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The impact of physical therapy Tele-rehabilitation intervention on the clinical outcomes of children during pandemic: systematic review

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***Abstract**:*
Background: the influence of the pandemic on the daily lives of children with disabilities and their parents has been significantly affected by Covid-19. Children are in danger for additional health risks, especially the children who had mental and physical problem. Without regular physical therapy, children's functional ability can deteriorate, and complications can occur. Despite a great variety in practices, the physical therapy tele-rehabilitation might be as useful as face- to-face management care for a variety of clinical outcomes. There are some studies confirmed that the physical therapy tele- rehabilitation is effective when coaching approach are used, in order to achieve the same outcomes. Further research is needed to clarify the impact of physical therapy tele-rehabilitation on children clinical outcomes.
Purpose: to summarize the efficacy of physical therapy tele-rehabilitation interventions on the children clinical outcomes during pandemic.
Methods: A systematic review was conducted on fifteen research: five randomised control trial, five pilot study, three systematic review used as background, one clinical trial, and one feasibility study published between 2010-2021. Data source was collected from PubMed, Cochrane library, Google Scholar database, and PEDro.
Data Extraction: any articles focused on physical activity without considering the impact of exercises program on clinical outcomes.
Data synthesis: the study focuses on the impact of physical therapy tele rehabilitation on children clinical outcomes.
Limitation of the study: the review study is limited to 15 study, only five of them randomised control trials.
Results: The literature review confirmed that tele-rehabilitation physiotherapy is an effective mode of treatment for helping children catch up with motor skills
***Keywords:** pandemic-Covid-19, disability, tele-rehabilitation, children, and physical rehabilitation.*

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I. Introduction

Physical therapy interventions are required when the children movement and function are threatened to develop, maintain, and re-establish movement and functional capacity under the consideration that functional movement is fundamental to health and an optimal quality of life[1]. Children with disabilities had been significantly affected by the Covid-19, as a result of discontinuation of physical therapy follow up sessions, their functional ability deteriorated, and complications occurred.

When these delays manifest in children, their parents or caregivers should seek medical attention to help them develop and catch up with others. In recent times, face-to-face interaction has been more difficult due to the COVID-19 pandemic. These conditions have introduced and advanced the use of telecommunication for almost all aspects of the operation. Tele-rehabilitation , which means "healing at a distance," has been a well-known technology since 1950, when audio-visual tele-rehabilitation links were started to be utilized for the provision of medical services.[2],[4] However, the physical therapy tele-Rehabilitation is currently in the phase of rapid development and advancement.

Consistent with Bican et al. (2021)[3] reported that COVID-19 pandemic changed the delivery of services in a hospital by studying and determine the characteristics of the people who took rehabilitation coupled with the therapists' perception of the remote service delivery program. When the child was below one-year-old, the parents would remain with face-to-face visits. Most of the parents for the other age groups opted for tele rehabilitation because they were safer at home, and their children were still receiving the care they would receive at the hospital. Likewise, the therapists were positive that tele rehabilitation was as effective as in-person visits.

The World Health Organization has adopted the following subsequent description: "The delivery of health care services, where distance is a critical factor, by all health-care professionals using information and communication technologies for the exchange of valid information for the diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities[4]. Multiple benefits come from physical therapy tele rehabilitation, even though the caregivers also experience some barriers as they complete their mandate. This paper does a systematic review to explore the effectiveness of physical therapy tele rehabilitation intervention on the clinical outcomes of children.

II. Methodology

Methods

Systematic review of the literature was performed through electronic search from May 2020. By identifying the studies from Google Scholar, PubMed, Cochrane library, and PEDro databases for the 2010-May2021 period of time. The references of retained articles were considered and articles responding to inclusion criteria which included all articles related to children, which meant that those relating to adults were filtered out. All the articles were required to have either telerehabilitation for children or a combination with motor skills for children. These search engines include Specific search words were used to filter out unnecessary and irrelevant articles. The search words used were topic-related and were targeted to get the best results from the search engines.

