

## EMOTIONAL INTELLIGENCE AND OBSTRUCTIVE SLEEP APNEA SYNDROME IN CHILDREN: PRELIMINARY CASE-CONTROL STUDY

LUCIA PARISI<sup>1</sup>, MARGHERITA SALERNO<sup>2</sup>, AGATA MALTESE<sup>1</sup>, GABRIELE TRIPPI<sup>3,4</sup>, PALMIRA ROMANO<sup>5</sup>, ANNABELLA DI FOLCO<sup>1</sup>, TERESA DI FILIPPO<sup>1</sup>, GIOVANNI MESSINA<sup>6</sup>, MICHELE ROCCELLA<sup>1</sup>

<sup>1</sup>Department of Psychological, Pedagogical and Educational Sciences, University of Palermo, Italy - <sup>2</sup>Sciences for Mother and Child Health Promotion, University of Palermo, Italy - <sup>3</sup>Department PROSAMI, University of Palermo, Italy - <sup>4</sup>Childhood Psychiatric Service for Neurodevelopmental Disorders, CH Chinon, France - <sup>5</sup>Clinic of Child and Adolescent Neuropsychiatry; Department of Mental Health and Physical and Preventive Medicine, Università degli Studi della Campania-Luigi Vanvitelli, Italy - <sup>6</sup>Department of Experimental Medicine, Section of Human Physiology and Unit of Dietetics and Sports Medicine, Department of Clinical and Experimental Medicine, University of Foggia, Foggia, Italy

**ABSTRACT**

**Introduction:** Obstructive sleep apnea syndrome (OSAS) affects up to 4% of pediatric population, with many co-morbidities in the medium-long term. Functional alterations in prefrontal cortex (PFC) may explain why OSAS impacts aspects such as: executive functions, memory, motor control, attention, visual-spatial skills, learning and mood regulation. Emotional intelligence (EI) is a complex neuropsychological function that could be impaired in many clinical conditions. Aim of the study is to evaluate the difference in emotional intelligence skills among children with OSAS and healthy subjects

**Materials and methods:** 29 children (16 males) mean age  $9.5 \pm 1.54$  years, affected by OSAS were compared with 60 typical developing children similar for gender ( $p = 0,871$ ), age ( $p = 0,934$ ) and socio-economic status ( $p = 0.714$ ). Bar-On emotional quotient inventory, youth version (EQ-i: YV) was used in order to assess the Emotional Quotient.

**Results:** Apnea/hypopnea index (AHI) results to be  $8.76 \pm 3.45$  with medium desaturation index (ODI) amounting to  $2:52 \pm 21.5$ , average saturation  $92.7 \pm 4.8$  %, average desaturation 4.9 %.

OSAS children have significant differences in Interpersonal scales ( $84.95 \pm 07.03$  vs.  $99.61 \pm 8.96$ ;  $p < 0.001$ ), Adaptability ( $7:36 \pm 79.61$  vs.  $101.32 \pm 9.4$ ;  $p < 0.001$ ), Stress Management ( $72.48 \pm 8.14$  vs.  $98.44 \pm 5.19$ ,  $p < 0.001$ ), QE Total ( $81.28 \pm 11.03$  vs.  $102.14 \pm 9.62$ ;  $p < 0.001$ ). Pearson correlation analysis shows an inverse relationship between QE total and ODI ( $p < 0.01$ ).

**Conclusion:** Our findings tend to highlight the role of intermittent hypoxia in OSAS effects genesis, involving also aspects different from physical impairments.

**Keywords:** emotional intelligence, OSAS, sleep apnea, Bar-On emotional quotient inventory; EQ-i: YV.

DOI: 10.19193/0393-6384\_2017\_3\_072

Received November 30, 2016; Accepted February 02, 2017

**Introduction**

Obstructive sleep apnea syndrome (OSAS) affects up to 4% of the pediatric population, particularly between 5-7 years of age and there are many co-morbidities in the medium and long term.

