Asia-Pacific Journal of Science and Technology

https://www.tci-thaijo.org/index.php/APST/index

Published by the Research and Technology Transfer Affairs Division,
Khon Kaen University, Thailand

Adaptable ergonomic interventions for patients with cerebral palsy to rice farmers activities: reviews and recommendations

Agung Kristanto[1,2,3], Manida S. Neubert[1,4,*], Rungthip Puntumetakul[1,5] and Weerapat Sessomboon[2]

[1]Research Center in Back, Neck, Other Joint Pain and Human Performance (BNOJPH), Khon Kaen University, Khon Kaen, Thailand
[2]Department of Industrial Engineering, Faculty of Engineering, Khon Kaen University, Khon Kaen, Thailand
[3]Department of Industrial Engineering, Faculty of Industrial Technology, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
[4]Program of Production Technology, Faculty of Technology, Khon Kaen University, Khon Kaen, Thailand
[5]School of Physical Therapy, Faculty of Associated Medical Sciences, Khon Kaen University, Khon Kaen, Thailand
[*]Corresponding author: manida@kku.ac.th

Received 24 April 2019
Revised 26 July 2019
Accepted 8 November 2019

Abstract

Although inherently different in causation, a previous study demonstrated that physical disabilities faced by people with cerebral palsy (CP) might also be experienced by rice farmers due to extreme working conditions. Certain assistive technology (AT) extensively developed for CPs might also be of benefit to healthy farmers to prevent occupational injuries. This article provides a constrained review of available ergonomic interventions for CPs that bear prospect to be applicable to rice farmers. All papers were retrieved from the last 20-years collection from nine major search engines. Terms of “ergonomic interventions”, “congenital disability”, “cerebral palsy” and “orthoses” were used as search keywords. Two reviewers defined whether the articles complied with the inclusion criteria of: (1) a review or the next best available; (2) contains ergonomic interventions; and (3) more than 25% of participants were CPs. The interventions were then categorized as: (1) engineering, (2) administrative and, (3) behavioral interventions. Most studies reported engineering and administrative interventions to significantly improve motor function and gait characteristics. Behavioral interventions successfully promoted positive mood and behavior. Types of intervention for CPs that might be adaptable for farmers were discussed, along with related examples previously proposed for reducing injury among farming workers. In general, the findings indicated most adapted interventions were based on educational programs, with no attempt to adapt engineering interventions from CPs for farmers. We recommended that a certain combination of engineering and administrative interventions for CPs treatment, with slight modifications, may be applicable to farmers for preventing risky environmental conditions and unsafe working postures.

Keywords: Ergonomic interventions, Congenital disability, Cerebral palsy, Paddy field farming

1. Introduction

Disability can be generally divided into two main groups based on the causation, namely congenital disabilities and circumstantial disabilities [1]. Congenitally disabled people with cerebral palsy (CP) display a walking-related disability or muscular weakness, which is often caused by upper neuron disorders. Previous studies indicated that certain characteristics of the working environment can potentially render healthy workers to have performances comparable to that of disabled people. It was also noted that indirect disabilities induced by various work-related tasks may possibly lead to physical and cognitive conditions resembling congenital disabilities [1]. With this possible association, muscle injury encountered by CP patients might, also be developed by rice farmers due to the unsafe work posture and environmental conditions experienced in paddy field.

The most common tasks during rice cultivation in Asian countries are still performed in a traditional fashion, involving awkward work posture and harsh environmental conditions. Typical examples for such processes of paddy field farming include plowing, seeding, planting, nursing, fertilizing, and harvesting. Notably, almost all stages of paddy farming involve repetitive motions, uncomfortable postures, heavy lifting and carrying, prolonged standing, and control of heavy and vibrating machinery [2]. Specifically, the plowing task is conducted by using a heavy vibrating plowing machine, while the seeding, nursing, and fertilizing activities implicate heavy lifting and carrying. The planting stage involves repetitive forward trunk bending and twisting and prolonged stooping and walking is required during harvest. All these tasks clearly represent risk factors for biomechanical malfunction and chronic musculoskeletal disorders (MSDs), which is further emphasized by a previous study reporting the rate of occurrence for MSDs among Thai rice farmers ranging between 10.3-73.3%. In addition, a high prevalence for foot pronation and knee valgus has been found with percentages of 20.9% and 18.5%, respectively [2]. This situation is exacerbated by the preference of farmers to perform their work with bare feet, since the muddy work environment in the paddy field has previously been found to increase force loading on foot and knee joints and muscles due to adverse effects of ground viscous force [3]. However, the development of technological interventions protecting workers, in particular rice farmers, from extreme occupational harm are still rare and limited.