Inclusion and Exclusion Criteria:

The inclusion of articles in this review was based on the following:

- Selected articles in English language,
- Clinical trial, randomised control trials, pilot study, feasibility study, and systematic review,
- Population children with developmental disorders,
- Interventions should be through physical therapy tele-rehabilitation as a tool of rehabilitation.
- Outcome: effect of physical therapy tele-rehabilitation intervention on children clinical outcomes.
- The exclusion criteria any study concentrated on adult, the way of intervention is face-to-face, or does not report the children clinical outcomes.

Study selection

Two investigator decided on study eligibility which is based on the preferred reporting items for systematic reviews and Meta-analysis (PRISMA) statement[5]. Full test of the RCTs, pilot study and clinical trials that examined the impact of physical therapy tele-rehabilitation on children clinical outcomes. Primary researcher (SA) independently performs a first selection of articles based on abstracts to retain articles dealing with tele-rehabilitation and children had developmental disorders. A recursive search of the references from relevant articles was completed. Articles were evaluated by one reviewers (NA) and verified that the selected articles met the criteria.

Quality of Methodological reporting:

The quality of study was analysed by using PEDRo scale. All studies met the first PEDRo. Criteria (participant selection, and intervention using tele-rehabilitation) and had similar groups prior to intervention (criteria #4). Only two studies respected PEDRo. Criteria #5 (blinding of subjects) and no study respected PEDRo. Criteria #6 (blinding of therapists). The last four PEDRo. Criteria were respected by most studies: criteria #8 (one key outcome for at least 90%of the subjects), #9 (intention to treat analysis), #10 (statistical comparisons). Several strategies were used to reduce bias, including a comprehensive literature search for published evidence in several databases.

III. Result:

Study selection

Figure 1 presents the flow chart of the identification, screening and selection process. The titles and abstract of 50 articles were screened; of these 33 articles were excluded because they did not meet the inclusion criteria for age, no full texts available or did not pertain to a genuine tele-rehabilitation intervention according to the definition used for the present review. After reading the full text of the 17 remaining articles, an additional 2 studies were excluded based on our inclusion criteria or because they were neither accessible through the Organization library, nor publicly available on the web or on PubMed. Fifteen articles were included in this study three of them systematic reviews. The study participant and intervention characteristics are summarized in table-1.

