An Ergonomic Perspective of User Need on Physio-Treadmill (*PhyMill*) Criteria: Knowledge and Awareness of Cerebral Palsy among Future Parents

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Abstract. Cerebral palsy (CP) is the most common childhood disability. This study focused to explore the future parents' perspective on the Physio-Treadmill (*PhyMill*) for the kid with CP, particularly how ergonomics influences the product. The study was carried out by a quantitative survey and involves 55 participants. The participants have answered a self-administered which consists of general information, knowledge awareness on cerebral palsy, product criteria and opinions. The result shows about 55% of participants have a poor level of awareness and 69% of participants have zero knowledge of CP treatment. However, based on the product criteria, most of the participants agreed, the present *PhyMill* shows well in functionality. Hence, this study emphasized the lack of awareness and knowledge of the disease and treatment among future parents. Besides, the *PhyMill* need to improve from the potential user recommendation as ergonomics consideration on medical devices.

Keywords: Cerebral palsy, treadmill training, physiotherapy, walking treatment, ergonomic.

1. Introduction

Cerebral palsy (CP) can be defined as a group of disorders that influence the development of body movement and posture causing limitation of activity: thus, it is not surprising that physiotherapy is one of the backbone of treatment and management for this disease [1,2]. Some known risk factors that may lead to CP are accidents, abuse, medical maltreatment, negligence, infections, and injury [2]. CP estimates for prevalences are reported at 1.5 to over 4 per thousand live births or children of a certain age from population-based surveys worldwide [3]. Based on Kamaralzaman et al.,(2018) [4], 53% of patients who suffered from CP are male. The majority of racial factors are Malay with 88%, followed by Chinese and other races [4]. An international study is commonly known as the Gross Motor Function Classification System (GMFCS) that consists of five levels, classify children with CP by their capacity to push themselves and their need for assistive technology and wheelled mobility. A GMFCS level classification is expected to stay the same for an individual's life but treatment and therapy can improve

the ability of sufferers. But without exercise and medical rehabilitation, people with CP can experience a decrease in physical ability [5,6]. Medical devices help millions of people, but can also lead to injuries and accidents which have serious impacts on patients and users affected. Consequently, manufacturers are obliged by law to regularly uphold the quality and efficiency of those health equipment already licensed and now in clinical care, in order to reduce the risk factor of medical devices. [7].

Recently, part body weight support associated with gait training on a treadmill (PBWSTT) was used successfully in children with CP as young as fifteen months and can be used with children that are still not independent. The alternative has been used in order to increase the performance of gait in persons with motor disabilities. [8,9]. One or more physical therapists may be required depends on the extent of the person's impairment to help maintain appropriate posture and move the person's legs through as temporally and kinematically physiological a gait pattern as possible [8]. Furthermore, the researchers reported that it seems PBWSTT can improve the ambulation velocity, walking endurance, gross motor function, step length, stride length and cadence [8–16].

Three types of CPs are spastic, athetoid and ataxic. The motor cortex of the brain, which causes severe muscle tension, is affected by spastic. Besides, athetoid also results from damage to the brain's basal ganglia and/or cerebellum. While ataxic is different from other forms of CP, it is caused mainly by damage to the cerebellum that regulates balance and coordination. This study focus on spastic diplegia which is a typically common problem with the disorder is muscle tension [17–19]. Spasticity is seen as a major barrier to patient rehabilitation and improvement. Different clinical approaches were proposed so far to address and improve motor difficulties and the output of CP children. Walking treatment on a treadmill seems effective for children with motor disorders [15]. The introduction of treadmills with a harness seat called body weight supported treadmill training (BWSTT). BWSTT used to improve the stride length and step length [10]. Besides, to get better self-selected walking velocity and gross motor function.

In this study, we focus to explore the engineering students' as future parent perspectives on the Physio-Treadmill (*PhyMill*) for the kid with CP, particularly how ergonomics influences the product.

2. Methodology

2.1. Sample size

A convenience sample of youth was recruited among final year engineering students in University Malaysia Pahang (UMP). These samples are used because they have the potential to become a parent in the future. Furthermore, CP is a common disease at the early age of children. The research questionnaire was administered to fifty-five (55) respondents and selected randomly among difference faculty in Universiti Malaysia Pahang.