A previous study revealed preliminarily evidence that both rice farmers and CP patients are potentially related in terms of perceived foot and knee soreness and MSDs injuries [1]. Although inherently different in causation, physical disabilities typically associated with CP patients, including knee and foot muscles and joints damage, were also experienced by rice farmers due to the risky environment and unsafe working posture (see detailed investigation in [1]). Likewise, a similarity between the standing posture of CP patients and that of rice farmers during the performance of cultivation activities has been observed, as both population were found to have a high prevalence of knee valgus and foot pronation. Therefore, knee and foot injuries and MSDs should be the main focus of intervention designs in order to avoid the potential risk of lower extremity (LE) harm for paddy farmers. Such interventions could potentially be based on assistive technology previously developed for the CP population. Non-occupational disabilities research can be used as a solid basis for assistive technology (AT) development studies for the agricultural workforce, as available AT designs for the disabled population are already widely available in the commercial market (e.g., back braces, foot orthotics, leg braces, wheelchairs, etc.) A broad range of research with a focus on AT development for people with disabilities has already been conducted which could also benefit healthy workers exposed to extreme working environments to ease daily life activities or prevent occupational-related injuries [1].

This article aims to provide a constrained review of available interventions for CP disabled people that could be applicable to rice farmers. Ergonomic interventions reviewed in this article were categorized into: (1) engineering, (2) administrative and (3) behavioral control measures [4]. Engineering interventions involve designing systems, equipment or process for eliminating or reducing exposure to dangers (i.e., combining engineering controls and personal protective equipment in the traditional ergonomic/safety preventive measures). Administrative interventions focus on controlling procedures and work practices for example work rotation, task units, and policies. Behavioral interventions are separated from traditional administrative controls in this article, as they concentrate on modifying personal behaviors, which includes behavior support and stress management. A subsequent section provided detailed discussions regarding the adaptability of each intervention in terms of assistance capability, ability improvement and MSD prevention. The intervention types of the CP population that might be applicable for farmers were then discussed, along with related intervention examples that had been proposed for reducing risk of injury among paddy field farming workers.

2. Materials and methods

In this study, we focused on the literature regarding ergonomic interventions for CP patients. A constrained review was performed using nine article databases, including: "Scopus", "Web of Science", "CINAHL", "Cochrane Database of Systematic Reviews", "Education Source", "ERIC", "Journals@OVID", "MEDLINE", and "PASCAL". The specified terms "ergonomic interventions", "congenital disability", "cerebral palsy", and "orthoses" were used as search keywords in this study. In the first stage, we recognized 256 pertinent manuscripts which were further refined by the restrictions of being in the English language and published within the last 20 years.

Subsequently, two independent reviewers defined whether the articles complied to the inclusion criteria of: (1) the article was a review or the next best available; (2) it contained ergonomic interventions; and (3) more than

25% of the participants were persons with CP. Ergonomic interventions were categorized into control measures involving adjusting workers' environment, tools, work methods and behavior, as well as long-term educational/training approaches to treat and prevent further damage due to MSDs [4]. Finally, after in-depth analysis of abstract and full text articles, 21 articles were included in this study. These comprise 8 papers from Scopus, 4 papers from Web of Science, 4 papers from CINAHL, and 5 papers from MEDLINE. No papers met the inclusion criteria in Cochrane, Education Source, ERIC, Journals@OVID, and PASCAL. The whole screening and acceptance process is described in Figure 1.