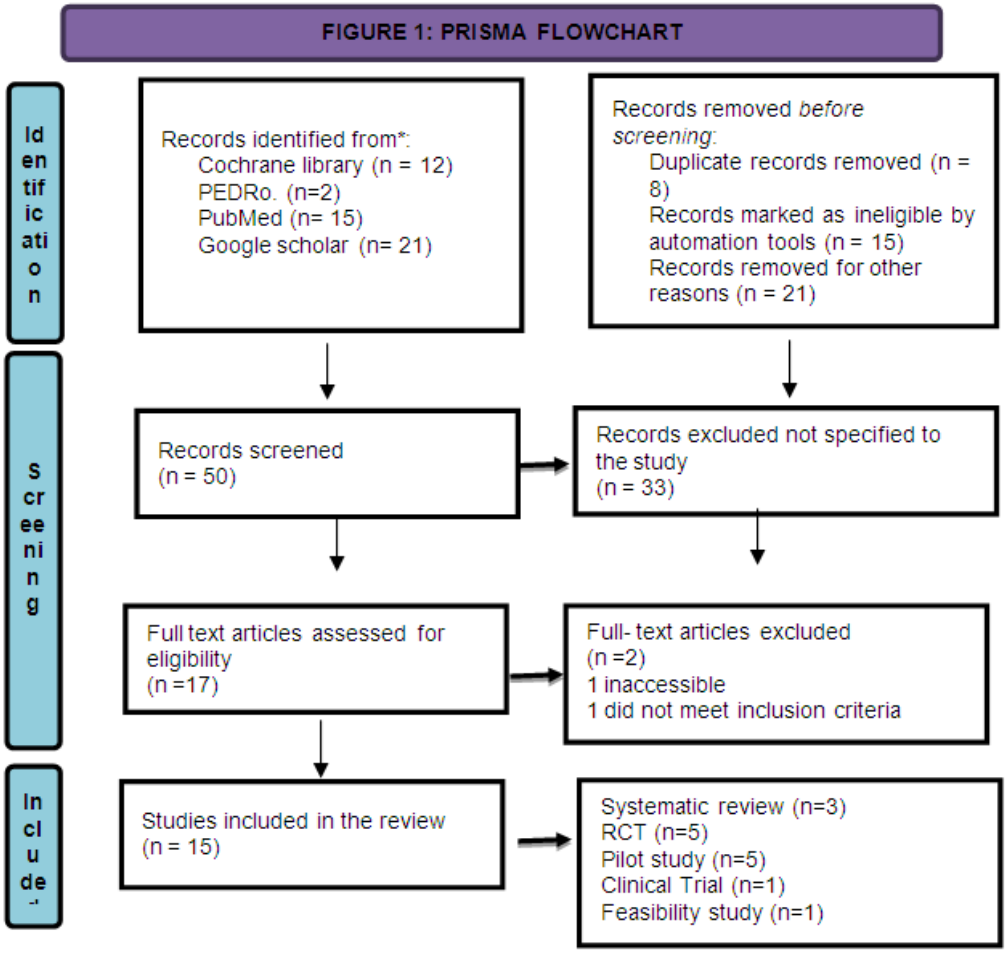

Table 1: Summary of studies characteristic and outcomes.

Author (year)	study design (PEDRo. Score)	Total n	Diagnosis	Child age	Intervention group	Control group	Outcome	Effect
Baque and al.(2017)	RCT (7)	60	Acquired brain injury	8-16 years old	Web-based therapy to improve motor skills -30 min, 6 times a week for 20 weeks and weekly contact with a therapist via phone, email or videoconferencing	Waitlist control	functional level, muscle strength tests for LE (sit-to-stand, steps-ups, half-kneel to stand), improve 6-min walk test, high-level mobility assessment tool, timed up and go test and habitual physical activity.	Significant improvements in the functional strength tests of LE, by 14.3%
Mitchell and al.(2016)	RCT (7)	101	Unilateral cerebral palsy	8-17 years old	Training program monitored by PT/OT via email, telephone or videoconference	Usual treatment in the clinic	Attentional control, cognitive flexibility, , WISC-IV),	No difference between the two groups

					to improve gross motor activities-training 30 min, 6 times a week for 20 weeks, contact with PT/OT as needed		D-KEFS, CTMT, TOL, and executive functioning performance by parents using (BRIEF).	
Piovesana and al (2017)	RCT (7)	60	Acquired brain injury	8-16 years old	6 times/week web based therapy to improve motor skills with a weekly contact (phone or mail), with PT for monitoring during 20 weeks	Waitlist control	Function: WISC-IV, GMFCS, CTMT	No difference between the two groups
Aqdasi, al (2019)	Pilot study (5)	9 families of children with high functioning of ASD.	Motor Proficiency and Severity of Autism Symptoms	0-12 years old	24 sessions of 45 minutes (weekly 3 sessions) and for 8 weeks.	No control group	GARS and BOTMP	The family based tele-rehabilitation has appeared to be an effective intervention to reduce motor problems in children with autism spectrum disorders
Akulwar, and al (2021)	Clinical trial (4)	21	Developmental delay or neurological condition	0-12 years old	14 sessions of 30 min.(once/week for 8 weeks)	No control group	Timely receipt of physiotherapy services, child clinical outcomes, families acceptability and satisfaction with the provision of Tele-rehabilitation	Enhance the capacity of families to meet the needs of their child with disability, and ensuring continuity of care.
Eguia, and al. (2019)	Feasibility study (4)	47	Developmental disorders	0-13 years old	One hour session/week , 9 weeks	No control group	Online survey questions (details of the service), satisfaction survey	Tele-rehabilitation is a satisfactory service model, which will be demand beyond pandemic
Laver et al, (2020)	RCT (4)	22	Stroke	All ages	One hour session/week, 8 weeks	Person regular rehabilitation	Online survey questions	No difference between the two groups
Rintala et al, (2019)	RCT (5)	20	Stroke	All ages	One hour session/week, 10 weeks	Person regular rehabilitation	Online survey questions	No difference between the two groups
Criss et al, (2013).	Pilot study	18	Cerebral palsy	6-11 years	Virtual tele rehabilitation on programme using web camera 30 min. session/week, 6 weeks	No control group	Print tool	Improved fine motor skills especially handwriting
Diane Solomon et al, (2010)	Pilot study	3	Hemiplegic cerebral palsy	13-15 years	Virtual rehabilitation 22 hours	No control group	Bruininks-Oseretsky test of motor proficiency	Improved gripping activities