Functional alterations in prefrontal cortex (PFC) may explain why OSAS, especially during childhood, impacts aspects such as: executive functions, memory, motor control, attention, visual-spatial skills, learning and mood regulation<sup>(1-7)</sup>.

Several studies have focused on alterations about executive functioning in children with OSA, with a putative specific relationship with the degree of respiratory troubles, supporting the role of intermittent hypoxia impact the fronto-prefrontal regions<sup>(6-12)</sup>.

The emotional intelligence (EI) may be defined as “the ability to monitor one’s own and others’ feelings and use this information to guide one’s thoughts and actions. Therefore EI is a complex neuropsychological function that could be

impaired in many clinical conditions.

The aim of the study is to evaluate the difference in emotional intelligence skills among children with OSAS and healthy subjects

## Materials and methods

29 children (16 males, 13 females) mean age  $9.5 \pm 1.54$  years, affected by OSAS diagnosed with polysomnography examination (PSG) in accordance with international criteria, were compared with 60 typical developing (TD) children according to gender ( $p = 0.871$ ), age ( $p = 0.934$ ) and socio-economic status ( $p = 0.714$ ).

Exclusion criteria were the following: overweight ( $z\text{-BMI} > 85$  pc) and obesity ( $z\text{-BMI} > 95$  pc), cognitive disability ( $IQ < 70$ ), neurological disorders (ie headaches, epilepsy), chromosomal syndromes (eg. Down, Prader-Willi, Crouzon, Pierre-Robin, trisomy 18), psychiatric illness (ie. mood disorders, anxiety disorders, psychosis) and specific neuropsychological disorders<sup>(13-38)</sup>.

### Polysomnographic (PSG) Data

After reviewing and analyzing PSG data collected from inpatients children between January and June 2016 to establish the presence of OSA in the experimental group, OSA severity was determined according to the current international guidelines: mild OSA was defined by an obstructive apnea-hypopnea index (o AHI) of 1 to  $<5$  events per hour; moderate OSA was defined as was defined as  $\geq 5$  to  $<10$  events/hour, and severe OSA  $\geq 10$  events/hour

### Bar-On emotional quotient inventory, youth version (EQ-i: YV).

This inventory is a self-report measure of emotionally and socially intelligent behavior, which provides an estimate of one's underlying emotional and social intelligence. It has 60 items which are distributed over six sub-scales (Intrapersonal Relationships, Interpersonal Relationships, Stress Management, Adaptability, General Mood and Positive Impression) and also provides a Total EQ score. Validation of the inventory on North American samples suggests that the Bar-On Emotional Quotient Inventory: Youth Version has excellent psychometric properties and identifies core features of emotional intelligence in children. A standard score in the range of 90-110 indicates effective emotional and social functioning.

A score greater than 110 suggests the presence of enhanced emotional and social skills, while a score of less than 90 suggests that emphasis should be placed on enriching skills in that area. Responses were rated by the psychology post-graduate student on a 4-point scale ranging from 1 ('very seldom true of me') to 4 ('very often true of me'). For measuring emotional intelligence has been used the Italian version of EQ-i: YV test in order to assess the skills related to themselves and the others understanding, adapting to the changes demanded by the environment and the management of emotions.

### Statistical analysis

Chi-square and t-test were performed when appropriated, in order to compare the two population (OSAS and TDC) for age, gender, EQ-i:YV scores.  $p$  values  $\leq 0.05$  were considered as statistical significant.

## Results

The apnea / hypopnea index (AHI) results to be  $8.76 \pm 3.45$  with medium desaturation index (ODI) amounting to  $2:52 \pm 21.5$ , average saturation  $92.7 \pm 4.8\%$ , average desaturation  $4.9\%$ .