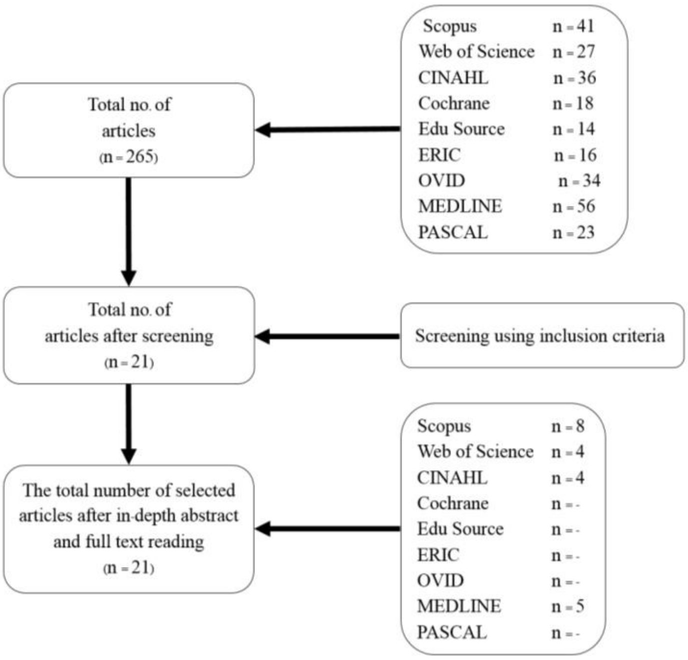

Figure 1 Article screening process.

3. Results and Discussion

Selected papers which focused on ergonomic interventions for people with CP were reviewed in detail. The results in brief are shown in Tables 1 to 3. Although the prior research showed that farmers and CP patients share similar problems in the foot and knee regions, the present review was conducted for the whole body, since some interventions might be adaptable to lower limb parts.

The following subsections discuss interventions for people with CP that could also be applied by healthy rice farmers working in extreme environments to prevent or treat occupation-related injuries. Subsequently, a similar literature search was conducted for interventions that had previously been proposed for rice farmers. The specified terms "ergonomic interventions", "rice", and "paddy" were used as search keywords. Table 4 shows the interventions developed for CP patients that might be adaptable for rice farmers, along with related examples that had been proposed in previous studies.

3.1 Engineering Interventions

Adaptive devices have been shown to be effective in both the disabled and aging population [5]. Adaptive devices successfully assist people with disability in functional problems, including difficulty with activities of daily living (ADLs), as evidenced by a high percentage of improvement in the desired outcomes. However, most devices were designed for home use or with environmental modifications (e.g., ramps). Therefore, adaptive devices might not be suitable for the environmental conditions in a paddy field.

Orthotic devices, including casted orthoses, have been demonstrated to successfully enhance the range of motion (ROM) of the lower extremities [6-7]. However, this type of orthosis is also associated with some adverse effects, including: difficulty to fit into footwear, skin irritation, foot and calf pain, cast breakdown, and continuing impairment conditions, as well as the high cost and time consuming production. [7]. Removable external orthotic devices, such as knee braces, ankle foot orthoses (AFO) and knee ankle foot orthoses (KAFO), are generally used to control movement, provide an opposing force, and support ineffective joints or muscles [8]. Previous research found braces to improve gait parameters as compared with standard treatment [8]. However, conventional rigid designs restrict movement as they keep the knee and ankle in a fixed position to provide stability during walking. More recent designs include adaptive control for joint restriction using pneumatic or electric actuators [9]. However, these are costly, often complicated, and need an external power source. Simple corrective insoles are less expensive and require significantly less time to produce. Previous research showed the corrective insoles to be successfully tested for the reduction of foot eversion in footwear that has restricted space [31].

