

Senzorni sistem za vadbo prezgodaj rojenih otrok

prof. dr. Matjaž Mihelj¹; Andraž Rihar¹; Jure Pašič¹; Janko Kolar¹; dr. Francesca Cecchi²; dr. Giuseppina Sgandurra³; prof. dr. Marko Munih¹

¹Univerza v Ljubljani, Fakulteta za elektrotehniko, Ljubljana, ²Scuola Superiore Sant' Anna, Italija, ³Fondazione Stella Maris, Italija

Korespondenca/Correspondence: prof. dr. Matjaž Mihelj; e-pošta: matjaz.mihelj@robo.fe.uni-lj.si

Uvod: Prezgodaj rojeni otroci z majhno porodno težo spadajo v najbolj ogroženo skupino v smislu nevroloških motenj. Pogostnost cerebralne paralize znaša od 2 do 3 primere na 1000 rojstev, vendar se poveča na 40 do 100 primerov na 1000 rojstev v primeru prezgodaj rojenih otrok (1). Sodobne tehnologije omogočajo zgodnje zaznavanje nevroloških motenj in ukrepanje v prvih mesecih življenja, ko so možgani še zelo prilagodljivi. Vadbo otrok je mogoče v domačem okolju izvajati v posebej prirejani igralnici, ki je opremljena z raznovrstnimi senzorji in zvočno-svetlobnimi dražljaji, vgrajenimi v pametne igrače. Senzorji omogočajo nemoteče spremljanje otrokovega razvoja (uravnavanje drže in ravnotežja prek pritiskovne merilne podloge in inercialnega senzorja na trupu ter spretnosti rokovanja in drugih gibalnih sposobnosti prek inercialnih senzorjev na zgornjih udih in v igračah). Zvočno-svetlobni dražljaji spodbujajo različne dejavnosti otroka in ga za pravilno izvedbo tudi nagrajujejo. Razvoj otroka je mogoče ocenjevati s kvantitativnimi parametri, ki vrednotijo nadzor gibanja trupa, glave, zgornjih udov in spretnosti prijemanja (2). **Metode:** V okviru projekta CareToy je bila razvita pametna igralnica in izvedena klinična študija, ki je vključevala 40 prezgodaj rojenih otrok, starih od 3 do 7 mesecev (popravljen starost). Študija je potekala s šestimi pametnimi otroškimi igralnicami hkrati. Tri igralnice so bile nameščene pri družinah prezgodaj rojenih otrok v Italiji, tri pa pri družinah na Danskem. Otroci so v igralnici vadili po en mesec. V tem času je vsak otrok izvedel približno 200 vadb s skupnim trajanjem vadbe vsaj 9 ur. Strokovni nadzor nad vadbo je bil izveden na podlagi koncepta telerehabilitacije. Vsakega otroka sta spremljala otroški nevrolog in fizioterapevt. Zanj sta pripravila individualni program vadbe. Strokovna klinična ocena otrokovih sposobnosti je bila izvedena pred vadbo in po njej. Podrobnosti protokola so predstavljene v (3). **Rezultati:** Rezultati študije kažejo na pozitivne spremembe v motoričnem razvoju, ki so posledica vadbe v igralnici. Pozitivne spremembe je mogoče zaznati tako v kliničnih ocenah kot tudi na podlagi objektivnih meritev s senzorji, vgrajenimi v igralnici. Spremembe so opazne v povezavi z gibanjem trupa, gibanjem zgornjih udov in prijemanjem igrač. Otroci so v igralnici v povprečju napredovali hitreje, kot bi bil pričakovani normalni razvoj brez dodatne spodbude. Negativni učinki vadbe niso bili zaznani. Sistem je bil pri starših dobro sprejet, čeprav so se v nekaterih primerih pojavljale tehnične težave, značilne za prototipne naprave. **Zaključki:** Koncept inteligentne igralnice omogoča prezgodaj rojenim otrokom, da skozi igro in pod nadzorom staršev zmanjšajo možnost pojava nevroloških motenj ali vsaj ublažijo njihove posledice. Prav prvi meseci življenja so najbolj kritični, saj so možgani še zelo plastični in pravilna vadba lahko pomembno vpliva na razvoj funkcij, ki so kritične za normalno življenje. Koncept pametne igralnice lahko postane primerno klinično orodje za spodbujanje pravilne vadbe otrok, ki zmanjša posledice nevroloških motenj v poznejših obdobjih razvoja. **Zahvala:** Raziskavo je delno financirala Evropska unija v okviru projekta CareToy po pogodbi ICT-2011.5.1-287932.

Ključne besede: prezgodaj rojeni otroci, nevrološke motnje, vadba, ocenjevanje.

Sensory system for training of preterm infants

Introduction: Prematurely born children with low birth weight represent the most endangered group in terms of neurological disorders. The incidence of cerebral palsy is 2 to 3 cases per 1000 births, but increases to 40 to 100 cases per 1000 births in the case of preterm infants (1). Modern technologies enable early detection of neurological disorders and targeted actions in the first months of life, when the brain is still very adaptive. Training of infants at home can be conducted in a specially designed gym equipped with various sensors and sound and light stimuli embedded in smart toys. Sensors allow for unobtrusive monitoring of child's development. Sounds and lights can stimulate a variety of child's activities as well as provide reward for properly completed actions. Child's development can be followed through various quantitative parameters that assess trunk, head and upper limbs control as well as grasping (2). **Methods:** Within the CareToy project a smart instrumented gym was developed and a clinical study with 40 three to seven months old (corrected age) preterm infants was conducted. Infants spent one month training in the gym. Within that period each infant performed approximately 200 training sessions in total duration of at least 9 hours. Clinical supervision of training was conducted based on the telerehabilitation approach. Each infant was monitored by a child neurologist and a physiotherapist that also prepared an individual training program for the particular infant. Clinical assessment of the infant's capabilities was obtained before and after the training. Details of the protocol are presented in (3). **Results:** The results of the study indicate a positive change in the motor development of children as a result of training in the gym. Positive changes can be detected in both clinical assessments as well as on the basis of objective measurements by sensors embedded in the gym. Changes are noticeable in relation to the movement of the trunk, movement of the upper limbs and grasping the toys. The children on average progressed faster while training in the gym than what would have been expected as a normal development without additional intervention. Negative effects of training were not detected. The system was well accepted by the parents, although in some cases, technical problems typical of prototype devices were encountered. **Conclusions:** The concept of the intelligent gym enables preterm infants to play under the supervision of their parents and through playing to reduce the chances of neurological disorders or at least mitigate their consequences. The first months of life are the most critical, because the brain is very plastic and appropriate training can have a significant impact on the development of functions that are critical for normal life. The concept of a smart gym can become a clinically relevant tool for encouraging proper training of infants, thus lowering the consequences of neurological disorders in later stages of development. **Acknowledgment:** This work was partially funded by the European Union Collaborative Project CareToy grant ICT-2011.5.1-287932.

Key words: preterm infants, neurological disorders, training, assessment.

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