	OSAS (N=29)	TDC (N=64)	p
Interpersonal	84.95±7.03	99.61±8.96	<0.001
Intrapersonal	92.19±8.96	94.17±9.23	0.336
Adaptability	79.61±7.36	101.32±4.09	<0.001
Stress management	72.48±8.14	98.44±5.19	<0.001
General Mood	91.06±9.18	92.41±10.32	0.547
QE Total	81.28±11.03	102.14±9.62	<0.001
Positive Impression	89.47±5.12	91.04±6.07	0.229
Inconsistency Index	<5	<5	-

**Table 1:** shows the comparison fir means and standard deviation ( $\pm$ ) between the two population of children affected by obstructive sleep apnea syndrome (OSAS) and typical developing children (TDC) for EQ-i:YV scores.

Chi-square and t-test were performed when appropriated.  $p$  values  $\leq 0.05$  were considered as statistical significant.

OSAS children have significant differences in Interpersonal scales ( $84.95 \pm 07.03$  vs.  $99.61 \pm 8.96$ ;  $p < 0.001$ ), Adaptability ( $7:36 \pm 79.61$  vs.  $101.32 \pm 9.4$ ;  $p < 0.001$ ), Stress Management ( $72.48$

$\pm 8.14$  vs.  $98.44 \pm 5.19$ ,  $p < 0.001$ ), QE Total ( $81.28 \pm 11.03$  vs.  $102.14 \pm 9.62$ ;  $p < 0.001$ ).

The Pearson correlation analysis shows an inverse relationship between QE total and ODI index ( $p < 0.01$ ) (table 1).

## Discussion

OSA represents a public health problem affecting approximately 1% to 6% of all children, up to 59% of obese children, and 2% to 24% of adults, and 70% of bariatric surgery patients. The incidence increases with age; and the disorder is responsible for billions of dollars of direct and indirect health care costs in the form of motor vehicle crashes; medical conditions, including cardiovascular disease, metabolic syndrome, diabetes, and cerebrovascular disease; as well as perioperative morbidity and mortality. The presence OSAS also has implications for job and school performance and has been associated with potentially life-long cognitive impairment as well as sudden death.

OSAS has numerous comorbidities in children which can affect various aspects of life, not only for the subsequent disability, but especially for those still not well identified<sup>(39-50)</sup>.

Moreover, OSAS contributes to cognitive deficits as supported by research showing impaired learning and behavioural problems in juvenile rats exposed to intermittent hypoxia during sleep, as well as by imaging studies showing cerebral neuronal injury in children with OSAS. In this light, several areas of the PFC (e.g., the dorsolateral prefrontal cortex [DLPFC] and ventrolateral prefrontal cortex [VLPFC]) play an important role in the integration of emotion and cognition. In fact, MRI studies have revealed abnormalities in the DLPFC, VLPFC, and orbitofrontal cortex (OFC) in patients with psychiatric conditions. In addition to the PFC, dispositional envy may also recruit the activation of regions related to the perception of emotions or intentions, such as the temporal gyrus ( $\theta$ ). Our findings tend to highlight the role of intermittent hypoxia in OSAS effects genesis, involving also aspects different from physical impairments., although further studies are necessary<sup>(39-50)</sup>.

## References

- 1) 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.
- 2) Perillo L, Esposito M, Caprioglio A, Attanasio S, Santini AC, Carotenuto M. Orthodontic treatment need for adolescents in the Campania region: the malocclusion impact on self-concept. *Patient Prefer Adherence*. 2014 Mar 19; 8: 353-9. doi: 10.2147/PPA.S58971.
- 3) Carotenuto M, Gimigliano F, Fiordelisi G, Ruberto M, Esposito M. Positional abnormalities during sleep in children affected by obstructive sleep apnea syndrome: the putative role of kinetic muscular chains. *Med Hypotheses*. 2013 Aug; 81(2): 306-8. doi: 10.1016/j.mehy.2013.04.023.
- 4) 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.
- 5) 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.
- 6) 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.
- 7) 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.
- 8) 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.
- 9) Carotenuto M, Esposito M, Precenzano F, Castaldo L, Roccella M. Cosleeping in childhood migraine. *Minerva Pediatr*. 2011 Apr; 63(2): 105-9.
- 10) Esposito M, Carotenuto M, Roccella M. Primary nocturnal enuresis and learning disability. *Minerva Pediatr*. 2011 Apr; 63(2): 99-104.
- 11) 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.
- 12) 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.
- 13) Esposito M, Gallai B, Parisi L, Roccella M, Marotta R, Lavano SM, Mazzotta G, Patriciello G, Precenzano F, Carotenuto M. Visuomotor competencies and primary monosymptomatic nocturnal enuresis in prepubertal aged children. *Neuropsychiatr Dis Treat*. 2013; 9: 921-6. doi: 10.2147/NDT.S46772.
- 14) Precenzano F, Ruberto M, Parisi L, Salerno M, Maltese A, Vagliano C, Messina G, Di Folco A, Di Filippo T, Michele Roccella. Executive functioning in preschool