Breathable orthotic garments, such as the TheraSuit [10], is another possible intervention that has been found to help improve gross motor function without any serious safety issues or skin abrasions reported during the treatment [10]. The suit was originally designed to be worn with bungee cords; however, the additional cords did not add any benefit when compared with wearing the suit alone [10]. Although the suit might provide only a small percentage of improvement, the noncompulsory requirement of supportive cords contributes some mobility to the device. Therefore, it might represent a possible intervention applicable to farmers performing field work.

Seating and positioning devices enable a person with CP to sit in a comfortable posture and help improving postural control in general [11]. A variant of the device comprising an air inflated seat has been introduced to farmers for postural control during the harvesting process [26].

3.2 Administrative Interventions

Educational programs and training, such as manual training, conductive education, and early intervention, which developed and successfully improved motor performance and safety for CP patients, may also be applied to rice farmers [12-14]. Regarding the educational programs, prior research [27-28] proposed to impart appropriate knowledge and control for safe rice farming work. Health education, as part of the Injury and Illness Preventive (IIP) intervention program [27], was conducted to support risk awareness and to provide safe work conditions during rice field farming. The training provided knowledge regarding work-related injury and illness, and ergonomic guidelines at work (e.g., appropriate work posture, material handling, tool use and working environment). Another part of the IIP program, safety inspection, included training for inspecting equipment safety and working conditions, in order to help farmers to be able to recognize unsafe behaviors and working environments.

Goal-directed functional training [15] using a motor learning approach might also be beneficial to rice farmers similar to the approach used for CP patients. A previous study reported a medium effect size of improvement when comparing goal-directed functional training and physical therapy based on normalization of the quality of movement [15]. In a simulated paddy field plowing task, the researcher found experienced farmers to generate a higher grip force, to use and balance muscles more effectively, and display a lower fatigue rate, as compared to novice farmers [32]. It was suggested to develop motor learning training for farmers to achieve effective muscle use and minimize the risk of injuries.

Fitness and strength training was found to significantly improve and maintain physical fitness and muscle strength for CP patients, when compared with regular physical therapy sessions [20-21]. These specific training programs were also proved to help increasing muscle endurance and physical function, as well as reducing pain in rice farmers with chronic low back pain [29]. Simple physical exercises during the normal work schedule were also proved to reduce musculoskeletal pain and improve productivity [33]. Massage therapy was also found to induce greater reduction in perception of pain and spasticity, as compared with a reading control group of CP patients [18]. Such corrective intervention might also alleviate pain experienced by rice farmers. In addition, manual stretching applied to CP patients to prevent muscle contracture [19], would be applicable to rice farmers. It was suggested to farmers that they perform simple stretching exercises during the lunch break. Furthermore, the application of massage therapy was suggested as a practical treatment to help relieve muscle pain and stiffness experienced by farmers [34] as in CP patients [18].

3.3 Behavioral Interventions

Caregivers successfully used animal assistance to improve patients' socialization and mood, reduce stress, and assist in ADLs [30]. In the rice cultivation context, paddy field preparation and the threshing process is sometimes conducted with the aid of farm animals [30]. Besides the use of farm animal assistance as a low-cost and environment-friendly farming technique, the farmer's relationship with the animal contributes to the concept of social and economic sustainability [30]. In some communities, farm animals are sometimes given as a gift to relatives, friends or in marriage, and used in religious functions.

Behavior therapy, developed to support positive behavior in children with CP [24], was identified as another form of possible intervention that could be adapted for promoting safety awareness and behavior by rice farmers. A previous study demonstrated a considerable reduction of oppositional behavior by CP children when a family group actively participated in the therapy, as compared with a wait-list control group [24]. Safety communication, as part of the IIP program [27], applied risk communication processes to deliver information regarding possible occupational hazards, health effects and techniques for hazard prevention to rice farmers. Health surveillance programs required paddy field farming workers to report their injury or illness in order to identify the root cause of the incident.

Table 1 Reviews of selected articles-Engineering interventions.