2.2. Questionnaire

A questionnaire was the main tool for data collection. A structured questionnaire was divided into four sections consisting of questions: A) general information B) knowledge of CP C) product criteria of *PhyMill* for CP D) opinions on investing for the *PhyMill* was used. The questionnaire was administered to the final year engineering students. The questionnaire combined closed-end questions like yes / no answers and multi-choice questions with predefined responses to allow respondents to pick and rank among a number of options or to rank on a "very unsatisfied" to "very satisfied" scale. At the end part of the questionnaire, the comments, suggestions, and concerns are open which can help us to improve the product. This open part is considered to be particularly important in order to enhance the understanding of the overall results of an investigation and provide more valuable material. The survey was conducted in the Human Engineering Group lab, Universiti Malaysia Pahang. Figure 1 shows details on how we conduct these perspectives study.

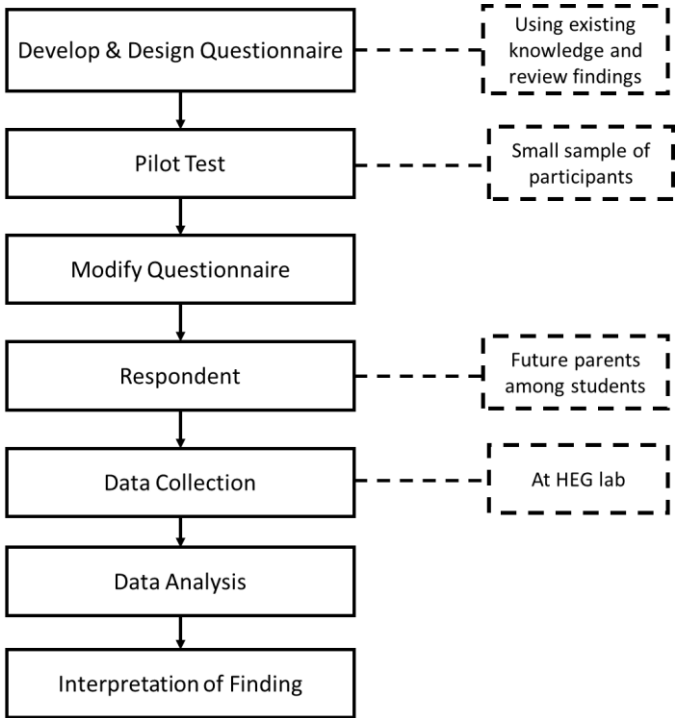

Figure 1. Survey process

2.3. Physio-Treadmill (PhyMill) for Cerebral Palsy

Figure 2 shows the Physio-Treadmill (*PhyMill*) product for kids with CP. A *PhyMill* for CP has successfully developed by the Human Engineering Group team, Universiti Malaysia Pahang. The treadmill can be used by CP's patients with spastic diplegia type and suitable for GMFCS II to III with age four to six years old. The treadmill can fit for kids with 90cm to 100cm range of height and can support up to 35kg.

Figure 2. Physio-Treadmill (*PhyMill*) for Cerebral Palsy

2.4. Limitation on the functionality of the PhyMill

The *PhyMill* is made for children with CP who have limited walking ability which specific for walking treatment to improve their gait. The kids with GMFCS II to III are the target user for this treadmill. The *PhyMill* is intended for children, so the design deal with a limited range of reach of children only. It is

impossible to fit all range of age. The *PhyMill* has an adjustable speed controller that can be control based on the ability of the patient to walk. The real-time adjustment to the patient's varying speed of walking called self-paced speed algorithm or self-selected walking speed. Besides, the height of the *PhyMill* can be lower down and raise up depends on the height of the patients. The *PhyMill* can be used by children aged around 4 to 6 years with a specific height of approximately 90cm to 100cm in medium waist size. The requirements of all levels of age can not be met, but the use of a *PhyMill* for CP patients from an early age will have a better impact than the delay in using this technology. At a much lower cost than oversea, this technology is available to many people who need it. Indirectly, it allows more patients to have the ability to walk without limitations and walking aid.

3. Results

3.1. Demographic

Based on the questionnaire, the result represents the personal demographic data of the participants. Figure 3 indicates the number of participants with 36 (65%) males and 19 (35%) females. The majority of respondents being Malays 50 (91%) and mostly come from the Faculty of Mechanical & Automotive Engineering Technology.

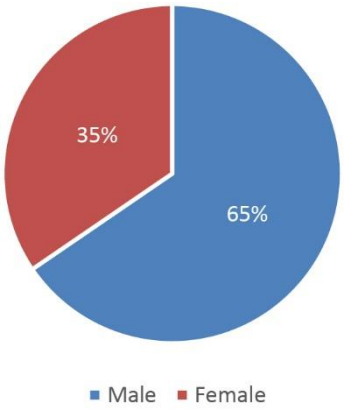

Figure 3. Illustrated the respondent details by gender.

