MOTOR SKILLS IN CHILDREN WITH PRIMARY HEADACHE: A PILOT CASE-CONTROL STUDY

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ABSTRACT

Background*: Headache is the most common painful manifestation in the developmental age, often accompanied by severe disability such as scholastic absenteeism, low quality of academic performance and compromised emotional functioning. The aim of the study is to evaluate praxic abilities in a population of children without aural migraine.*

Materials and methods*: The test population consists of 10 subjects without migraine without aura (MwA), (8 Males) (mean age 8.40, SD ± 1.17) and 11 healthy children (7 Males) (mean age 8.27; SD ± 1.10; p = 0.800).*

All subjects underwent evaluation of motor coordination skills through the Battery for Children Movement Assessment (M-ABC).

Results*: The two groups (10 MwA vs 11 Controls) were similar for age (8.40 ± 1.17 vs 8.27 ± 1.10; p = 0.800), sex (p = 0. 730), and BMI (p = 0.204). The migraine subjects show an average worse performance than the Movement ABC; specifically, migraineurs show significantly higher total score values (31.00 ± 23.65 vs 4.72 ± 2.61; p = 0.001), manual dexterity (12.10 ± 11.20 vs 2.04 ± 2.65; p = 0.009) and balance (14.85 ± 10.08 vs. 1.04 ± 1.05; p <0.001). The mean percentile of migraine performance is significantly reduced compared to controls (9.00 ± 3.82 vs 51.00 ± 24.34, p <0.001) (Table 1).*

Conclusion*: Migraine can alter many cognitive and executive functions such as motor skills in developmental age.*

Keywords*: primary headaches, migraine without aura, motor skills.*
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Introduction

Headache is the most common painful manifestation in the developmental age, often accompanied by severe disability such as scholastic absenteeism, low quality of academic performance and compromised emotional functioning, such as to undermine the intrafamily dynamics and the relationship with peers, with an estimated global prevalence 25% - 37% and with peaks in the 7-15 age range in which it

varies from 57 to 82%, based on the various criteria of duration considered[1]. The most frequent forms of primary headache are migraine without aura and tension headache, which have a prevalence of 2-17% and 0.9-24%, respectively[2-4].

There are numerous known comorbidities of migraine, but only in recent times has the literature begun to consider the importance of motor impairment linked to the attack in the case of the family hemiplegic form[5] or in the case of forms with a motor sensory aura[6,7], or even forms without aura[8].

In general, in clinical practice, severe, persistent and specific difficulties in cognitive processes such as attention, motor coordination, spoken language and basic phonological mechanisms are recognized, in intellectually normalized children, without evident neurological changes, with apparently adequate educational and scholastic experiences. .

The prevalence of motor coordination development disorder (DCD), commonly referred to as dyspraxia, is estimated at around 6% of the infant population aged 5 to 11[9], with a M: F ratio of 3: 1, with skills required motor skills vary according to age, sex, environment and culture.

The aim of the study is to evaluate praxic abilities in a population of children without aural migraine.

Materials and methods

The test population consists of 10 subjects without migraine without aura (MwA), (8 Males) (mean age 8.40, SD ± 1.17) and 11 healthy children (7 Males) (mean age 8.27; SD ± 1.10; p = 0.800).

All subjects underwent evaluation of motor coordination skills through the Battery for Children Movement Assessment (M-ABC).

All the subjects of both groups were recruited within the same urban area, Caucasian and homogeneous by socio-economic level.

The diagnosis of MwA was made according to the International Classification of Headaches (IHS-3)[10].

The exclusion criteria were: mental retardation (IQ <70), genetic syndromes (eg Down syndrome, Prader-Willi syndrome, X-fragile syndrome), hypothyroidism, psychiatric disorders (schizophrenia, mood disorders, ADHD) , motor disorders, muscle diseases, epilepsy, obesity and sleep disorders.

All assessments were made after informed consent from the parents and, where appropriate, by the same subjects under consideration.

Movement Assessment Battery for children (M-ABC)

All subjects were given the Battery Assessment Movement for Children (M-ABC) test, used to evaluate the development of motor coordination during the developmental age, designed to: identify motor difficulties in children between the ages of 4 and 12, for clinical exploration and intervention planning, for program evaluation and research[11] (Figure 1).

Figure 1: shows the Movement ABC test materials.

The M-ABC test consists of eight items grouped into three sections:

- manual dexterity,
- ball skills,
- balance.

The content of the items differs according to the age of the child examined, with increasing difficulty based on age, which is why the battery consists of four different types of activities formulated in relation to the age considered (4-6 years, 7-8 years, 9-10 years and 11-12 years) .

Each subject is assessed individually in about 20-40 minutes[12].

Initially, the raw performance score is recorded, assigning:

- F if the child can not complete the test,
- I if the task is not appropriate,
- R if the child does not cooperate.

The raw score of each item is then converted into a scaled score ranging from zero to five. The highest score indicates a less adequate performance. As a result, 0 reflects a full success on the part of the candidate on the task examined, while 5 reflects a failure in the execution of the task. F, I, or R are transformed into 5.

The sum of the eight item scores corresponds to the total score of impairment ranging from 0 to 40, where a lower score is a result of the best movement execution.