No	Intervention	Outcome	Reference
1	Assistive devices: equipment or devices to improve independence, such as walking frames, wheelchairs, adapted computer access	Improvement of desired outcomes in activities of daily living tasks (PDcontrol = 66%, PDintervention = 75%); slower decline in functional level of independent (PDcontrol = -3.8%, PDintervention = -1.8%)	[5]
2	Casting: plaster casts applied to limbs for muscle lengthening or to reduce spasticity	Improvement of passive range of motion (ROM) of lower limbs and stride length	[6-7]
3	Orthotics: removable external devices designed to support weak or ineffective joints or muscles	Improvement of stride length, ROM and walking distance (RPD =45%), and reduction of abnormal alignment (RPD = -1.1%)	[6, 8-9]
4	Orthotic garments: breathable soft dynamic orthotic full body suit, designed to improve proprioception, reduce reflexes, restore synergies and provide resistance	Gross motor function improvement (PDcontrol, suit only = 5.9%, PDintervention, suit with supportive cords = 4.5%)	[10]
5	Seating and positioning: assistive device that enables a person to sit upright with functional, symmetrical or comfortable posture	Improvement of posture and postural control	[11]

Abbreviations: PD, percentage of difference from baseline; RPD, relative percentage of difference of control vs intervention.

Table 2 Reviews of selected articles-Administrative interventions.

No	Intervention	Outcome	Reference
1	Manual training: repetitive task training in the use of one hand or two hands together	Hand function improvement; reduce time to complete Jebsen-Taylor Test of Hand Function (PDunimanual = -37.8%, PDbimanual = -34.5%)	[12]
2	Conductive education (CE): an educational classroom-based approach to teaching movement using rhythmic intention, routines and groups	Improvement of motor responses (percentage of participants that improved = 23-100%)	[13]
3	Early intervention (EI): therapy and early education to promote acquisition of milestones, via group or individual stimulus	Motor outcomes improvement	[14]
4	Goal-directed training/functional training: task specific practice of goal-based activities using a motor learning approach	Improvement of mobility of functional skill (effect size = 0.61)	[15]
5	Hip surveillance: active surveillance and treatment for hip joint integrity to prevent hip dislocation	Reduction of need for surgery on hip dislocation (requirement of reconstructive surgery reduced from 37.1% to 29%; and salvage surgery reduced from 11.4% to 0%)	[16]
6	Home programs: therapeutic practice of goal-based tasks by the child, led by the parent and supported by the therapist, in the home environment	Improvement of performance of functional activities	[17]

No	Intervention	Outcome	Reference
7	Massage: therapeutic stroking and circular motions applied by a massage therapist to muscles	Pain and spasticity reduction (PDcontrol = -9.1%, PDintervention =-33.3%)	[18]
8	Stretching: use of an external passive force exerted upon the limb to move it into a new and lengthened position	Improvement of joint ROM and functional ability	[19]
9	Fitness training: planned structured activities involving repeated movement of skeletal muscles that result in energy expenditure	Aerobic fitness improvement (RPD =18-22% for short-term training; RPD = 26-41% for long-term training) and increase activity (RPD = 0-13% for short-term training; RPD = 2-9% for long-term training)	[20]
10	Strength training: use of progressively more challenging resistance to muscular contraction	Muscle strength improvement (effect size = 1.16 – 5.27)	[21]
11	Treadmill training: walking practice on a treadmill, with and without partial body support	Improvement of body structures and function, and gross motor function	[22]

Abbreviations: PD, percentage of difference from baseline; RPD, relative percentage of difference of control vs intervention.

Table 3 Reviews of selected articles – Behavioral interventions.

No	Intervention	Outcome	Reference
1	Animal assistance: use of animals to give companionship and help with independence	Improvement of mood, behavior and self-perception	[23]
2	Behavior therapy: positive behavior support, behavior interventions, and positive parenting	Reduction of oppositional behaviors (PDcontrol = {-40}-20%, PDintervention = {-75}-{89.7}%)	[24]
3	Respite: temporary caregiving break for parents where the child is usually accommodated outside home	Reduction of life and parental stress	[25]

Abbreviations: PD, percentage of difference from baseline.

Table 4 Possible interventions of CP patients adaptable for rice farmers.

