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Holistic Approach to Establishing Product Design Guidelines for Physically Disabled Children in Remote Areas

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Abstract
There are insufficient medical services and personnel in the rural areas of Thailand, where five times as many children are born with cerebral palsy (CP) compared to the urban regions (National Statistical Office, 2012). Physical rehabilitation is considered a primary need for these children to enable them to live independently. This research therefore focuses on establishing guidelines for the development of both indoor and outdoor assistive and rehabilitation products for children with CP aged from three to nine years living in rural areas of Thailand.

To determine assistive and rehabilitation product criteria applicable for these children, on-site research was conducted together with observations and in-depth interviews with all stakeholders, including parents, carers and patients. The interviews helped to understand user behaviour, culture, living patterns, problems with the available equipment, attitudes and motivation.

Most social groups in the rural areas of Thailand are made up of extended families. Families with a child with CP generally have at least one family member committed as a dedicated full time carer. The attitude towards physical therapy by carers is considered an essential mechanism to improve the physical strength of the children. Regular physical activities and exercises at home help to maintain physical condition and improve progress.

The desired outcome from the guidelines suggested here is to promote the mobility and independence of the children, thereby reducing care time, particularly for those with Diplegia and Hemiplegia. Together with the functional aspect, the equipment also offers an emotional approach to promote physical training as well as being intuitive and enjoyable.

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Keywords: Physical Rehabilitation, children with Cerebral Palsy, Assistive and Rehabilitation Products

Introduction

Access to medical treatment is limited for children in the rural areas of Thailand. Full services physical therapy are available in only large municipal hospitals, located in the cities. Therefore, parents have to bring their children to the municipal hospitals in the cities. Physical therapy consultation therefore involves high expense and travelling time for parents with children with CP in rural areas. This research mainly targets the younger group of children between three and nine years old. Research has indicated that the earlier the treatment, then the greater chance exits for the child to overcome developmental disabilities (United Cerebral Palsy, 2014).

Understanding the living condition of children with cerebral palsy (CP)

Children with CP can be categorised by children's physical disabilities including Monoplegia, Diplegia, Triplegia, Quadriplegia and Hemiplegia (MCCARTHY, James J. MD and DRENNAN, James C., 2009). Children in each group require different physical therapy procedures. Children with Monoplegia have the least difficulty in performing their daily routine. Quadriplegia and Triplegia patients require close attention from the physician and physical therapist to correct posture. They need complex medical apparatus to improve their physical condition. Children with Hemiplegia and Diplegia have the potential to become functional in their daily activities (Kenny, T., Knott, L. and Bonsal, A., 2015). Family attitude is a critical factor in helping the children become independent (Berker and Yalçin, 2010). Therefore, this research focuses only on children with Diplegia and Hemiplegia, who can be easily assisted with carer support.

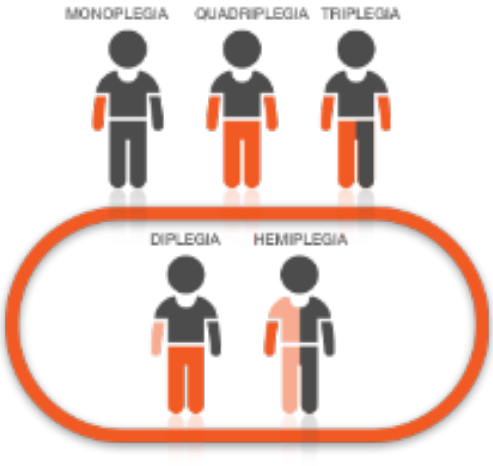

Figure 1: Anatomic Grouping of Children with Cerebral Palsy

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Understanding the Thai rural lifestyle

To design physical training equipment criteria for children with CP, understanding their living context, including their attitudes, belief, culture and behaviour is crucial. Four case studies of families with a child with CP were selected, interviewed and observed in Wangsang District, Mahasarakarm Province, Thailand.

Pam, a six year old girl, stopped working with a physical therapist when she was two years old. Her father created physical therapy equipment for her, using available local materials. She loves to spend time outdoors feeding her pet chicken, using her walker with DIY customised seating.

