Current perspectives in child rehabilitation

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Rehabilitation is defined, according to the World Health Organization (WHO), as "a set of interventions designed to optimize functioning and reduce disability in individuals with health conditions in interaction with their environment" (https://www.who.int/news-room/fact-sheets/detail/rehabilitation). The need for rehabilitation has long been thought to concern only a little proportion of the population. However, a very recent, thorough study of global needs for rehabilitation found that 2.41 billion individuals worldwide would benefit from rehabilitation (1). Among children below age 15 years, sensory impairments (including visual impairments), mental health disorders (including autism spectrum disorder), musculoskeletal disorders, and cerebral palsy (CP) accounted for 91% of the 162.3 million prevalent cases. Despite those numbers, rehabilitation in many countries has never been prioritized and this report is an urgent pledge to health policy makers. In high-income countries, life expectancy and quality of life of individuals with CP, for example, has come increasingly closer to that of the general population, and rehabilitation interventions could be beneficial throughout the life span (2,3).

For people with childhood-onset disabilities and in particular those with neurodevelopmental disorders, rehabilitation is even more complex, as it addresses needs of individuals who have not previously acquired skills for independence, and their skill acquisition takes place along alternative developmental trajectories. Therefore, some authors prefer the term 'habilitation' in this context' (4).

This sets the tone for this important issue of the *Belgian Journal of Pediatrics*. It was a pleasure to act as guest editors, bringing together many outstanding contributions, sharing proof not only of high-level clinical science approaches, but also of great empathy towards children and their family, as the topic is so close to our hearts.

Rehabilitation for children with disabilities is organized following a holistic approach within the framework of the International Classification of Functioning, Disability and Health for Children and Youth (ICF-CY) suggested by the WHO. This incorporates the so-called favorite F-words suggested for childhood disability by Rosenbaum and Gorter (5). These authors draw a parallel between those 5 F-words with dimensions described in the ICF-CY: Fitness corresponds to Body Structure and Function; Function to Activity; Friends with Participation; Family with Environmental Factors; and Fun with Personal Factors. In addition, they have included Future to emphasize the lifelong perspective. All these dimensions are notably present in the contributions in this issue, expanding health care beyond the sole biomedical approach to a vision in which empowerment of the child with a disability no longer reduces them to that disability, but on the contrary, makes them a more independent individual (6). Societal attitudes towards issues relating to impairment still need to change for the better, however we have advanced in empowerment of disabled children, for example by involving them better in designing interventions and engaging them in the development of our research (7,8).

All contributions reflect the dynamism of the players in this field, eager to report on the latest findings and guiding principles on a range of topics from autistic spectrum disorder (ASD) to neuromuscular disorders, oncology, cerebral palsy (CP), and traumatic brain injury. The reader might notice that a few gaps remain to be filled. Several of the contributions to this themed issue report on *best possible* evidence, as in clinical research, high quality randomized controlled trials with large homogeneous samples are often impossible to perform. This is why even collaborators on Cochrane Reviews are moving from best evidence to the best *possible* evidence that can be trusted and is sufficiently informative to guide our practice and decision making (9). This might prove to be an important motivation for addressing the current lack of reimbursement of certain therapy models, such as the camp models for upper limb rehabilitation in CP as reported in this issue by De Queker and Mailleux.

Pediatric rehabilitation has several guiding principles among which the nature of recovery and reorganization mechanisms in children (10). In infancy, neurons and neural networks have the capacity to change their connections and behavior in response to experience. Consequently, early intervention is advocated when the neuroplasticity of the infant's brain is at its highest (11). In this issue, Defresne et al nicely describe the strategy for early diagnosis of ASD in children with a two-visits approach and the additional use of a questionnaire. The strategy is focused on three groups of children, those whose parents already have a concern, those in which primary caregivers are worried and thirdly the siblings of children with an ASD diagnosis; Implementing a systematic visit policy, the authors noted a threefold increase of referrals to their center. Unfortunately, although resources and services for parents in Belgium are available, long waiting lists prevent a timely start of intervention for their children. Alongside awareness raising for early detection with cost effective screening programs, rehabilitation settings should organize themselves to persuade the government to invest more in children's future.