							(BOT2-SF)	
Golomb MR. et al. (2010)	Pilot study	3	Hemiplegic cerebral palsy	3 months	Virtual reality video based games rehabilitation system using sensored glove. 5 days/week for 30 min. aday	No control group	Standardized assessments , remote assessments of finger ROM, DXA,POCT, FMRI of hand grip task	Improved functions of pelagic hand , improved finger ROM
Danielle Levac et al. (2017)	Pilot non randomised control trial	5	Cerebral palsy ambulatory children	6-12 years	Based on VR system monitored by therapist videogame 7 weeks one hour for 5 days	Regular treatment in the clinic	GMFM-CM, 6MWT	neither intervention improved outcome in small sample

Study, participant and intervention characteristics
Study characteristics

Five studies were RCTs, five studies were described as pilot study, another one was clinical trial, and the last one feasibility study. Usual treatment is consultation and training exercises program. Studies evaluated a mean of 4 outcomes pre-and post-intervention, ranging from 1-8 different outcomes. Most interventions had multiple expected outcomes such as child behaviour, parent's skills and stress, and parent child interactions, the severity of symptoms in relation to diagnostic criteria, communication skills, motor skills, functional abilities, some studies documented satisfaction with intervention and retention rate, with high parental satisfaction and reported high retention. No information reported about the intervention costs in any of the included studies.

Participants Characteristics

Total sample sizes were reported. All interventions were designed for children aged between 0-14 years old, although two studies also included all age, and four studies included age of 8-17 years old. All the studies targeted children, two studies targeted all ages with different developmental disorders.

Key intervention characteristics:

The general goal of most interventions was to improve function. The types of interventions can be classified into the following: exercises program to be implemented by the parents, measure real time of treatment for children, and sharing of information which is targeted to the parents. Frequency of the intervention in most cases tele-rehabilitation sessions were varied from once/week to six times per week, the duration of the intervention was 30 min. to one-hour session time for a period of 8 weeks or up to 20 weeks. The interventions were provided by Physical Therapist /Occupational Therapist (83%).

Characteristics most frequently associated with significant improvements:

As presented in table 1, seven studies reported a significant improvement in the outcomes. Another five articles reported no significant improvement on any outcome measure. The mean outcome improvement across studies was 58.3%. when the general aim of the study was to improve function, the mean improvement per study was 58.3% compared to 41.7% when the focus was on physical function. The type of intervention that seemed to lead to greater effectiveness was an intervention/exercise program to be implemented by the parent (mean improvement per study 58.3%). Interventions targeting predominantly the parent as opposed to focusing on the child (83%) also appeared as characteristics leading to a greater percentage of improvements.

With regard to the type of technology, studies that included videoconferencing reported a greater percentage of outcome improvement than those they used email, phone, or video base games by 83% Vs 17%. The literature review found that the frequency and duration of the intervention influenced the outcomes improvement, additionally, contacted with parents at least once/week and offering the intervention from 8-20 weeks led to greater improvements.

Overall, these results confirmed that the physical therapy tele-rehabilitation to children is 58.3% efficient mainly to the children with developmental disorders (chronic).

IV. Discussion

Fifteen articles on tele-rehabilitation in paediatric physical therapy sectors were included in this review. These reviews covered different areas of the practice of physical therapy mainly neurology area, and autism. To our knowledge this is the first overview that complies results on the effectiveness of physical therapy tele-rehabilitation (neurology, and autism) in the sector of paediatric. This makes the available evidence so widely

applicable in different areas of rehabilitation for children and adult. in addition to have greater access to various technologies, it has been made urgently necessary for such rehabilitation services to reach users without them having to leave the home because they are geographically remote and due to the COVID-19 pandemic.

In this review, tele-rehabilitation interventions aiming to improve physical functioning, most often for children with developmental disorders, reported improvement for some outcomes, but current evidence for improving function in neurology cases via tele-rehabilitation appears moderately weak compared to face-to-face visit outcomes. For children with neurology disorders, future tele-rehabilitation interventions reflecting best practice, by coaching parents and fostering knowledge transfer with the aim to increase parent's skills to improve the child's functioning, might prove more effective while delivered online, instead of interventions providing direct treatment to the child.