- children affected by autism spectrum disorder: a pilot study. *Acta Medica Mediterranea*, 2017, 33: 35-39; DOI: 10.19193/0393-6384\_2017\_1\_005.
- 15) Precenzano F, Lombardi P, Ruberto M, Parisi L, Salerno M, Maltese A, D'alessandro I, Della Valle I, Magliulo RM, Messina G, Roccella M. Internalizing symptoms in children affected by childhood absence epilepsy: a preliminary study. *Acta Medica Mediterranea*, 2016, 32: 1749-1753; DOI: 10.19193/0393-6384\_2016\_6\_158.
  - 16) Precenzano F, Ruberto M, Parisi L, Salerno M, Maltese A, D'alessandro I, Della Valle I, Visco G, Magliulo RM, Messina G, Roccella M. ADHD-like symptoms in children affected by obstructive sleep apnea syndrome: a case-control study. *Acta Medica Mediterranea*, 2016, 32: 1755-1759; DOI: 10.19193/0393-6384\_2016\_6\_159.
  - 17) Precenzano F, Ruberto M, Parisi L, Salerno M, Maltese A, D'alessandro I, Grappa MF, Magliulo RM, Messina G, Roccella M. Borderline intellectual functioning and parental stress: an italian case-control study. *Acta Medica Mediterranea*, 2016, 32: 1761-1765; DOI: 10.19193/0393-6384\_2016\_6\_160.
  - 18) Ruberto M, Precenzano F, Parisi L, Salerno M, Maltese A, Messina G, Roccella M. Visuomotor integration skills in children affected by obstructive sleep apnea syndrome: a case-control study. *Acta Medica Mediterranea*, 2016, 32: 1659; DOI: 10.19193/0393-6384\_2016\_5\_146.
  - 19) Parisi L, Ruberto M, Precenzano F, Di Filippo T, Russotto C, Maltese A, Salerno M, Roccella M. The quality of life in children with cerebral palsy. *Acta Medica Mediterranea*, 2016, 32: 1665; DOI: 10.19193/0393-6384\_2016\_5\_147.
  - 20) Epifanio, M.S., Genna, V., De Luca, C., Roccella, M., La Grutta, S. Paternal and maternal transition to parenthood: The risk of postpartum depression and parenting stress (2015) *Pediatric Reports*, 7 (2), pp. 38-44.
  - 21) Parisi, L., Di Filippo, T., Roccella, M. The child with Autism Spectrum Disorders (ASDs): Behavioral and neurobiological aspects. *Acta Medica Mediterranea*, 2015, 31 (6), pp. 1187-1194.
  - 22) Vecchio, D., Salzano, E., Vecchio, A., Di Filippo, T., Roccella, M. A case of femoral-facial syndrome in a patient with autism spectrum disorders. *Minerva Pediatrica*, 2011, 63 (4), pp. 341-344.
  - 23) Parisi, L., Di Filippo, T., Roccella, M. Hypomelanosis of Ito: Neurological and psychiatric pictures in developmental age. *Minerva Pediatrica*, 2012, 64 (1), pp. 65-70.
  - 24) Di Filippo, T., Parisi, L., Roccella, M. Psychological aspects in children affected by duchenne de boulogne muscular dystrophy. *Mental Illness*, 2012, 4 (1), pp. 21-24.
  - 25) Epifanio MS, Genna V, Vitello MG, Roccella M, La Grutta S. Parenting stress and impact of illness in parents of children with coeliac disease. *Pediatr Rep*. 2013 Dec 19;5(4):e19. doi: 10.4081/pr.2013.e19.
  - 26) 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.
  - 27) 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.
  - 28) Maltese A, Pepi A, Scifo L, Roccella M. Referential communication skills in children with Down Syndrome. *Minerva Pediatr*. 2014 Feb; 66(1): 7-16.
  - 29) 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.
  - 30) Alesi M, Battaglia G, Roccella M, Testa D, Palma A, Pepi A. Improvement of gross motor and cognitive abilities by an exercise training program: three case reports. *Neuropsychiatr Dis Treat*. 2014 Mar 14; 10: 479-85. doi: 10.2147/NDT.S58455.
  - 31) Panico A, Messina G, Lupoli GA, Lupoli R, Cacciapuoti M, Moscatelli F, Esposito T, Villano I, Valenzano A, Monda V, Messina A, Precenzano F, Cibelli G, Monda M, Lupoli G. Quality of life in overweight (obese) and normal-weight women with polycystic ovary syndrome. *Patient Prefer Adherence*. 2017 Mar 2; 11: 423-429.
  - 32) Precenzano F, Ruberto M, Parisi L, Salerno M, Maltese A, Gallai B, Marotta R, Lavano SM, Lavano F, Roccella M. Visual-spatial training efficacy in children affected by migraine without aura: a multicenter study. *Neuropsychiatr Dis Treat*. 2017 Jan 27; 3: 253-258. doi: 10.2147/NDT.S119648.
  - 33) Epifanio, M.F., Genna, V., Di Marco, S., Furnari, M.L., Pardo, F., Collura, M., Roccella, M., La Grutta, S. Quality of life, affect regulation and resilience in adult patients with cystic fibrosis. *Gazzetta Medica Italiana Archivio per le Scienze Mediche*, 2013 172 (9), pp. 705-711.
  - 34) Parisi L, Di Filippo T, La Grutta S, Lo Baido R, Epifanio MS, Esposito M, Carotenuto M, Roccella M. Sturge-weber syndrome: a report of 14 cases. *Ment Illn*. 2013 Jun 3; 5(1): e7. doi: 10.4081/mi.2013.e7.
  - 35) 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.
  - 36) 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.
  - 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) 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.