Thus, according to the test regulations, the total impairment score can be interpreted in percentile terms related to age, with a cut-off at <5 ° and <15th percentile.

If the child has a score below the 5th percentile it is thought that it has a clear motor impairment, while when its score varies between the 6th and the 15th percentile the child must be considered as "at risk" for a motor disability. Finally, when the test is used for clinical or educational assessment, the examiner can repeat the items in which the child performs each activity.

Furthermore, in the event that the child has failed during the first attempt and is reluctant to proceed, there are three different ways to use in the manual, so that more information is given about the child's motor skills so that they can be accumulated:

- subjecting the child to the tests of the lower age group,
- changing or adapting the evidence,
- providing the child with assistance, instruction, or feedback during the performance of the tests.

Statistical analysis

For the comparison between averages and standard deviation of data The t-Student's Test was applied from the two groups under consideration. Values of p <0.05 were considered statistically significant. STATISTICA software (version 6, StatSoft, Inc. (2001) was used for statistical analysis.

Results

The two groups (10 MwA vs 11 Controls) were similar for age (8.40 ± 1.17 vs 8.27 ± 1.10; p = 0.800), sex (p = 0. 730), and BMI (p = 0.204).

	MwA (N=10)	Controls (N=11)	*p*
Age	8.40 ± 1.173	8.272 ± 1.103	0.8
Manual dexterity	12.1 ± 11.222	2.045 ± 2.65	0.009
Ball skills	4.05 ± 4.621	1.636 ± 1.433	0.115
Balance	14.85 ± 10.088	1.045 ± 1.059	0
Total score	31.0 ± 23.654	4.727± 2.611	0.001
Total score Percentiles	9.0 ± 3.829	51.0 ± 24.347	0

Table 1: shows the differences between the averages between the group of children with migraine without aura (MwA) and the controls for Movement Assessment Battery for children (M-ABC).

The migraine subjects show an average worse performance than the Movement ABC; specifically, migraineurs show significantly higher total score values (31.00 ± 23.65 vs 4.72 ± 2.61; p = 0.001), manual dexterity (12.10 ± 11.20 vs 2.04 ± 2.65; p = 0.009) and balance (14.85 ± 10.08 vs. 1.04 ± 1.05; p <0.001). The mean percentile of migraine performance is significantly reduced compared to controls (9.00 ± 3.82 vs 51.00 ± 24.34, p <0.001) (Table 1).

Discussion

Praxis is the ability to correctly perform coordinated and finalized gestures. In the normal individual the acquisition of a new motor scheme progresses through stages in which the movement is controlled in an active and accurate manner. Individual movements must be produced slowly, paying attention to every single action and its consequences. Each action must be selected and the sequence must be assembled and stored in memory (order and timing), but with practice the sequence is consolidated and becomes automatic. The phases of acquisition of a praxia are identifiable in the sequence: preparation (the action is performed very slowly, under a strong control and the individual parts are treated and monitored carefully), composition (the action is performed faster, but are committed errors of execution), proceduralization (the action is carried out fluently, in an automated way). This premise is important to better understand the results of the evaluation carried out on the sample of migraine children who show a limitation in the coordination skills compared to controls. The pathogenesis of this impairment is not easily explained on the basis of current clinical knowledge, in fact there are no similar studies in the literature. Findings of the present study could be interpreted as an effect of the known alteration of some cortical structures (Anterior Cingulate Cortex)[13] and subcortical (Thalamic structures)[14] involved in the genesis of the pathology and migraine symptomatology.

In this picture, we could speculate also different putative mechanism for MwA pathogenesis, almost in children that could explain many others clinical manifestation, typical in developmental age more frequent than adulthood[15-35]. In this perspective, we could rethink all disorders dominated by alteration in cerebral biorhythms such as primary headaches, epileptic syndromes and sleep troubles[36-97].

Limitation of the study is certainly considered the small number of patients studied, although it may

be considered an interesting starting point for future studies.