Adaptable intervention	Related intervention proposed for rice farmers	Reference
Engineering intervention		
Orthotics	Have not yet implemented	
Orthotic garments	Have not yet implemented	
Seating and positioning	An air inflated pillow, like a floating seat in paddy field harvesting posture	[26]
Administrative intervention		
Bimanual training/ Conductive education/ Early intervention	Health education for rice farmer groups via the Injury and Illness Prevention (IIP) program	[27]
	Safety inspection for rice farmers via the Injury and Illness Prevention (IIP) program	[27]
	Model development for health promotion and control of agricultural occupation health hazards and accidents	[28]
Goal-directed training/ Functional training	Have not yet implemented	
Massage	Have not yet implemented	
Stretching	Have not yet implemented	
Fitness training/ Strength training	Intervention based on the Transtheoretical Model (TTM) on back muscle endurance, physical function and pain in rice farmers with chronic low back pain	[29]
Behavioral intervention		
Animal assistance	Paddy field preparation and threshing process were conducted by farm animals (e.g., buffalo, bullock)	[30]
Behavior therapy	Safety Communication for rice farmers via the Injury and Illness Prevention (IIP) program	[27]
	Health surveillance for rice farmer groups via the Injury and Illness Prevention (IIP) program	[27]

4. Conclusion

As farmers face severe ergonomic problems physically, assistive tools and proper work process design by considering the ergonomic perspective are urgently needed for MSD prevention in paddy farming work environments**.** Farmers experience severe ergonomic problems; for example, MSDs, tool-related accidents and injuries, and lack of safety training. Ergonomic interventions are an effective method for micro-ergonomic occupational related problem prevention. Based on the literature review, engineering and administrative interventions, developed for CP patients, contributed significantly to the improvement of motor function and gait characteristics. Behavioral interventions successfully promoted positive emotion and appropriate behavior, as well as reduced stress and oppositional behavior in CP patients. Discussions of the adaptability of interventions revealed that a multitude of interventions developed for CP patients might be easily adapted to rice farmers. However, most of the proposed interventions for farmers are based on educational programs, which are closely related to administrative and behavioral interventions. Although in previous research engineering interventions had been developed through tool design for paddy cultivation, including seeding, planting, threshing and harvesting (e.g., [35-36]), none of these approaches attempted to adapt already available interventions for congenital disabilities, including CPs, for farmers. Similarly, despite modern harvesting and planting machines being introduced, limitations for widespread use of such mechanical power still persist, not least due to socio-economic conditions and infra-structural limitations of the society [26]. Based on interventions that have been applied for CP patients, orthotic devices and breathable orthotic garments might be applicable for rice farmers, however, they have not yet been implemented in previous studies.

In summary, farmer interventions should emphasize both tool design and educational programs. The following key points were recommended to prevent MSDs and improve occupational health and safety in the rice farming industry**:**

- Design and develop specific job descriptions according to ergonomic guidance;
- Design and develop assistive devices considering ergonomic guidance;
- Promote fitness and strength training, as well as designing motor learning training for effective movement;
- Implement assessment tools and reviewing systems for MSD and injury prevention, as well as accident and risk factor reduction among rice farmers;
- Create supportive collaborations with involved farmers through intervention programs and assessments and;
- Support campaigns for safety and health programs and drive rice farmers' awareness of work safety**.**

5. Acknowledgements

This study was supported by a grant from the Thailand Research Fund (TRF) and the Office of the Higher Education Commission (OHEC) (No. MRG6080225). The opinions expressed in this paper are those of the authors and do not necessarily reflect the views of TRF or OHEC.

6. References

[1] Swangnetr M, Karukunchit U, Juntaracena K, Puntumetakul R, Gross MT, Kaber DB. Relating musculoskeletal and disability conditions of occupation-induced musculoskeletal disorders to nonoccupational congenital disabilities. In: Goonetilleke R, Karwowski W, editors. Advances in Physical Ergonomics and Human Factors: Proceedings of the 7th International Conference on Applied Human Factors and Ergonomics; 2016 Jul 27-31; Orlando, FL. Springer; 2016. p. 65-73.

