers with age.

Results by gender

The negative difference in omissions (OG-OD) indicates that there are more omissions on the right in both sexes (-6 for boys and -5 for girls).

This figure shows that the total omissions of bells are greater in boys than in girls.

On the other hand, the passing time does not seem to differ according to age and gender.

Rey complex figure test

To assess attentional and memory status in children using the RCF test, percentile analysis is used. Percentiles less than 25% at the copying or reproduction level indicate attention or memory deficit. Percentiles above 75%, on the other hand, indicate significant attentional and memory performance.

For attention at copy, 51 children have percentiles less than 25%. At reproduction, only 3 children have

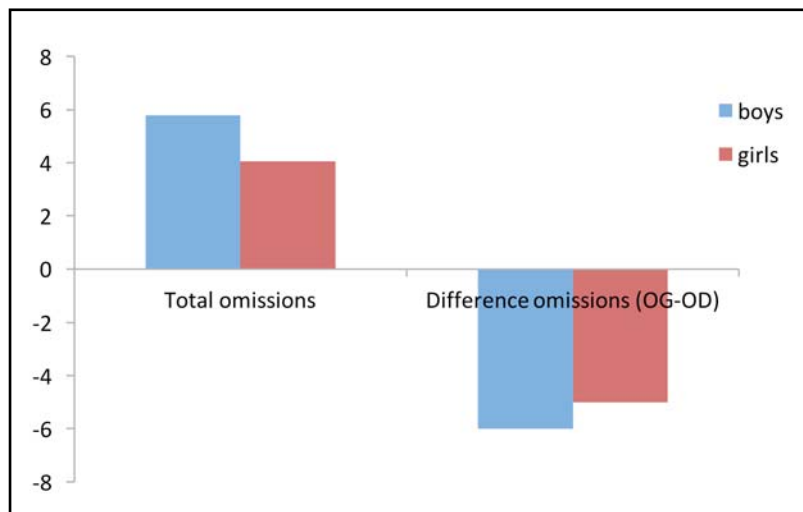


Fig. 2. Average of total omissions and differences in omissions by gender

a percentile less than 25%. This result shows a very significant attention deficit in the children studied.

Tab. 3. Results for the entire sample

For the general population	
Average copy	21,29
Average reproduction	16,08
Median copy	21
Median reproduction	16
Standard deviation copy	4,94
Standard deviation reproduction	4,33

Comparing these results with the calibration:

4 years :

- The copy and reproduction averages are much higher than the calibration values (20.5 and 14.5 against 8.8 and 6.1);
- The copy and reproduction medians are much higher than the calibration values (20 and 15 against 9.5 and 5).

5 years

- The copy and reproduction averages are almost equal to the calibration values (20.9 and 14.7 versus 20 and 14.9).
- Same remark for the medians (22.5 and 14 against 20.3 and 15).

6 years

- The copy and reproduction averages are slightly lower compared to the calibration values (22 and 18.1 versus 24.2 and 20.1).
- Same remark for the medians (21 and 18 against 26.3 and 21.5).

By comparing these results with the calibration values, we see that the children who passed the test take much longer to copy and reproduction.

Finger Tapping test

Our study is descriptive on a population of preschool children.

We find a good verification of Stevens' law (full form of Weber's law) with an R^2 of 0.63 which is very strong, and few outliers upwards, which is a sign of good prior data processing.

This figure shows a clearer change in the median IPIs at normal cadence in the 2nd trial than in the 1st trial. The values in N2 being greater than those in N1, the children take longer in the 2nd attempt and the normal pace becomes slower.

Precision and regularity of rhythms according to age

Calculations were made using the median and minimum coefficients of variation (standard deviation/sequence mean) per subject because they are less sensitive to outliers than the mean. By analyzing the regularity estimated by the coefficient of variation according to the dates of birth, we obtained the following results.

These results show no expected effect of age on the precision/regularity estimated by the coefficient of variation.

Precision of the rhythms according to the tempos

The coefficient of variation (standard deviation/mean of the sequence) is the parameter estimating the precision and regularity of the rhythms. The study of this parameter for the different cadences studied gives us the following results.

These results suggest a general regularity, with a better tendency for regularity at faster tempos.

The cadences, estimated by the median of the IPIs, are higher for the slow and very slow tempos, lower for the fast and very fast tempos.