That goes with Aqdasi and colleagues (2019) confirmed that the efficacy of a family-based teleintervention program intended to help children with autism spectrum disorders. The major aspect of this study was the sessions undertaken by family members as they were directed on improving the motor proficiency of their children. The SPARK program significantly improved motor proficiency even though the online sessions had no significant impact on children with high-functioning ASD. The conclusions of this study show the benefits of family-based tele rehabilitation given the attention they get from their primary caregivers in parents and the people around them[6].

Additionally, Frigerio et al. (2021) conduct a study to determine parents' reactions to the tele rehabilitation of their children. In this study, many caregivers reported that they were satisfied with telecare, and they believed that the whole aspect of remote care would be important in the future. Regardless, they pointed out a few barriers before the pandemic, which would remain an issue to consider. Technology access is a major issue that cuts across various demographics. In some instances, there also are issues relating to culture and technology to deal with issues. This study concludes by highlighting the potential of telemedicine for caregivers during such conditions[7].

Using a coaching approach was identified as being more frequently associated with outcome improvement, compared to providing information. Rosenaum et al, (1998) reported that providing information to parents is part of best practices and patient centred care, it might not be sufficient to engage parents of children with disabilities to manage disabilities, what diverse coaching approaches might be able to achieve, even if currently, inconsistencies in defintions and components challenge rigorous evaluations of coaching approach[8]. Similarly, coaching approaches described by authors in the included articles varied from self-reporting the use of a non-defined coaching approach to using a previously developed coaching intervention that built on establishing coach approaches. Most of the studies in this review appeared to use traditional coaching approaches especially the ones that focused on improving physical function.

Another result, the healthcare providers should carefully consider the need to include children in the online intervention or not, and how is this will be associated with percentage of outcomes improvement. According to Bryanton et al.[9] confirmed that the monitoring of children with cerebral palsy virtually during the exercises sessions, the children enjoyed the virtual clinic exercises as they completed more repetitive tasks. The authors concluded that using virtual clinic to guide activities could increase compliance and improve the efficiency of exercises.

Additionally, Holden[10] reviews virtual clinic and its application in the field of motor rehabilitation. Various studies are reviewed and linked to the main objective of the paper. The key findings of the paper indicate that people are capable of motor learning in virtual environments. There are additional benefits for the patients when they are subjected to virtual clinic training. This includes enjoyment of repetitive tasks and improved indulgence in the activities being demanded of the patients. Besides, in impaired populations, there is no risk of cyber sickness when undertaking tele-rehabilitation activities.

Additionally, A review conducted by Pahwa and Mahni (2018) confirmed that the role of tele-physiotherapy for children with cerebral palsy. The benefits of tele-rehabilitation activities on children were highlighted, with many of the articles pointing to positive effects on fine and gross motor skills[11].

Also the multimodal approach (eg. a combination of technologies such as videoconferencing, phone, email) appeared to influence effectiveness, and functional outcomes. Latulippe, et al [12], suggested that the choice of the technology should probably be guided by the intervention's goals and parent's preferences. This consistent with this review, the authors discovered that the type of technology, that included videoconferencing reported a greater percentage of outcome improvement than those that did not by (83%)

Results found that for tele-rehabilitation interventions, if the parents contacted therapist by email or phone at any time is more effective and help them to better identify child's need. Some of the literature studies did include the frequency and the duration of the time according to the parents and child needs.

Finally, most of the studies reported high adherence rates and tele rehabilitation satisfaction experience, which is consistency with other qualitative studies that explored parental satisfaction[13.]

V. Conclusion

While we live through the COVID-19 pandemic, there have been multiple changes in how we typically operate. The medical sector has not been an exemption. People are embracing telemedicine with the restrictions put in place by various jurisdictions. As such, children with delays in motor development can get medical attention remotely. Tele rehabilitation is an important avenue that is being embraced on many levels. Children and their carers do not have to get into physical appointments for attention. They can do it from their homes and get better results from the instructed sessions, this literature confirmed that the physical therapy tele-rehabilitation is an effective mode of treatment for helping children catch up with motor skills. Regardless, more work needs to be done with the barriers to tele rehabilitation to ensure effective and efficient outcomes for everyone.

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