3.2 Knowledge and Awareness of Cerebral Palsy

Figure 4 demonstrated the number of participants that have knowledge of CP treatment. The proportion of participants who do not have knowledge about the treatment is substantially. The results show only 17 (31%) of the respondents know CP treatment. Meanwhile, 38 (69%) of the respondent do not recognize about the CP treatment.

Figure 5 presented the percentage of awareness among participants about CP. Recorded, more than half of the respondents never heard and not concerned about CP. Approximately 55 % were moderately aware and only 45 % had an advanced knowledge of the disease. The research highlights the need for better education for the patient, parent and also family members about the CP since it has an influence on the consciousness of care enforcement.

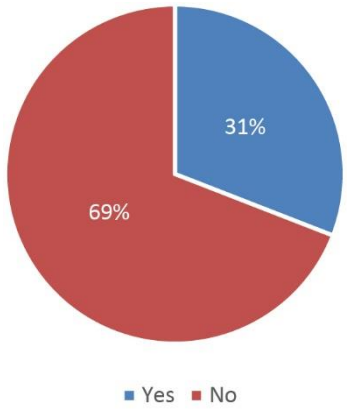

Figure 4. Presented the knowledge of respondents about Cerebral Palsy's Treatment

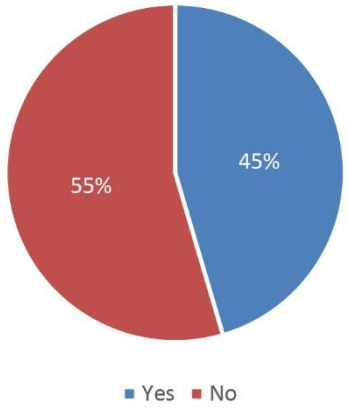

Figure 5. Presented the awareness of respondents about Cerebral Palsy

Figure 6 shows the percentage of the respondent on CP undergo rehabilitation treatment. The highest percentage of about 46 (84%) reported that they don't have any experience with CP treatment.

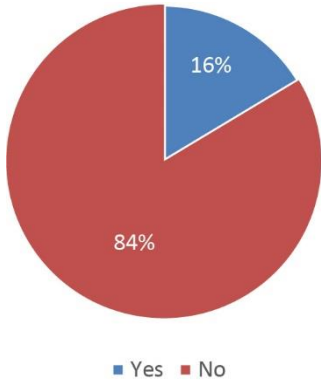

Figure 6. Demonstrated the Cerebral Palsy patient undergo rehabilitation treatment

3.3 Criteria of the Product need from Customer

Figure 7 proves that the product criteria of the *PhyMill* included functionality, comfortability, safety, quality of product, appearance and etc. The survey distributed to final year engineering students as future parents. As shown in this figure, most participants satisfied with the treadmill's functionality. Comfortability is the lowest followed by safety. Comfort will help the

patient to be happier which has a positive impact on the productivity of walking treatment. Most of them very satisfied with functionality which is 26 respondents, followed by meet the patient's requirements, 24 respondents. Other criteria as an overall product, appearance, quality of product and user-friendliness of the product have 20 respondents voted. Meanwhile, 17 respondents very sensitive to the safety issues.