[2] Karukunchit U, Puntumetakul R, Swangnetr M, Boucaut R. Prevalence and risk factor analysis of lower extremity abnormal alignment characteristics among rice farmers. Patient Prefer Adherence. 2015;9:785-795.

[3] Juntaracena K, Neubert MS, Puntumetakul R. Effects of muddy terrain on lower extremity muscle activity and discomfort during the rice planting process. Int J Ind Ergon. 2018;66:187-193.

[4] Karwowski W, Marras WS. Interventions, Controls, and Applications in Occupational Ergonomics. Crc Press; 2006.

[5] Wilson DJ, Mitchell JM, Kemp BJ, Adkins RH, Mann W. Effects of assistive technology on functional decline in people aging with a disability. Assist Technol. 2009;21(4):208-217.

[6] Autti-Rämö I, Suoranta J, Anttila H, Malmivaara A, Mäkelä M. Effectiveness of upper and lower limb casting and orthoses in children with cerebral palsy: an overview of review articles. Am J Phys Med Rehabil. 2006;85(1):89-103.

[7] Blackmore AM, Boettcher-Hunt E, Jordan M, Chan MDY. A systematic review of the effects of casting on equinus in children with cerebral palsy: an evidence report of the AACPDM. Dev Med Child Neurol. 2007;49(10):781-790.

[8] Brouwer RW, Jakma TSC, Verhagen AP, Verhaar JAN, Bierma-Zeinstra SM. Braces and orthoses for treating osteoarthritis of the knee. Cochrane Database Syst Rev. 2005;25(1):CD004020.

[9] Meyer-Heim A, van Hedel HJA. Robot-assisted and computer-enhanced therapies for children with cerebral palsy: current state and clinical implementation. Semin Pediatr Neurol. 2013;20(2):139-145.

[10] Bailes AF, Greve K, Burch CK, Reder R, Lin L, Huth MM. The effect of suit wear during an intensive therapy program in children with cerebral palsy. Pediatr Phys Ther Off Publ Sect Pediatr Am Phys Ther Assoc. 2011;23(2):136-142.

[11] Chung J, Evans J, Lee C, Lee J, Rabbani Y, Harris SR. Effectiveness of adaptive seating on sitting posture and postural control in children with cerebral palsy. Pediatr Phys Ther. 2008;20(4):303-317.

[12] Brandao M, Gordon AM, Hung Y-C, Brandao M, Friel K, Charles JR. Bimanual training and constraint-induced movement therapy in children with hemiplegic cerebral palsy: a randomized trial. Neurorehabil Neural Repair. 2011;25(8):692-702.

[13] Darrah J, Watkins B, Chen L, Bonin C. Conductive education intervention for children with cerebral palsy: an AACPDM evidence report. Dev Med Child Neurol. 2004;46(3):187-203.

[14] Blauw-Hospers CH, Hadders-Algra M. A systematic review of the effects of early intervention on motor development. Dev Med Child Neurol. 2005;47(6):421-432.

[15] Ketelaar M, Vermeer A, Hart HT, van Petegem-van Beek E, Helders PJ. Effects of a functional therapy program on motor abilities of children with cerebral palsy. Phys Ther. 2001;81(9):1534-1545.

[16] Gordon GS, Simkiss DE. A systematic review of the evidence for hip surveillance in children with cerebral palsy. J Bone Joint Surg Br. 2006;(11):1492-1496.

[17] Novak I, Cusick A. Home programmes in paediatric occupational therapy for children with cerebral palsy: Where to start? Aust Occup Ther J. 2006;53(4):251-264.

[18] Hernandez-Reif M, Field T, Largie S, Diego M, Manigat N, Seoanes J, Bornstein J. Cerebral palsy symptoms in children decreased following massage therapy. Early Child Dev Care. 2005;175(5):445-456.