Kake, a seven year old boy, has physical treatment at the hospital once every three months. His grandmother regularly helps him with body massage and muscle stretching while she works in the rice field, using techniques she learnt from the therapists.

PhePhe is a six year old boy. His legs were straightened using a casting procedure. He cannot walk, but moves around in a sitting position, using his arms and hands to move his hips.

Faith, an eight year old boy, stopped visiting the doctor and the therapist six years ago. Most of the time, his teenage mother looks after him. He did not do any physical exercise when he was young and has become very dependent on his mother. He enjoys being swayed gently in his hammock, listening to music.

From the interviews and observations, the factors influencing the developmental progress of these children with cerebral palsy are carer attitudes, carer generation, way of living and the cultural lifestyle context. These can be identified as follows:

Carer typology:

Most of the young children with CP have no capability for speech articulation and all interviews were conducted with their carers. The carer is considered to be a very influential person in the development of children with CP. There were three types of carer delineated by this research; daily life influencer, treatment and therapy believer and constantly assistive carer.

Daily life influencer carer: Continuous physical exercise in daily life activities

Physical therapy is required to achieve improved physical development for children with CP. Daily life influencer carers have a positive attitude towards physical improvement, using activities around the house. This approach maximises the benefit of enjoying freedom of movement, which creates self-motivation and substantially increases family interaction and pleasure in performing their own daily activities.

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Treatment and therapy believer carer: Continuous in-home physical therapy

This group follows therapist advice strictly for children from a very early age. This leads to the building of fundamental physical strength and improves muscle control in the children. This approach allows in-home physical therapy to become more successful due to the constant nature of the treatment.

Constantly assistive carer: Discontinued therapy process

Constantly assistive carers are concerned about child discomfort and pain during the in-home physical therapy process. They have a tendency to stop the in-home physical training because of pain and to reduce physical therapy and activities. Older children with CP who do not receive assistance with physical movement and therapy will have less potential for recovery. There is also the chance of calcification in the bone joints, particularly around the hips, which then requires surgery.

Generation difference

There are two generations of children with CP carers; the local-wisdom generation and the consumer generation.

The local-wisdom generation of carers believes in local wisdom, craftsmanship and farming. This group has special skills in creating their own physical training equipment from scratch. They are adaptive, making modifications and integrating local materials when they receive support equipment from the government that is not appropriate to the rural area environment or child's body size. Figure 2 illustrates samples of adaptions that have been made to some equipment; a Thai sarong for walker seating, bamboo walking bars and a wooden rocking animal chair for sitting training.

Figure 2: Thai local sarong for walker seating, bamboo walking bars and rocking animal chair

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With their limited leg strength, children need resting time between walking training sessions. The Thai local sarong has been incorporated into the walker. This helps the children to enjoy a longer walking training session. The apparatus becomes a walking companion rather than just equipment. The bamboo walking bars are made from simple, readily available local materials. The rocking animal chair is created to assist body balance, improving sitting capability.

The consumer generation is predominantly the younger age group. They are influenced by western culture and high tech gadgets. They work in the factories of the cities. Skilled craftsmanship is not their forte. Making adjustments to available products in the market to adapt to individual needs is foreign to them. This group of carers therefore only purchases what is affordable and available off the shelf, rather than creating their own equipment. For example, one of the carers bought a standard size adult walker from the store because the child size was unavailable. This leads to awkwardness and failure in the children's physical training.

The equipment should be designed to allow users to personalise the product using local materials. Replacement parts should be available in local stores at an economical price.

Balancing the caretaking, housekeeping and occupational roles

People in Thai rural areas generally start families at a young age, late teens to early 20s. Most of these young parents work in the city or in factories. With disabled children with CP at home, some have to leave their jobs and become fulltime carers. The time required for caring and physical training work with the children at home precludes any other employment.

Reduce idle time and increase efficient training time

Some children with CP are left unattended in their hammocks or on their sleeping mattresses. Establishing equipment to promote self-motivation and enjoyment gives children the desire to move around and explore their immediate environment, without realizing that they are actually exercising. This has been very successful in previous case studies, increasing both confidence and physical strength.