GENERAL DISCUSSION

The bell test is a simple but highly effective tool. Bell test or bell test allowed us to diagnose 17% of hemineglect children in preschool, which is alarming for health and schooling, specifying that a study carried out in school children showed a percentage of 5.88% in school children (El Azmy *et al.* 2014).

The children studied are arabic speakers and only write arabic (therefore writing from right to left). In the children studied, we find that 54 out of 117 surround

Tab. 4. Copy and reproduction scores according to age

By age group, according to scores				
Age	3 ans	4 ans	5 ans	6 ans
Average copy	-	20,5	20,9	22
Average reproduction	-	14,5	14,7	18,1
Median copy	-	20	22,5	21
Median reproduction	-	15	14	18
Standard deviation copy	-	3,31	6,64	3,71
Standard deviation reproduction	-	5,5	4	3,75

Tab. 5. Duration of execution by age

Depending on the execution time				
Age	3 ans	4 ans	5 ans	6 ans
Average copy	-	154	127,3	123,5
Average reproduction	-	248,75	106,4	81,5
Median copy	-	123,5	100	128,5
Median reproduction	-	110,5	70,5	80
Standard deviation copy	-	113	74,7	45,05
Standard deviation reproduction	-	322	89,75	27,5

a bell located on the right. This means that more than half of children who write from right to left begin by circling a bell on the left, which is abnormal.

Children who have forgotten more than 6 bells on the right or on the left may present with right or left hemineglect depending on the situation of the forgotten bells. This could be due to lesions of the brain regions involved in attentional processes or an alteration of their normal development.

The bell test also allows us to evaluate the strategy by numbering the circled bells in order. This gives us an idea of the way or the strategy followed by the child to accomplish this task (organized from right to left, from left to right, random). It is difficult to study the

strategy through the paper version of the bell test, however it can be well studied by the computerized version of the bell test.

The FCR test exists in two forms: simple (on paper) and computerized using a digital pen (ELIAN). Also, two FCR are available depending on the age group: FCR-A and FCR-B, the FCR-B being the simplified form intended for children aged 6 and under. The version used in this study is the FCR on paper simplified form. This test provides very important information on the child's neurocognitive abilities, including attentional and memory abilities.

The results for visual perception and visual episodic memory showed that the average copying score was

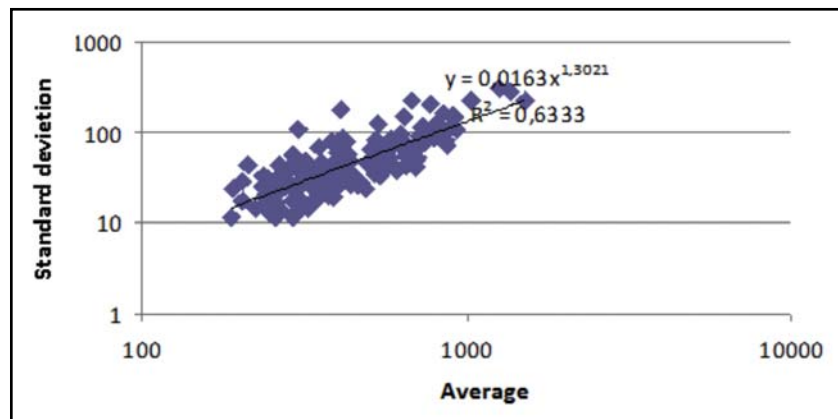


Fig. 3. Stevens law for the sample of children studied

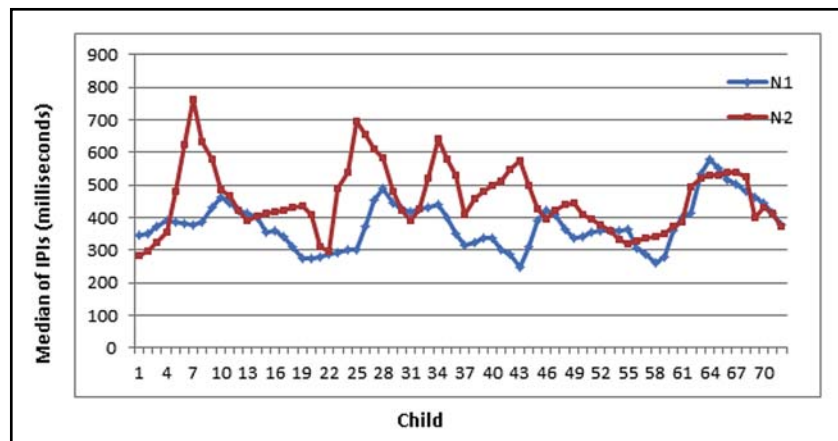


Fig. 4. Comparison between the normal cadences in the first pass (N1) and in the second pass (N2)

higher than average reproduction score. This result is consistent with results reported by (Wallon & Messmin 2009; Alice 2012).