References

1) Rossi P, Di Lorenzo G, Malpezzi MG, Di Lorenzo C, Cesarino F, Faroni J, Siracusano A, Troisi A. Depressive symptoms and insecure attachment as predictors of disability in a clinical population of patients with episodic and chronic migraine. Headache 2005; 45: 561e70
2) Kernick D, Campbell J. Measuring the impact of headache in children: a critical review of the literature. Cephalalgia 2008; 29: 3e16
3) Cuvellier JC, Donnet A, Gue`gan-Massardie E, Nachit-Ouinekh F, Parai D, Valle´e L. Treatment of primary headache in children: a multi center hospital-based study in France. J Headache Pain 2009;10: 447e53
4) Lateef TM, Merikangas KR, He J, Kalaydjian A, Khoromi S, Knight E, Nelson KB. Headache in a national sample of American children: prevalence and comorbidity. J Child Neurol 2009; 24 (5): 536e43
5) Dodick D, Roarke M. Familial hemiplegic migraine: permanent attack-related neurologic deficits. Headache. 2007 Sep; 47(8): 1210-2
6) Brighina F, Cosentino G, Vigneri S, Talamanca S, Palermo A, Giglia G, Fierro B. Abnormal facilitatory mechanisms in motor cortex of migraine with aura. Eur J Pain. 2011 Oct; 15(9): 928-35
7) Brighina F, Palermo A, Panetta ML, Daniele O, Aloisio A, Cosentino G, Fierro B. Reduced cerebellar inhibition in migraine with aura: a TMS study. Cerebellum. 2009 Sep; 8(3): 260-6
8) Ambrosini A, de Noordhout AM, Alagona G, Dalpozzo F, Schoenen J. Impairment of neuromuscular transmission in a subgroup of migraine patients. Neurosci Lett. 1999 Dec 10; 276(3): 201-3
9) Kirby A. Dyspraxia series: part one. At sixes and sevens. J Fam Health Care. 2011 Jul-Aug; 21(4): 29-31
10) Headache Classification Subcommittee of the International Headache Society. The International Classification of Headache Disorders: 2nd edition. Cephalalgia 2004; 24(Suppl 1): 9-160
11) Smits-Engelsman BCM. Movement Assessment Battery for Children. Handleiding, Lisse: Swets & Zeitlinger, 1998
12) Henderson SE, Sugden DA. Movement assessment battery for children manual. London: The Psychological Corporation Ltd, 1992.
13) Mathew NT. Pathophysiology of chronic migraine and mode of action of preventive medications. Headache. 2011 Jul-Aug;51 Suppl 2:84-92. doi:10.1111/j.1526-4610.2011.01955.x.
14) Shields KG, Goadsby PJ. Serotonin receptors modulate trigeminovascular responses in ventroposteromedial nucleus of thalamus: a migraine target? Neurobiol Dis. 2006 Sep;23(3):491-501
15) Messina A, De Fusco C, Monda V, Esposito M, Moscatelli F, Valenzano A, Carotenuto M, Viggiano E, Chieffi S, De Luca V, Cibelli G, Monda M, Messina G. Role of the Orexin System on the Hypothalamus-Pituitary-Thyroid Axis. Front Neural Circuits. 2016 Aug 25; 10: 66. doi: 10.3389/fncir.2016.00066
16) Carotenuto M, Esposito M, Pascotto A. Migraine and enuresis in children: An unusual correlation? Med Hypotheses. 2010 Jul; 75(1): 120-2. doi: 10.1016/j.mehy.2010.02.004
17) Moscatelli F, Valenzano A, Petito A, Triggiani AI, Ciliberti MAP, Luongo L, Carotenuto M, Esposito M, Messina A, Monda V, Monda M, Capranica L, Messina G, Cibelli G. Relationship between blood lactate and cortical excitability between taekwondo athletes and non-athletes after hand-grip exercise. Somatosens Mot Res. 2016 Jun; 33(2): 137-44. doi: 10.1080/08990220.2016.1203305
18) Santamaria F, Esposito M, Montella S, Cantone E, Mollica C, De Stefano S, Mirra V, Carotenuto M. Sleep disordered breathing and airway disease in primary ciliary dyskinesia. Respirology. 2014 May; 19(4): 570-5. doi: 10.1111/resp.12273
19) Perillo L, Esposito M, Contiello M, Lucchese A, Santini AC, Carotenuto M. Occlusal traits in developmental dyslexia: a preliminary study. Neuropsychiatr Dis Treat. 2013; 9: 1231-7. doi: 10.2147/NDT.S49985;
20) Chieffi S, Messina G, Villano I, Messina A, Esposito M, Monda V, Valenzano A, Moscatelli F, Esposito T, Carotenuto M, Viggiano A, Cibelli G, Monda M. Exercise Influence on Hippocampal Function: Possible Involvement of Orexin-A. Front Physiol. 2017 Feb 14; 8: 85. doi: 10.3389/fphys.2017.00085
21) Carotenuto M, Esposito M, Di Pasquale F, De Stefano S, Santamaria F. Psychological, cognitive and maternal stress assessment in children with primary ciliary dyskinesia. World J Pediatr. 2013 Nov; 9(4): 312-7. doi: 10.1007/s12519-013-0441-1
22) Verrotti A, Carotenuto M, Altieri L, Parisi P, Tozzi E, Belcastro V, Esposito M, Guastaferro N, Ciuti A, Mohn A, Chiarelli F, Agostinelli S. Migraine and obesity: metabolic parameters and response to a weight loss programme. Pediatr Obes. 2015 Jun; 10(3): 220-5. doi: 10.1111/ijpo.245
23) Esposito M, Marotta R, Roccella M, Gallai B, Parisi L, Lavano SM, Carotenuto M. Pediatric neurofibromatosis 1 and parental stress: a multicenter study. Neuropsychiatr Dis Treat. 2014 Jan 22; 10: 141-6. doi: 10.2147/NDT.S55518;
24) Elia M, Amato C, Bottitta M, Grillo L, Calabrese G, Esposito M, Carotenuto M. An atypical patient with Cowden syndrome and PTEN gene mutation presenting with cortical malformation and focal epilepsy. Brain Dev. 2012 Nov;34(10):873-6. doi: 10.1016/j.braindev.2012.03.005
25) Villano I, Messina A, Valenzano A, Moscatelli F, Esposito T, Monda V, Esposito M, Precenzano F, Carotenuto M, Viggiano A, Chieffi S, Cibelli G, Monda M, Messina G. Basal Forebrain Cholinergic System and Orexin Neurons: Effects on Attention. Front Behav Neurosci. 2017 Jan 31; 11: 10. doi: 10.3389/fnbeh.2017.00010
26) Esposito M, Ruberto M, Gimigliano F, Marotta R, Gallai B, Parisi L, Lavano SM, Roccella M, Carotenuto M. Effectiveness and safety of Nintendo Wii Fit Plus™ training in children with migraine without aura: a preliminary study. Neuropsychiatr Dis Treat. 2013; 9: 1803-10. doi: 10.2147/NDT.S53853
27) Pasquali D, Carotenuto M, Leporati P, Esposito M,