While the parents are working during the daytime in factories or even living in different locations, grandparents assume parental responsibility. They can stay at home or in the rice fields and take care of the children.

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Figure 3: Daily life routine of a grandmother massaging her grandson at the rice field

Time becomes a key issue for carers with children with CP. Any equipment that could help to free some time, allowing the carer to carry on working, whilst simultaneously supporting the child with physical exercise would be beneficial.

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Indoor and floor based activities culture

Thai urban housing space and living area has been influenced by western culture. Houses are divided into rooms, based on purpose or activity. The urban lifestyle has adopted the method of performing activities on a table surface.

Compared to this urban lifestyle, rural indoor living space and activities have remained consistent with the past. Rural indoor space is small and generally open plan. There are no partitions or rooms. This allows the space to become more versatile. One large room is used for hand crafting, eating, sleeping, and playtime activities which are all floor based.

In this open plan environment the children can become involved and a part of all activities within the house. The space allows them to become explorers.

Extend physical strength & explore outdoor activities

People in Thai rural areas spend most of the day outdoors. Family members perform outdoor activities together with the child, including feeding pets, playtime and walking exercises. Children who spend time outdoors generally have more physical interaction with people and their surroundings.

Step-by-step physical progression

Children with CP with underdeveloped physical strength in Thai rural areas are often left bedridden or confined indoors. Occasionally the carer will carry the child outside and sit him/her on their lap to take part in family activities. Some carers place the child in a hammock when they need their own personal time. This has an adverse effect on the backbone structure of the child.

Equipment for supporting sitting training which is available in Thailand is generally unaffordable, bulky, and difficult to be adjusted to the individual body size. Most of this physical equipment is designed specifically for medical purposes, with no consideration for use in the home. Some equipment requires the child to be strapped in. Local carers see this as a negative, rather than a therapeutic process. The equipment should be designed to encourage children to use it and promote motivation. Without sitting training equipment, the fundamental precursor for standing and walking, some children with CP struggle to properly develop muscle strength.

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Design criteria framework for physical product development of children with CP in the rural areas of Thailand

Design direction framework

Ideally, consultations and frequent visits to a physical therapist help children with CP with successful and improved physical and verbal development. However, this model does not work for children with CP in Thai rural areas with constraints of expense and time. Case studies have demonstrated clear evidence that encouraging children with CP in their daily life activities at home has a significant impact on physical development. Integrating physical therapy with daily life activities by a carer allows the children to have fun and motivates them to move around. Being stationary has an adverse impact on child well-being. Effective and viable solutions are required to fit in with the Thai rural context.

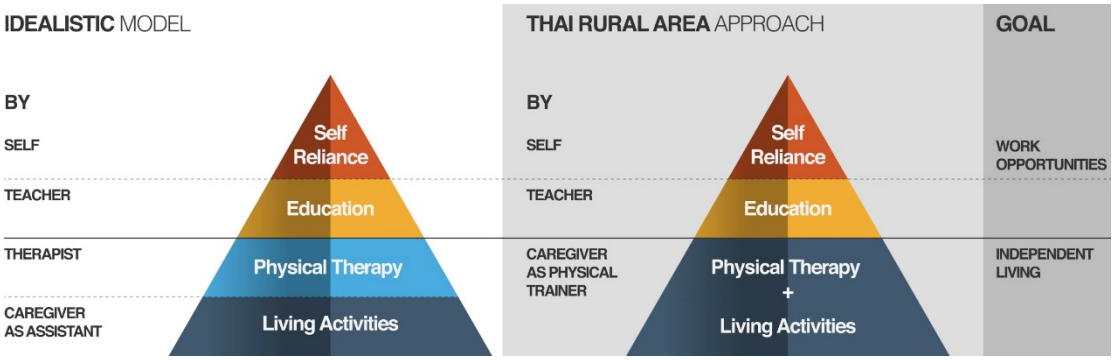

Figure 4: Design criteria framework for physical development of children with CP in Thai rural areas

Design criteria

There is great potential for developing two sets of equipment to help both children with CP and the lifestyle of the carer in Thai rural areas.