The results obtained, which are alarming and serious in terms of health and education, may have an explanation other than attention deficit; children did not follow regular drawing activities in kindergarten. This can influence the results, especially the execution time and the precision and clarity of the shape of the drawn objects.

The descriptive study of motor rhythmicity reveals a reduced age effect on the regularity and precision of slow and fast rhythms. In general, this regularity proved to be clearer at the fastest tempos, results that correlate with a similar study done on primary school children (Graff & El Methni 2011); they thus differ from adults, who perform better around the "normal" tempos N1 and N2 (Graff *et al.* 2006).

On another side, the study of the two normal cadences shows that this cadence becomes slower from the 1st attempt to the 2nd. This can be explained by the effect of the other tempos carried out between the two sessions N1 and N2, or even by the simple fact that young children begin to feel tired following the passing

of the different rhythms (even if short pauses between the sessions).

The comparison between the results of the three tests shows that children suspected of presenting heminegligence have normal values for slow and fast rhythms. However, the coefficient of variation evaluating the regularity of the rhythms is high (15%, 18%), which means a low regularity of slow and fast rhythms.

The results of the F.C.R correlates with the results of the finger-tapping; Indeed, children with high attentional performance (percentile > 75%) have low coefficients of variation (between 8% and 10%), therefore better regularity and precision of rhythms.

Also, the Bell test and the F.C.R show a correlation. Indeed, children with heminegligence have very low percentiles (16%, 10%), which means severe attention deficit.

The evaluation of the execution time and its exploit in the analysis of the results, in particular those of the test of the bells, is largely neglected (normal time can go up to 20 minutes), while time is an essential criterion given its possible involvement in the study of psychomotricity; for example, six children studied took a long time with a very slow execution speed and presented

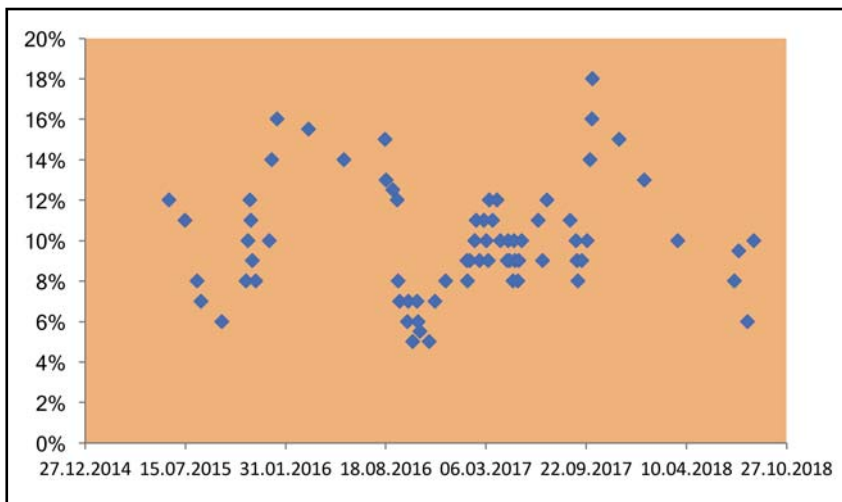


Fig. 5. Distribution of the medians of the coefficient of variation by age of child