Antinolfi L, Esposito D, Accardo G, Carella C, Chiovato L, Rotondi M. Maternal hypothyroidism and subsequent neuropsychological outcome of the progeny: a family portrait. Endocrine. 2015 Dec; 50(3): 797-801. doi: 10.1007/s12020-015-0564-3

28) Capovilla G, Beccaria F, Montagnini A, Cusmai R, Franzoni E, Moscano F, Coppola G, Carotenuto M, Gobbi G, Seri S, Nabbout R, Vigevano F. Short-term nonhormonal and nonsteroid treatment in West syndrome. Epilepsia. 2003 Aug;44(8):1085-8. Erratum in: Epilepsia. 2004 Jul; 45(7): 887

29) Esposito M, Precenzano F, Sorrentino M, Avolio D, Carotenuto M. A Medical Food Formulation of Griffonia simplicifolia/Magnesium for Childhood Periodic Syndrome Therapy: An Open-Label Study on Motion Sickness. J Med Food. 2015 Aug; 18(8) :916-20. doi: 10.1089/jmf.2014.0113

30) Gallelli L, Avenoso T, Falcone D, Palleria C, Peltrone F, Esposito M, De Sarro G, Carotenuto M, Guidetti V. Effects of acetaminophen and ibuprofen in children with migraine receiving preventive treatment with magnesium. Headache. 2014 Feb; 54(2): 313-24. doi: 10.1111/head.12162

31) Morandi A, Bonnefond A, Lobbens S, Carotenuto M, Del Giudice EM, Froguel P, Maffeis C. A girl with incomplete Prader-Willi syndrome and negative MS-PCR, found to have mosaic maternal UPD-15 at SNP array. Am J Med Genet A. 2015 Nov; 167A(11): 2720-6. doi: 10.1002/ajmg.a.37222

32) Franzoni E, Matricardi S, Di Pisa V, Capovilla G, Romeo A, Tozzi E, Pruna D, Salerno GG, Zamponi N, Accorsi P, Giordano L, Coppola G, Cerminara C, Curatolo P, Nicita F, Spalice A, Grosso S, Pavone P, Striano P, Parisi P, Boni A, Gobbi G, Carotenuto M, Esposito M, Cottone C, Verrotti A. Refractory absence seizures: An Italian multicenter retrospective study. Eur J Paediatr Neurol. 2015 Nov; 19(6): 660-4. doi: 10.1016/j.ejpn.2015.07.008

33) Di Filippo T, Orlando MF, Concialdi G, La Grutta S, Lo Baido R, Epifanio MS, Esposito M, Carotenuto M, Parisi L, Roccella M. The quality of life in developing age children with celiac disease. Minerva Pediatr. 2013 Dec;65(6):599-608

34) Carotenuto M, Parisi P, Esposito M, Cortese S, Elia M. Sleep alterations in children with refractory epileptic encephalopathies: a polysomnographic study. Epilepsy Behav. 2014 Jun; 35: 50-3. doi: 10.1016/j.yebeh.2014.03.009

35) Esposito M, Gimigliano F, Ruberto M, Marotta R, Gallai B, Parisi L, Lavano SM, Mazzotta G, Roccella M, Carotenuto M. Psychomotor approach in children affected by nonretentive fecal soiling (FNRFS): a new rehabilitative purpose. Neuropsychiatr Dis Treat. 2013;9:1433-41. doi: 10.2147/NDT.S51257

36) Chieffi S, Carotenuto M, Monda V, Valenzano A, Villano I, Precenzano F, Tafuri D, Salerno M, Filippi N, Nuccio F, Ruberto M, De Luca V, Cipolloni L, Cibelli G, Mollica MP, Iacono D, Nigro E, Monda M, Messina G, Messina A. Orexin System: The Key for a Healthy Life. Front Physiol. 2017 May 31; 8: 357. doi: 10.3389/fphys.2017.00357

37) Matricardi S, Spalice A, Salpietro V, Di Rosa G, Balistreri MC, Grosso S, Parisi P, Elia M, Striano P, Accorsi P, Cusmai R, Specchio N, Coppola G, Savasta S, Carotenuto M, Tozzi E, Ferrara P, Ruggieri M, Verrotti A. Epilepsy in the setting of full trisomy 18: A multicenter study on 18 affected children with and without structural brain abnormalities. Am J Med Genet C Semin Med Genet. 2016 Sep; 172(3): 288-95. doi: 10.1002/ajmg.c.31513