'Indoor low rider'

The 'Indoor low rider' approach could help children with CP explore their indoor environment and spend time with other family members while doing daily activities. The 'low rider' is designed to motivate children to move around, rather than providing a strict posture correction. Setting up the equipment requires minimal effort and it is considerably simpler than regular medical physical therapy devices. This 'low rider' is mainly focused as a child indoor companion vehicle. Simultaneously, it also assists the carer and frees up some carer time while the child is having fun.

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To fit in with daily floor based activities, the equipment should be low in height. The 'low rider' is equipped with wheels to encourage children to move around the house with ease.

Figure 5: Design guideline for the 'indoor low rider'

I. Sitting Training Apparatus

The equipment should be used as sitting training for balancing and strengthening their gross motor skills around their back. Once the children have improved back strength and balancing skills, they can then use their hands and legs to propel the 'low rider' in any desired direction.

II. Add-on modules with increased functions

Auxiliary parts and modules can be installed to the 'indoor low rider', including a headrest, dining or playtime tray, spread-apart leg module, and personalised covers. These will allow the 'low rider' to become personalised, versatile and support multiple activities.

III. Materials

The use of easy-to-clean materials is recommended. All parts and pieces should be available in local stores and replaceable with available local materials. Colourful, friendly and curvy shapes are attractive to children who will develop an emotional bond with this product.

IV. Safety issues

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With all these key considerations, safety is a priority. Children will be encouraged to get on and off the equipment by themselves, if it is sufficiently stable. This will help to strengthen their arms. Alternatively if the children cannot mount the 'low rider' by themselves, then carers can assist them. Some braking system may be necessary as a safety feature.

'Outdoor rugged walker'

The 'outdoor rugged walker' could help to improve gross motor skills for standing and walking training procedures. This 'outdoor walker' will help to promote freedom of movement rather than correcting posture. The walker will allow the children to gain confidence and depend on themselves. It will significantly reduce the time required by carers to pay close attention to the children.

Figure 6: Design guideline for the 'outdoor rugged walker'

I. Adjustability

Physical therapists at Srisangwan School have noted that the physical strength and skills of children with CP are not defined by age. Some older children have less physical capabilities and some younger children have advanced physical capabilities. The 'walker' should be adjustable in both height and width to accommodate the different body sizes of the children.

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II. Resting and safety seat

With limited leg strength, the children will need to rest in the seat during walking training sessions, or sit still while enjoying other outdoor activities. The seating does not need to be extremely comfortable, but merely provide the facility for a short rest. This will stimulate children to spend a longer time on the walking activity. The seating also functions as a 'safety net' to protect the child from any injury in case of sudden weakness of their legs and free fall.

III. All-terrain walker

In rural areas, the house environs are normally paved with sand, gravel, or are grassed. This differs from urban well-paved surfaces. For travelling on rough surfaces, larger wheels are easier to manoeuvre. The wear and tear factor also becomes a significant consideration. Wheels should be available in local stores at low cost.

IV. Portability

The equipment should be collapsible and compact in size for driving trips, particularly for therapist consultation at the Municipal Hospital.

V. Materials

The materials used should be lightweight, with a collapsible and therefore easily portable design. Seating can be customised based on the child's preference and replaceable with local materials after wear and tear. For outdoor use in a tropical environment, materials should be rugged, rust resistant and easy to clean.

VI. Safety

Controlling the 'walker' by hand may be challenging for children with CP. For safety, the 'walker' should have a semi-automatic stopping mechanism, particularly necessary when travelling down a slope. Brakes should also be deployed when the 'walker' is used as a standing training device.

Discussion

The project targets local maintenance for equipment which is adaptable and suitable for use in rural areas. All parts in the design should be affordable and easy to adjust by the carer without instructions. These products can help children with CP in rural areas to have more opportunity for physical training. They will have more freedom, which will make the activities enjoyable, and help support their independent living in the future.

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