[19] Wiart L, Darrah J, Kembhavi G. Stretching with children with cerebral palsy: what do we know and where are we going? Pediatr Phys Ther Off Publ Sect Pediatr Am Phys Ther Assoc. 2008 Summer;20(2):173-178.

[20] Butler JM, Scianni A, Ada L. Effect of cardiorespiratory training on aerobic fitness and carryover to activity in children with cerebral palsy: a systematic review. Int J Rehabil Res. 2010;33(2):97-103.

[21] Dodd KJ, Taylor NF, Damiano DL. A systematic review of the effectiveness of strength-training programs for people with cerebral palsy. Arch Phys Med Rehabil. 2002;(8):1157-1164.

[22] Zwicker JG, Mayson TA. Effectiveness of treadmill training in children with motor impairments: an overview of systematic reviews. Pediatr Phys Ther Off Publ Sect Pediatr Am Phys Ther Assoc. 2010;22(4):361-377.

[23] Lasa SM, Ferriero G, Brigatti E, Valero R, Franchignoni F. Animal-assisted interventions in internal and rehabilitation medicine: a review of the recent literature. Panminerva Med. 2011;53(2):129-136.

[24] Roberts C, Mazzucchelli T, Studman L, Sanders MR. Behavioral family intervention for children with developmental disabilities and behavioral problems. J Clin Child Adolesc Psychol. 2006;35(2):180-193.

[25] Julie AS. Respite care for families of special needs children: a systematic review. J Dev Phys Disabil. 2010;(6):615.

[26] Nag PK, Goswami A, Ashtekar SP, Pradhan CK. Ergonomics in sickle operation. Appl Ergon. 1988;19(3):233-239.

[27] Santaweesuk S, Chapman RS, Siriwong W. Effects of an injury and illness prevention program on occupational safety behaviors among rice farmers in Nakhon Nayok Province, Thailand. Risk Manag Healthc Policy. 2014;7:51-60.

[28] Buranatrevedh S, Sweatsriskul P. Model development for health promotion and control of agricultural occupational health hazards and accidents in Pathumthani, Thailand. Ind Health. 2005;43(4):669-676.

[29] Thanawat T, Nualnetr N. Effects of an intervention based on the Transtheoretical Model on back muscle endurance, physical function and pain in rice farmers with chronic low back pain. J Back Musculoskelet Rehabil. 2017;30(4):847-856.

[30] Nanda AS, Nako T. Role of buffalo in the socioeconomic development of rural Asia: Current status and future prospectus. Anim Sci J. 2003;74(6), 443-455.

[31] Branthwaite HR, Payton CJ, Chockalingam N. The effect of simple insoles on three-dimensional foot motion during normal walking. Clin Biomech Bristol Avon. 2004;19(9):972-977.

[32] Swangnetr M, Kaber D. Analysis of grip force and arm muscle activity between novice and experienced rice farmers in plowing task. In: Jang R, Ahram T, editors. Advances in Physical Ergonomics and Human Factors Part II: Proceedings of the 5th International Conference on Applied Human Factors and Ergonomics; 2014 Jul 19-23; Krakow, Poland. AHFE Conference ©2014; 2014. p. 49-56.
[33] Lee KS, Waikar A. Types of activities and body parts affected in the recommended exercises for VDT operators. J Hum Ergol (Tokyo). 1991;20(1):13-26.
[34] Keawduangdee P, Puntumetakul R, Swangnetr M, Laohasiriwong W, Settheetham D, Yamauchi J, Boucaut R. Prevalence of low back pain and associated factors among farmers during the rice transplanting process. J Phys Ther Sci. 2015;27, 2239-2245.
[35] Khayer SM, Patel T, Dewangan KN. Ergonomic design improvement of pedal thresher: an approach combining digital human modelling and response surface analysis. J Ergon. 2017;7(6):1-9.
[36] Swangnetr M, Kaber D, Phimphasak C, Namkorn P, Saenlee K, Zhu B, Puntumetakul R. The influence of rice plow handle design and whole-body posture on grip force and upper-extremity muscle activation. Ergonomics. 2014;57(10):1526-1535.