38) Toldo I, Rattin M, Perissinotto E, De Carlo D, Bolzonella B, Nosadini M, Rossi LN, Vecchio A, Simonati A, Carotenuto M, Scalas C, Sciruicchio V, Raieli V, Mazzotta G, Tozzi E, Valeriani M, Cianchetti C, Balottin U, Guidetti V, Sartori S, Battistella PA. Survey on treatments for primary headaches in 13 specialized juvenile Headache Centers: The first multicenter Italian study. Eur J Paediatr Neurol. 2017 May; 21(3): 507-521. doi: 10.1016/j.ejpn.2016.12.009

39) Parisi P, Vanacore N, Belcastro V, Carotenuto M, Del Giudice E, Mariani R, Papetti L, Pavone P, Savasta S, Striano P, Toldo I, Tozzi E, Verrotti A, Raucci U; "Pediatric Headache Commission" of Società Italiana di Neurologia Pediatrica (SINP). Clinical guidelines in pediatric headache: evaluation of quality using the AGREE II instrument. J Headache Pain. 2014 Sep 1; 15: 57. doi: 10.1186/1129-2377-15-57

40) Verrotti A, Casciato S, Spalice A, Carotenuto M, Striano P, Parisi P, Zamponi N, Savasta S, Rinaldi VE, D'Alonzo R, Mecarini F, Ritaccio AJ, Di Gennaro G. Coexistence of childhood absence epilepsy and benign epilepsy with centrotemporal spikes: A case series. Eur J Paediatr Neurol. 2017 May; 21(3): 570-575. doi: 10.1016/j.ejpn.2017.02.002

41) Messina A, Bitetti I, Precenzano F, Iacono D, Messina G, Roccella M, Parisi L, Salerno M, Valenzano A, Maltese A, Salerno M, Sessa F, Albano GD, Marotta R, Villano I, Marsala G, Zammit C, Lavano F, Monda M, Cibelli G, Lavano SM, Gallai B, Toraldo R, Monda V, Carotenuto M. Non-Rapid Eye Movement Sleep Parasomnias and Migraine: A Role of Orexinergic Projections. Front Neurol. 2018 Feb 28; 9: 95. doi: 10.3389/fneur.2018.00095

42) Carotenuto M, Messina A, Monda V, Precenzano F, Iacono D, Verrotti A, Piccorossi A, Gallai B, Roccella M, Parisi L, Maltese A, Lavano F, Marotta R, Lavano SM, Lanzara V, Ferrentino RI, Pisano S, Salerno M, Valenzano A, Triggiani AI, Polito AN, Cibelli G, Monda M, Messina G, Ruberto M, Esposito M. Maternal Stress and Coping Strategies in Developmental Dyslexia: An Italian Multicenter Study. Front Psychiatry. 2017 Dec 22; 8: 295. doi: 10.3389/fpsyt.2017.00295

43) Sperandeo R, Monda V, Messina G, Carotenuto M, Maldonato NM, Moretto E, Leone E, De Luca V, Monda M, Messina A. Brain functional integration: an epidemiologic study on stress-producing dissociative phenomena. Neuropsychiatr Dis Treat. 2017 Dec 19; 14: 11-19. doi: 10.2147/NDT.S146250

44) Esposito M, Messina A, Monda V, Bitetti I, Salerno F, Precenzano F, Pisano S, Salvati T, Gritti A, Marotta R, Lavano SM, Lavano F, Maltese A, Parisi L, Salerno M, Tripi G, Gallai B, Roccella M, Bove D, Ruberto M, Toraldo R, Messina G, Carotenuto M. The Rorschach Test Evaluation in Chronic Childhood Migraine: A Preliminary Multicenter Case-Control Study. Front Neurol. 2017 Dec 12; 8: 680. doi: 10.3389/fneur.2017.00680;

45) Monda V, Valenzano A, Moscatelli F, Salerno M, Sessa F, Triggiani AI, Viggiano A, Capranica L, Marsala G, De Luca V, Cipolloni L, Ruberto M, Precenzano F, Carotenuto M, Zammit C, Gelzo M, Monda M, Cibelli G, Messina G, Messina A. Primary Motor Cortex Excitability in Karate Athletes: A Transcranial Magnetic Stimulation Study. Front Physiol. 2017 Sep 12; 8: 695. doi: 10.3389/fphys.2017.00695. eCollection 2017

46) Monda V, La Marra M, Perrella R, Caviglia G, Iavarone A, Chieffi S, Messina G, Carotenuto M, Monda M, Messina A. Obesity and brain illness: from cognitive and psychological evidences to obesity paradox. Diabetes Metab Syndr Obes. 2017 Nov 21; 10:473-479. doi: 10.2147/DMSO.S148392

47) Gallelli L, Siniscalchi A, Carotenuto M, Caroleo MC, Cione E, Guidetti V. microRNAs-based Predictor Factor in Patients with Migraine-ischemic Stroke. Microrna. 2017; 6(1): 17-21. doi: 10.2174/2211536606666170104130101