The era of SARS-CoV-2 has taught us some creativity and skills in telemedicine, not only to provide medical assistance outside the traditional face-to-face approach, but also for rehabilitation purposes (12). Telerehabilitation seems to be an effective, flexible, and individualized intervention, making significant saving on costs. In Italy, for example, patients reported a high level of satisfaction, reinforcing the hypothesis that the rehabilitative services at a distance is a feasible alternative to routine care (13). Personal experience however has shown that serial casting had to be performed more frequently for stretching of gastrocnemius muscles in children with CP after a period of "home"- rehabilitation. Nevertheless, Dequeker and Mailleux, in their contribution, report on the feasibility of early home intervention programs for toddlers with a unilateral lesion and present a very nice overview of the current evidence for rehabilitation strategies in this group. For over more than 10 years, modified constraint induced movement therapy has been advocated for and new evidence is emerging that this approach, in combination with

bimanual treatment, is the gateway to better outcome. Moreover, recent neuro imaging work nicely shows how brain (re)wiring after an early brain insult, can possibly dictate the individualized treatment strategies. Lastly, studies, not only in CP, have also been trying to identify the right dosage regimen, proposing more weeks of therapy but at a reduced intensity (14,15). Assisting Hand Assessment, Jebsen Taylor Test of Hand Function and Canadian Occupational Performance Measure which were administered at baseline, three and 26 weeks. Mixed linear modelling was used to compare between dose (e.g. \"full dose\" to \"half dose\" of either mCIMT or bimanual therapy.

Research of Vander Linden, in this issue, also indicates that executive skills of adolescents in the chronic phase of traumatic brain injury improved after an 8-week home-based computerized cognitive intervention. Interestingly, her group also found that the benefit of serious game training was rather poor in adolescents with diffuse axonal damage in the basal ganglia. This again stresses the need for thorough behavioral but also neuroimaging evaluation before embarking on any therapy.

As one form of technology for rehabilitation, serious gaming has gained popularity worldwide, and already has a history in Belgium as well (16). Although serious, rehabilitation should be fun and this is exactly where serious gaming has an added value, as it responds to the lack of motivation which often pops up in children having frequent therapy. In their contribution on exergaming, Bonnechère overviews the introduction of gaming in the rehabilitation field, and the expansion of their use in several conditions such as CP and ASD. For children with CP, the use of Brain Computer Interfaces for gameplay is an emerging field of research and assistive technologies for children who lack communication abilities are increasingly well known (17,18).

Insight in the child's behavioral and cognitive phenotype is equally import for individually tailored intervention. One example of genotype-phenotype importance for therapy guidance, is the exon skipping potential in Duchenne muscular dystrophy (19). Geuens et al, in their contribution, elegantly summarize the behavioral and psychiatric comorbidities in boys with Duchenne muscular dystrophy and stress the need for further unraveling the brain structure – function relation in this condition. In another contribution on neuromuscular disorders, den Brave et al overview the management of spinal muscular atrophy, stressing multidisciplinary approach and touching on emerging disease-modifying treatments and new technologies.

Having a disability should however not stand in the way of having friends and fun, which is what Uyttebroeck and Van de Walle et al stress in their contributions. Promoting physical fitness in children with a disability is one thing, however, we should also actively try to understand the barriers. Over the last years, some nice examples of organized physical activity and sports have found their way in Belgium thanks to Van de Walle's team. Uyttebroeck et al report on similar issues in survivors of childhood cancer, promoting (re)habilitation from the early start of treatment. Equally important in pediatric rehabilitation is the principle of family-centered care and the added value of having friends (10). Practical management decisions must be endorsed by the family from young age onward up until adolescence and the children themselves should have an active part in decision making (6).

Lastly, transition from adolescence to adulthood (see Moens et al) deserves an extra contribution in this journal of pediatrics, as it has become clear that many issues remain. Recently, The Child Neurology Foundation has published open source, practical guides designed to facilitate this process (20).

In sum, the rehabilitation process requires a coordinated transdisciplinary team working to provide integrated evaluations and (best) evidence based interventions. We should foster the colleagues embarking on this important field in pediatrics and stimulate sound research to answer the many questions that remain, taking the 5 factors into account.

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