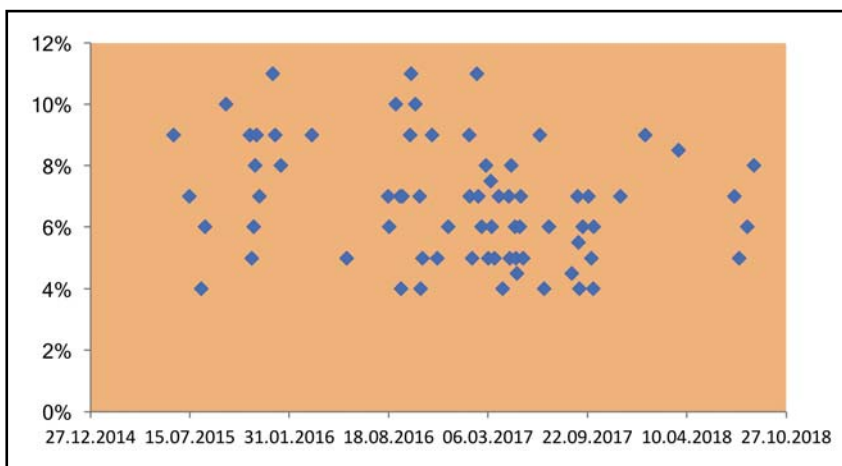


Fig. 6. Distribution of the minimum coefficient of variation by age of child

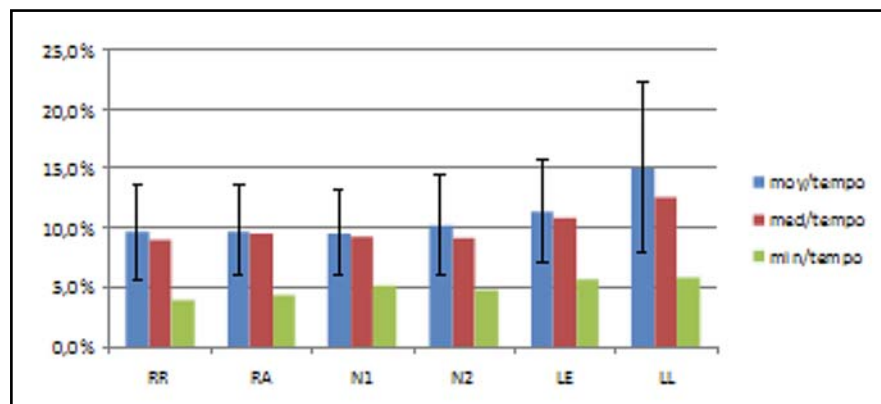


Fig. 7. Distribution of the minimum coefficient of variation by age of child

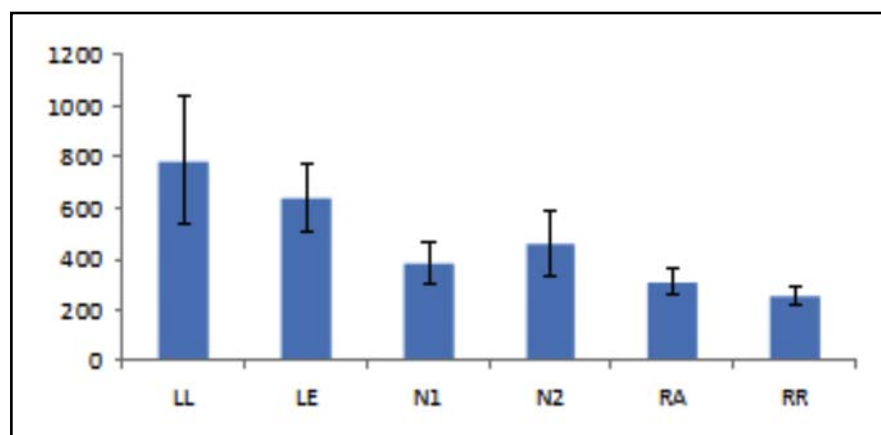


Fig. 8. Distribution of the minimum coefficient of variation by age of child

poor control of the pen (two children). Unfortunately, we could not pass the test of the rhythms to these children because of their refusal to pass it.

CONCLUSION AND PERSPECTIVES

The present study carried out on a population of 117 preschool children from the city of Khemisset allowed us to reveal an attention deficit in the preschool children studied (17% hemineglect, 51 children among 72 present a possible attention deficit, which reflects the seriousness of the situation).

Also, the results of the different tests do not present any contradictions, the children found to be hemineglect according to the bells test present a serious attention deficit according to the F.C.R test, which reinforces and confirms the results thus obtained.

The study of motor rhythmicity shows a better regularity and precision of rhythms in children with better performance of attention, however, children suspected of attention deficit produce rhythms of low regularity.

The establishment of a calibration on a national scale is to be hoped for as well as collaboration between the Ministry of Health and the Ministry of National Education with the aim of implementing a strategy for the early detection and remediation of psychomotor and attentional disorders in order to ensure quality health and education.

ACKNOWLEDGEMENT

The authors declare that there are no relevant financial interests in this manuscript.

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