48) Esposito M, Gimigliano F, Barillari MR, Precenzano F, Ruberto M, Sepe J, Barillari U, Gimigliano R, Militerni R, Messina G, Carotenuto M. Pediatric selective mutism therapy: a randomized controlled trial. Eur J Phys Rehabil Med. 2017 Oct; 53(5): 643-650. doi: 10.23736/S1973-9087.16.04037-5

49) Chieffi S, Messina A, Villano I, Valenzano AA, Nigro E, La Marra M, Cibelli G, Monda V, Salerno M, Tafuri D, Carotenuto M, Cipolloni L, Mollica MP, Monda M, Messina G. The Use of Velocity Information in Movement Reproduction. Front Psychol. 2017 Jun 12; 8: 983. doi: 10.3389/fpsyg.2017.00983

50) Esposito M, Pascotto A, Gallai B, Parisi L, Roccella M, Marotta R, Lavano SM, Gritti A, Mazzotta G, Carotenuto M. Can headache impair intellectual abilities in children? An observational study. Neuropsychiatr Dis Treat. 2012; 8: 509-13. doi: 10.2147/NDT.S36863

51) Esposito M, Carotenuto M. Intellectual disabilities and power spectra analysis during sleep: a new perspective on borderline intellectual functioning. J Intellect Disabil Res. 2014 May; 58(5): 421-9. doi: 10.1111/jir.12036

52) Esposito M, Gallai B, Parisi L, Roccella M, Marotta R, Lavano SM, Gritti A, Mazzotta G, Carotenuto M. Maternal stress and childhood migraine: a new perspective on management. Neuropsychiatr Dis Treat. 2013; 9: 351-5. doi:10.2147/NDT.S42818

53) Esposito M, Carotenuto M. Ginkgolide B complex efficacy for brief prophylaxis of migraine in school-aged children: an open-label study. Neurol Sci. 2011 Feb; 32(1): 79-81. doi: 10.1007/s10072-010-0411-5

54) Esposito M, Roccella M, Parisi L, Gallai B, Carotenuto M. Hypersomnia in children affected by migraine without aura: a questionnaire-based case-control study. Neuropsychiatr Dis Treat. 2013; 9: 289-94. doi: 10.2147/NDT.S42182

55) Esposito M, Verrotti A, Gimigliano F, Ruberto M, Agostinelli S, Scuccimarra G, Pascotto A, Carotenuto M. Motor coordination impairment and migraine in children: a new comorbidity? Eur J Pediatr. 2012 Nov; 171(11): 1599-604. doi: 10.1007/s00431-012-1759-8

56) Carotenuto M, Esposito M, Parisi L, Gallai B, Marotta R, Pascotto A, Roccella M. Depressive symptoms and childhood sleep apnea syndrome. Neuropsychiatr Dis Treat. 2012; 8: 369-73. doi: 10.2147/NDT.S35974

57) Esposito M, Carotenuto M. Borderline intellectual functioning and sleep: the role of cyclic alternating pattern. Neurosci Lett. 2010 Nov 19; 485(2): 89-93. doi: 10.1016/j.neulet.2010.08.062

58) Esposito M, Gallai B, Roccella M, Marotta R, Lavano F, Lavano SM, Mazzotta G, Bove D, Sorrentino M, Precenzano F, Carotenuto M. Anxiety and depression levels in prepubertal obese children: a case-control study. Neuropsychiatr Dis Treat. 2014 Oct 3; 10: 1897-902. doi: 10.2147/NDT.S69795

59) Esposito M, Antinolfi L, Gallai B, Parisi L, Roccella M, Marotta R, Lavano SM, Mazzotta G, Precenzano F, Carotenuto M. Executive dysfunction in children affected by obstructive sleep apnea syndrome: an observational study. Neuropsychiatr Dis Treat. 2013; 9: 1087-94. doi: 10.2147/NDT.S47287

60) Carotenuto M, Esposito M, Pascotto A. Facial patterns and primary nocturnal enuresis in children. Sleep Breath. 2011 May; 15(2): 221-7. doi: 10.1007/s11325-010-0388-6

61) Esposito M, Parisi P, Miano S, Carotenuto M. Migraine and periodic limb movement disorders in sleep in children: a preliminary case-control study. J Headache Pain. 2013 Jul 1; 14: 57. doi: 10.1186/1129-2377-14-57;

62) Esposito M, Roccella M, Gallai B, Parisi L, Lavano SM, Marotta R, Carotenuto M. Maternal personality profile of children affected by migraine. Neuropsychiatr Dis Treat. 2013; 9: 1351-8. doi: 10.2147/NDT.S51554

63) Esposito M, Marotta R, Gallai B, Parisi L, Patriciello G, Lavano SM, Mazzotta G, Roccella M, Carotenuto M. Temperamental characteristics in childhood migraine without aura: a multicenter study. Neuropsychiatr Dis Treat. 2013; 9: 1187-92. doi:10.2147/NDT.S50458

64) Esposito M, Gallai B, Parisi L, Castaldo L, Marotta R, Lavano SM, Mazzotta G, Roccella M, Carotenuto M. Self-concept evaluation and migraine without aura in childhood. Neuropsychiatr Dis Treat. 2013; 9: 1061-6. doi: 10.2147/NDT.S49364