- 39) 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.
- 40) 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.
- 41) 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.
- 42) Morandi A, Bonnefond A, Lobbens S, Carotenuto M, Del Giudice EM, Froguel P, Maffei 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.
- 43) Verrotti A, Carotenuto M, Altieri L, Parisi P, Tozzi E, Belcastro V, Esposito M, Guastaferrò 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.
- 44) 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.
- 45) 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.
- 46) 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.
- 47) 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.
- 48) Esposito M, Gallai B, Parisi L, Roccella M, Marotta R, Lavano SM, Mazzotta G, Carotenuto M. Primary nocturnal enuresis as a risk factor for sleep disorders: an observational questionnaire-based multicenter study. *Neuropsychiatr Dis Treat.* 2013; 9: 437-43. doi: 10.2147/NDT.S43673.
- 49) 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.
- 50) Carotenuto M, Esposito M, D'Aniello A, Rippa CD, Precenzano F, Pascotto A, Bravaccio C, Elia M. Polysomnographic findings in Rett syndrome: a case-control study. *Sleep Breath.* 2013 Mar; 17(1): 93-8. doi: 10.1007/s11325-012-0654-x

---

*Corresponding author*

MICHELE ROCCELLA; MD; PhD  
Department of Psychological,  
Pedagogical and Educational Sciences  
University of Palermo  
(Italy)