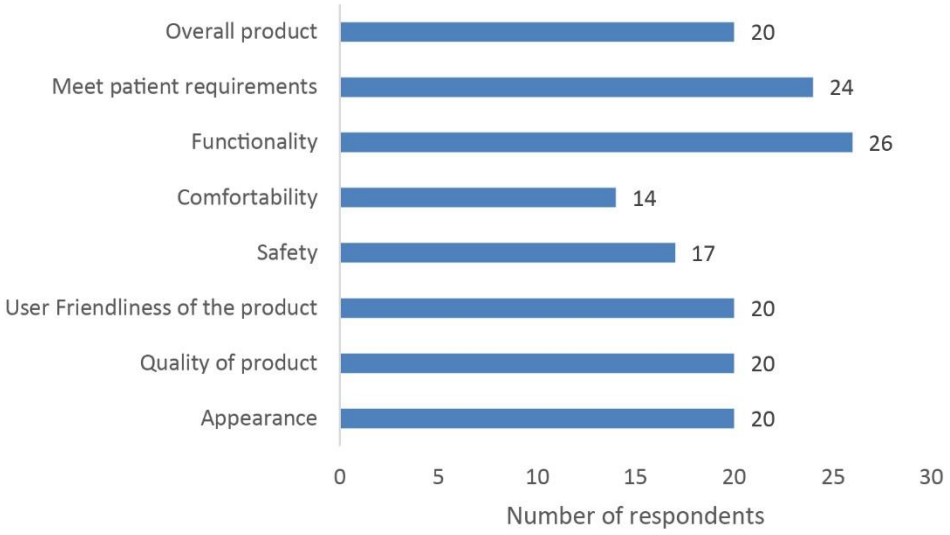

Figure 7. Product criteria of *PhyMill*

The safety of the *PhyMill* also plays very important roles in product selection criteria. Normally, the shape of the product is a crucial criterion in which defect shape will influence to the safety issues. In figure 8 shows the majority of 30 respondents satisfied with the safety of the product while the other 18, 6 and 1 respondents are very satisfied, neutral and unsatisfied with the safety of *PhyMill*, respectively.

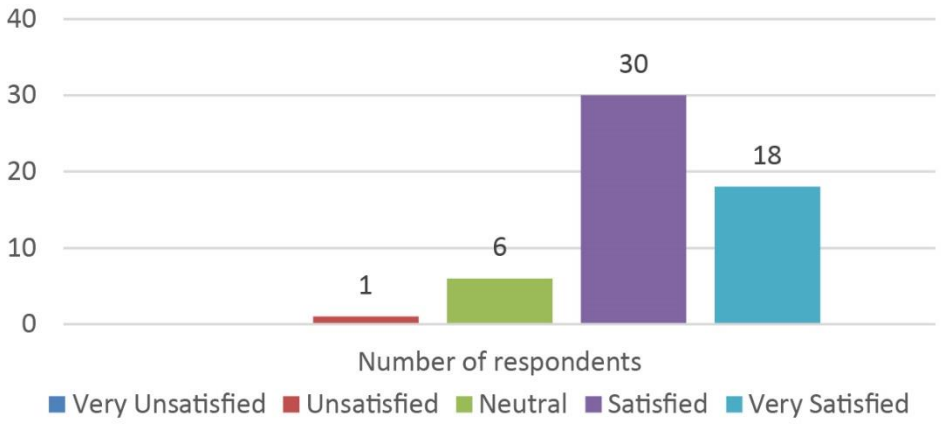

Figure 8. Represented the product safety of *PhyMill*

4. Discussion

4.1. Awareness and Knowledge

Awareness of disease symptoms is necessary for screening and early detection. They are more likely to take action to prevent it from happening if members of the public are aware of a disease. Lack of

awareness in the community is not only dangerous in terms of worsening health effects, but it can also be divisive in society and can affect the quality of life. The fact that CP is not contagious [20]. Future parents should have knowledge of this common disease for their children. Parental fear and anxiety arise usually due to a lack of knowledge about the disease and treatment.

4.2. Comfortability

Results clearly indicated the *PhyMill* needs several adjustments on the comfortability of the harness seat by adding the backrest and use softer fabric.

"Can make the seat to be more fashionable and improve the harness safety"

said by most of the respondents. This statement shows that the *PhyMill* needs improvement on harness with better fabric and the strap should be wide as it needs strength to carry heavier weights. Anthropometric data will make sure the product suits the target user or user range [21]. The respondent also said by added the features, the height of the *PhyMill* can be adjustable. So, it can widely use a different range of patients for the overall of the product.

4.3. User-Friendly

Improvement in terms of appearance needs to be emphasized as

"Make its variety of color since it for the child so it can look more cheerful and fun for kid"

said one of the participants. The automatic treadmill for CP especially for walking treatment purposes is not widely used. One of the possible reasons is they are not available in Malaysia because relatively expensive compared to overground training.

4.4. Safety

Nowadays, the development and use of medical devices are increasing rapidly, implementing measures to guarantee patient safety. All products made are required by law to be safe to use. The safety and reliability of medical devices have influences on the patients' health and life. Evidence shows that a significant proportion of device-related adverse events are caused by human error. To help reduce accidents and enhance patient safety, potential users of a specific medical device should know how to use it properly [22].

5. Conclusions

As a summary, future parents should be having the initiative to learn about CP. Working with a potential product as *PhyMill,* it made possible to identify information considered relevant for the users. The results show the patient's requirement and comfortable criteria totally agreed that *PhyMill* can be used as a support for the physiotherapist and physician. Determining user needs on the *PhyMill* also compulsory and reflects an ideal on the design process especially in medical device products.

Acknowledgments

The support of the University Malaysia Pahang under grant RDU190153 and MedEHiT are gratefully acknowledged.

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