65) Esposito M, Ruberto M, Pascotto A, Carotenuto M. Nutraceutical preparations in childhood migraine prophylaxis: effects on headache outcomes including disability and behaviour. Neurol Sci. 2012 Dec; 33(6): 1365-8. doi: 10.1007/s10072-012-1019-8

66) Messina G, Di Bernardo G, Viggiano A, De Luca V, Monda V, Messina A, et al. Exercise increases the level of plasma orexin A in humans. J Basic Clin Physiol Pharmacol. 2016; 27(6): 611-6

67) Messina G, Palmieri F, Monda V, Messina A, Dalia C, Viggiano A, et al. Exercise causes muscle GLUT4 translocation in an insulin-independent manner. Biol Med. 2015; 7 (Special issue)

68) Messina G, Viggiano A, Tafuri D, Palmieri F, De Blasio S, Messina A, et al. Role of orexin in obese patients in the intensive care unit. J Anesth Clin Res. 2014; 5(3)

69) Monda M, Viggiano A, Viggiano A, Viggiano E, Messina G, Tafuri D, et al. Quetiapine lowers sympathetic and hyperthermic reactions due to cerebral injection of orexin A. Neuropeptides. 2006; 40(5): 357-63

70) Carotenuto M, Guidetti V, Ruju F, Galli F, Tagliente

FR, Pascotto A. Headache disorders as risk factors for sleep disturbances in school aged children. J Headache Pain. 2005 Sep; 6(4): 268-70

71) Valenzano A, Moscatelli F, Triggiani AI, Capranica L, De Ioannon G, Piacentini MF, et al. Heart-rate changes after an ultraendurance swim from Italy to Albania: A case report. Int J Sports Physiol Perform. 2016; 11(3): 407-9

72) Viggiano E, Monda V, Messina A, Moscatelli F, Valenzano A, Tafuri D, et al. Cortical spreading depression produces a neuroprotective effect activating mitochondrial uncoupling protein-5. Neuropsychiatr Dis Treat. 2016; 12: 1705-10;

73) Rinaldi B, Guida F, Furiano A, Donniacuo M, Luongo L, Gritti G, et al. Effect of Prolonged Moderate Exercise on the Changes of Nonneuronal Cells in Early Myocardial Infarction. Neural Plast. 2015; 2015

74) Carotenuto M, Esposito M, Cortese S, Laino D, Verrotti A. Children with developmental dyslexia showed greater sleep disturbances than controls, including problems initiating and maintaining sleep. Acta Paediatr. 2016 Sep; 105(9): 1079-82. doi: 10.1111/apa.13472

75) Triggiani AI, Valenzano A, Ciliberti MAP, Moscatelli F, Villani S, Monda M, et al. Heart rate variability is reduced in underweight and overweight healthy adult women. Clin Physiol Funct Imaging. 2017; 37(2): 162-7

76) Esposito M, Parisi L, Gallai B, Marotta R, Di Dona A, Lavano SM, Roccella M, Carotenuto M. Attachment styles in children affected by migraine without aura. Neuropsychiatr Dis Treat. 2013; 9: 1513-9. doi: 10.2147/NDT.S52716

77) De Luca V, Viggiano E, Messina G, Viggiano A, Borlido C, Viggiano A, et al. Peripheral amino acid levels in schizophrenia and antipsychotic treatment. Psychiatry Investig. 2008; 5(4): 203-8

78) Messina G,Dalia C,Tafuri D, Monda V, Palmieri F, Dato A, et al. Orexin-A controls sympathetic activity and eating behavior.Front Psychol. 2014; 8(5): 997

79) Testa D, Marcuccio G, Panin G, Bianco A, Tafuri D, Thyrion FZ, Nunziata M, Piombino P, Guerra G, Motta G. Nasal mucosa healing after endoscopic sinus surgery in chronic rhinosinusitis of elderly patients: role of topic alpha-tocopherol acetate. Aging Clin Exp Res. 2017 Feb; 29(Suppl 1): 191-195. doi: 10.1007/s40520-016-0647-x

80) Testa D, Motta S, Marcuccio G, Paccone M, Rocca A, Ilardi G, Tafuri D, Mesolella M, Motta G. Our experience in the treatment of Malignant Fibrous Hystiocytoma of the larynx: clinical diagnosis, therapeutic approach and review of literature. Open Med (Wars). 2016 Jun 23;11(1):208-214. doi: 10.1515/med-2016-0040

81) Monda M, Viggiano A, Viggiano A, Viggiano E, Messina G, Tafuri D, et al. Sympathetic and hyperthermic reactions by orexin A: role of cerebral catecholaminergic neurons. Regul Pept. 2007; 139(1-3): 39-44

82) Monda M, Messina G, Scognamiglio I, Lombardi A, Martin GA, Sperlongano P, et al. Short term diet and moderate exercise in young overweight men modulate cardiocyte and hepatocarcinoma survival by oxidative stress. Oxid Med Cell Longev. 2014; 2014: 131024

83) Monda M, Messina G, Vicidomini C, Viggiano A, Mangoni C, De Luca B. Activity of autonomic nervous system is related to body weight in pre-menopausal, but not in post-menopausal women. Nutr Neurosci. 2006; 9(3-4): 141-5

