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A soft, flexible, wearable device for cough detection in paediatric cystic fibrosis patients

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Objectives: New or increased cough is an important sign of pulmonary exacerbation. There is unmet need to objectively quantify and analyse cough trends in early life. Advances in flexible electronics and materials allow development of soft, skin-like, accelerometer-based wearable devices that seamlessly interface with the human body in unique locations, enabling the simultaneous capture of low-frequency body, chest, and throat motion along with high-frequency vocal, throat, and lung sound signals associated with various body processes including coughs and vital signs.
Methods: A small, flexible, fully wireless, accelerometer-based mechano-acoustic sensor (MAS) was applied using gentle adhesives to the suprasternal notch of 10 paediatric CF subjects during regular clinic visits. A 15-minute protocol consisting of eliciting cough, throat clearing, speech, and laughs in various head/body orientations, ambient environments, and physical activity intensities. The MAS recorded at a high bandwidth 1.6kHz rate and automatically uploaded to a cloud server upon replacement on a wireless charging platform.
Results: The captured sensor data was analysed using an existing machine learning algorithm developed for COVID-19 symptom tracking. Preliminary results show the device differentiates cough from other vocal, respiratory noises and motion artifacts, both at rest and during activity. A majority of children found the device to be acceptable, though device size and adhesive removal caused minor discomfort for some.
Conclusion: The extraction of well-classified cough events is feasible, facilitating further analysis of cough episode duration, force, and clinically relevant features associated with early decompensation, response to treatment, and daily symptom tracking. Objective measurement of cough may be useful as a clinical study outcome measure and for clinical monitoring. Future work will include evaluation for longer time periods during stability and pulmonary exacerbations.

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CT-signs and the effectiveness of surgical treatment of sinonasal disease in children with cystic fibrosis

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Objective: To evaluate the condition of the paranasal sinuses and the effectiveness of functional endoscopic sinus surgery (FESS) in children with chronic rhinosinusitis on the background of cystic fibrosis.
Methods: 37 children aged 4–18 years (mean age 9.4 ± 3.6), operated by FESS method. The state of nasal sinuses was evaluated on the Lund-Makkey modified scale for children (M-LM) in dynamics before and three times after surgery with an average interval of 10.6 ± 4.2 months. The quality of life was analysed using the SNOT22 questionnaire before and after surgery.
Results: CT analysis showed the presence of hypoplasia of the frontal sinuses in 21 (56.8%) children, and one child had simultaneously hypoplasia of the frontal and sphenoid sinuses; remodeling of the medial wall of the maxillary sinus into the nasal cavity was noted in 25 (67.6%) of 37 observed children.
According to CT data, the SD CT before the operation was the highest and amounted to 1.83 ± 0.2, which was one of the indications for the operation. After FESS (in 9.7 ± 3.9 months) the M-LM index averaged 1.55 ± 0.3, which meant a good positive trend. At the next examination after 9.6 ± 3.9 months there was an increase in M-LM indicators to 1.58 ± 0.4 and 1.63 ± 0.5 after 10.64 ± 4.2 months, which indicates an increase in the pathological process in the sinuses. However, the statistically significant difference was between CT2 and CT3 ($p < 0.05$). Analysis of the quality of life showed that SD on the SNOT 22 scale before surgery was 49.43 ± 16.7, while after surgery this indicator was significantly less ($p < 0.05$) and amounted to 17.68 ± 11.8, which indicates an improvement in the quality of life after surgical treatment.
Conclusion: Chronic sinusitis in CF is characterised by hypoplasia of the frontal and sphenoid sinuses, FESS shows its effectiveness in relation to objective and subjective indicators; however, in the long-term, its effectiveness decreases.

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Sleep disorders and exercise capacity in adult patients with cystic fibrosis in the Republic of North Macedonia

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Introduction: Nocturnal hypoxemia and sleep disturbances in patients with cystic fibrosis (CF) are problems that affect their daytime life. Overnight polysomnography (PSG) may help identify respiratory deterioration.
Aim: To evaluate the presence of sleep disorders and its association with exercise capacity and daily physical activity.
Methods: The study included 15 adult CF patients with mild to moderate lung disease who regularly attend the CF centre at the Institute for Pulmonary Diseases in Skopje, N. Macedonia. We analysed anthropometric data (age, sex and BMI), forced expiratory volume in one second (FEV_1), walk distance, oxygen saturation, pulse rate during walk, and full overnight polysomnography evaluation.
Results: The mean age of CF patients was 24.5 years (5 girls), with mean BMI 20.4. During sleep, ten CF cases with clinical lung disease (15%) had SaO_2 <90% during more than 30% of total sleep time and 5 cases (33%) had a SaO_2 below 85%. FEV_1 values for CF cases with clinical lung disease were related to SaO_2 ($P < 0.01$). Frequency of impaired sleep was not different in CF cases with and without significant lung disease. Sleep apnea was present in three CF cases with clinical lung disease and in one case without significant lung disease. They performed a 6MWT following a standard protocol. Mean distance walked for all patients at the day of admission was 495 meters which means 67.8% predicted, range from 300 m (41.4%pred.) - 690 m (94.2%pred). At the start of the intravenous therapy, mean FEV_1 was 66% (range 24%-108%). Desaturation during the 6MWT was found in 5 (20.8%) patients with FEV_1 < 40%. predicted. They all have good cardiac adaptation, but had significant fall in oxygen saturation.
Conclusion: Sleep disorders are related with exercise capacity and daily physical activity, as nocturnal hypoxemia is associated with exercise intolerance, nutritional status, SpO2, and daytime sleepiness.

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Integration of Qi Gong sessions into a respiratory rehabilitation program: the experience of the CF Centre in Roscoff (France)

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Qi gong is a traditional Chinese gymnastics based on respiratory mastery combined with slow movements, in mindfulness. Accessible to all, it aims to improve physical and mental balance. Recent studies highlighted its interest for patients with respiratory diseases. The testimony of our oldest CF patient, practicing Qi gong for years, convinced us of the potential interest for our CF patients.