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Editorial

Pediatric Sleep Apnoea and Passive Smoking: A Window of Opportunity?

Apnea del sueño pediátrica y tabaquismo pasivo: ¿Una ventana de oportunidades?

The prevalence of obstructive sleep apnea (OSA) in children is between 1% and 4%, although this disorder is significantly underdiagnosed despite its serious repercussions.[1] OSA is characterized by recurrent episodes of partial or complete upper airway obstruction, associated with intermittent hypoxia and a proinflammatory state.[2] As a result, OSA can lead to cardiovascular, neurocognitive, and metabolic disturbances as well as delayed growth.[3]

Compared with adults, children are more susceptible to environmental pollutants owing to their smaller alveolar surface area, lack of collateral ventilation (pores of Kohn and canals of Lambert), greater peripheral airway resistance, less effective cough, and immature immune system.[4] Prenatal exposure to tobacco smoke may be a risk factor for developing sleep-disordered breathing because nicotine can cross the placental barrier and induce placental insufficiency, fetal hypoxia due to increased carboxyhemoglobin concentrations, and alterations in brainstem regions associated with regulating wakefulness.[5] All these mechanisms can impair arousability, one of the main protective mechanisms against sleep-disordered breathing in children.[5,6] Furthermore, both maternal smoking during pregnancy and passive smoking after birth have been associated with sudden infant death syndrome, with the risk increasing proportionally to the intensity of smoke exposure.[7]

The available evidence regarding passive smoking in children relates to secondhand smoke (as opposed to third- and fourth-hand smoke, discussed further down).[8–10] Secondhand smoke is a combination of sidestream smoke and exhaled mainstream smoke diluted with ambient air, and it contains over 7000 chemicals.[8] Unlike mainstream smoke, sidestream smoke is a product of incomplete combustion; as such, it contains smaller particles and a larger quantity of waste products. In addition, some components (e.g. nicotine) can be transmitted as gases rather than particles and react with agents such as ozone, nitrous acid, and other oxidants, producing nitrosamines that increase cancer risk in nonsmokers.[9] Regarding the relationship between secondhand smoke and sleep-disordered breathing in the pediatric population, Subramanyam and colleagues found that among children with severe OSA, those exposed to secondhand smoke had a higher median apnea–hypopnea index (AHI) than those without this exposure (20.9 vs 19.5, $p = 0.04$). There was no significant association without stratification by severity. In a multivariable analysis, secondhand smoke exposure increased AHI by 48% (95% CI 8–102%, $p = 0.01$) in the severe OSA subgroup.[10] Groner and colleagues reported an increased risk of sleep-disordered breathing in children aged two to five years exposed to secondhand smoke, with exposure determined by hair nicotine level.[11] In their meta-analysis of 26 studies, Chang and colleagues found that children exposed to secondhand smoke presented a higher risk of OSA (risk ratio [RR] 1.84) than adult passive smokers (RR 1.35).[12]

There are other, commonly overlooked forms of passive smoking that could increase the risk of sleep-disordered breathing. Thirdhand smoke refers to the residual chemicals from tobacco smoke (e.g. nitrosamines, toxic metals, alkaloids, organic combustion products, and volatile organic compounds) that adhere to indoor surfaces (e.g. curtains, rugs, furniture), dust particles, hair, clothing, vehicle upholstery, etc. They can persist for months after secondhand smoke has dissipated, leading to the continuous transfer of toxins.[13] Children are particularly vulnerable to thirdhand smoke because they spend a considerable portion of the day at home. This situation was exacerbated during the COVID-19 lockdowns.

Fourth-hand smoke refers to environmental pollution and biodiversity changes (due to water pollution) caused by tobacco waste products. Cigarette butts are especially harmful, as they can take eight to 12 years to decompose and are made up of toxic substances such as pesticides, nicotine, diethylene glycol, tar, and ethylphenol.[14] What is more, there have been many reported cases of accidental cigarette butt ingestion (e.g. in parks and at beaches) leading to neurological toxicity and vomiting in children.[15] Despite the potential impact of third- and fourth-hand smoke, there are no pediatric studies evaluating the association of these exposures with sleep-disordered breathing.

Spain recently implemented its 2024–2027 comprehensive smoking prevention and control plan. While this represents a step in the right direction, there is still a need for legislative changes aimed at reducing secondhand tobacco exposure, limiting new forms of use, and protecting children. Public awareness and education campaigns targeted at specific risk groups such as Romani people, adolescents, or parents during pregnancy/after birth are also crucial for reducing exposure among children.