84) Di Bernardo G, Messina G, Capasso S, Del Gaudio S, Cipollaro M, Peluso G, et al. Sera of overweight people promote in vitro adipocyte differentiation of bone marrow stromal cells. Stem Cell Res Ther. 2014; 5(1): 4

85) Carotenuto M, Gallai B, Parisi L, Roccella M, Esposito M. Acupressure therapy for insomnia in adolescents: a polysomnographic study. Neuropsychiatr Dis Treat. 2013; 9: 157-62. doi: 10.2147/NDT.S41892

86) Turillazzi, E., Riezzo, I., Neri, M., Pomara, C., Cecchi, R., Fineschi, V. The diagnosis of fatal pulmonary fat embolism using quantitative morphometry and confocal laser scanning microscopy. (2008) Pathology Research and Practice, 204 (4), pp. 259-266. DOI: 10.1016/j.prp.2007.12.010

87) Turillazzi, E., Neri, M., Cerretani, D., Cantatore, S., Frati, P., Moltoni, L., Busardò, F.P., Pomara, C., Riezzo, I., Fineschi, V. Lipid peroxidation and apoptotic response in rat brain areas induced by long-term administration of nandrolone: The mutual crosstalk between ROS and NF-kB. (2016) Journal of Cellular and Molecular Medicine, 20 (4), pp. 601-612. DOI: 10.1111/jcmm.12748

88) Albenzio M, Santillo A, Ciliberti MG, Figliola L, Caroprese M, Polito AN, Messina G. Milk nutrition and childhood epilepsy: an ex vivo study on cytokines and oxidative stress in response to milk protein fractions. J Dairy Sci. 2018 Jun; 101(6): 4842-4852. Doi: 10.3168/Jds.2017-13104

89) Albenzio M, Santillo A, Ciliberti MG, Figliola L, Caroprese M, Marino R, Polito AN. Milk from different species: relationship between protein fractions and inflammatory response in infants affected by generalized epilepsy. J Dairy Sci. 2016 Jul; 99(7): 5032-5038. Doi: 10.3168/Jds.2015-10704

90) Albenzio M, Santillo A, Caroprese M, Polito AN. Role of milk from small ruminant species on human health. Nutrients in dairy and their implications for health and disease. 21 June 2017, Pages 435-440

91) Li Volti G, Ientile R, Abraham NG, Vanella A, Cannavò G, Mazza F, Currò M, Raciti G, Avola R, Campisi A. Immunocytochemical localization and expression of heme oxygenase-1 in primary astroglial cell cultures during differentiation: effect of glutamate. Biochem Biophys Res Commun. 2004 Mar 5; 315(2): 517-24

92) Rizzo M, Abate N, Chandalia M, Rizvi AA, Giglio RV, Nikolic D, Marino Gammazza A, Barbagallo I, Isenovic ER, Banach M, Montalto G, Li Volti G. Liraglutide reduces oxidative stress and restores heme oxygenase-1 and ghrelin levels in patients with type 2 diabetes: a prospective pilot study. J Clin Endocrinol Metab. 2015 Feb; 100(2): 603-6. doi: 10.1210/jc.2014-2291

93) Salamone F, Li Volti G, Titta L, Puzzo L, Barbagallo I, La Delia F, Zelber-Sagi S, Malaguarnera M, Pelicci PG, Giorgio M, Galvano F. Moro orange juice prevents fatty liver in mice. World J Gastroenterol. 2012 Aug 7; 18(29): 3862-8. doi: 10.3748/wjg.v18.i29.3862

94) Viggiano E, Mollica MP, Lionetti L, Cavaliere G, Trinchese G, De Filippo C, Chieffi S, Gaita M, Barletta

A, De Luca B, Crispino M, Monda M. Effects of an High-Fat Diet Enriched in Lard or in Fish Oil on the Hypothalamic Amp-Activated Protein Kinase and Inflammatory Mediators. Front Cell Neurosci. 2016 Jun9; 10: 150. doi: 10.3389/fncel.2016.00150

95) Carotenuto M, Esposito M. Nutraceuticals safety and efficacy in migraine without aura in a population of children affected by neurofibromatosis type I. Neurol Sci. 2013 Nov; 34(11): 1905-9. doi: 10.1007/s10072-013-1403-z

96) Smirni D, Oliveri M, Turriziani P, Di Martino G, Smirni P. Benton visual form discrimination test in healthy children: normative data and qualitative analysis. Neurol Sci. 2018 May; 39(5): 885-892. doi: 10.1007/s10072-018-3297-2

97) Messina A, Monda V, Sessa F, Valenzano A, Salerno M, Bitetti I, Precenzano F, Marotta R, Lavano F, Lavano SM, Salerno M, Maltese A, Roccella M, Parisi L, Ferrentino RI, Tripi G, Gallai B, Cibelli G, Monda M, Messina G, Carotenuto M. Sympathetic, Metabolic Adaptations, and Oxidative Stress in Autism Spectrum Disorders: How Far From Physiology? Front Physiol. 2018 Mar 22; 9: 261. doi: 10.3389/fphys.2018.00261

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