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References

1. Solano-Pérez E, Coso C, Castillo-García M, Romero-Peralta S, Lopez-Monzoni S, Laviña E, et al. Diagnosis and treatment of sleep apnea in children: a future perspective is needed. Biomedicines. 2023;11:1708, http://dx.doi.org/10.3390/biomedicines11061708.
2. Kaditis AG, Alonso Alvarez ML, Boudewyns A, Alexopoulos EI, Ersu R, Joosten K, et al. Obstructive sleep disordered breathing in 2- to 18-year-old children: diagnosis and management. Eur Respir J. 2016;47:69–94, http://dx.doi.org/10.1183/13993003.00385-2015.
3. Lo Bue A, Salvaggio A, Insalaco G. Obstructive sleep apnea in developmental age. A narrative review. Eur J Pediatr. 2020;179:357–65, http://dx.doi.org/10.1007/s00431-019-03557-8.
4. Sly PD, Flack F. Susceptibility of children to environmental pollutants. Ann N Y Acad Sci. 2008;1140:163–83, http://dx.doi.org/10.1196/annals.1454.017.
5. Balaguer C, Palou A, Alonso-Fernández A. Smoking and sleep disorders. Arch Bronconeumol. 2009;45:449–58, http://dx.doi.org/10.1016/j.arbres.2009.03.003.
6. Horne RS, Franco P, Adamson TM, Groswasser J, Kahn A. Influences of maternal cigarette smoking on infant arousability. Early Hum Dev. 2004;79:49–58, http://dx.doi.org/10.1016/j.earlhumdev.2004.04.005.
7. Kim TH, Lee H, Woo S, Lee H, Park J, Fond G, et al. Prenatal and postnatal factors associated with sudden infant death syndrome: an umbrella review of meta-analyses. World J Pediatr. 2024;20:451–60, http://dx.doi.org/10.1007/s12519-024-00806-1.
8. Kim J, Song H, Lee J, Kim YJ, Chung HS, Yu JM, et al. Smoking and passive smoking increases mortality through mediation effect of cadmium exposure in the United States. Sci Rep. 2023;13:3878, http://dx.doi.org/10.1038/s41598-023-30988-z.
9. Sleiman M, Gundel LA, Pankow JF, Jacob P3rd, Singer BC, Destaillats H. Formation of carcinogens indoors by surface-mediated reactions of nicotine with nitrous acid, leading to potential thirdhand smoke hazards. Proc Natl Acad Sci U S A. 2010;107:6576–81, http://dx.doi.org/10.1073/pnas.0912820107.
10. Subramanyam R, Tapia IE, Zhang B, Mensinger JL, Garcia-Marcinkiewicz A, Jablonka DH, et al. Secondhand smoke exposure and risk of obstructive sleep apnea in children. Int J Pediatr Otorhinolaryngol. 2020;130:109807, http://dx.doi.org/10.1016/j.ijporl.2019.109807.
11. Groner JA, Nicholson L, Huang H, Bauer JA. Secondhand smoke exposure and sleep-related breathing problems in toddlers. Acad Pediatr. 2019;19:835–41, http://dx.doi.org/10.1016/j.acap.2019.03.008.
12. Chang CW, Chang CH, Chuang HY, Cheng HY, Lin CI, Chen HT, et al. What is the association between secondhand smoke (SHS) and possible obstructive sleep apnea: a meta-analysis. Environ Health. 2022;21:58, http://dx.doi.org/10.1186/s12940-022-00868-6.
13. Lovelina Francis D, Sampoornam Pape Reddy S. The silent assassin: third hand smoking. J Glob Health. 2022;12:03079, http://dx.doi.org/10.7189/jogh.12.03079.
14. De Granda-Orive JI, Girón-Matute W, López-Yepes L. Cigarette butts: the collateral effects of cigarettes on humans, animals and the environment. Arch Bronconeumol. 2016;52:285, http://dx.doi.org/10.1016/j.arbres.2015.07.019.
15. Novotny TE, Hardin SN, Hovda LR, Novotny DJ, McLean MK, Khan S. Tobacco and cigarette butt consumption in humans and animals. Tob Control. 2011;20 Suppl_1:i17–20, http://dx.doi.org/10.1136/tc.2011.043489.

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