Educational Administration: Theory and Practice
2024, 30(10), 607-612
ISSN: 2148-2403
https://kuey.net/

Research Article

Effectiveness of Intrinsic Foot Muscle Training on Balance, Physical Activity and Quality of Life in Down's Syndrome (DS) Children and Adult Population - A Scoping Review.

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Citation: M.Premkumar et al. (2024), Effectiveness of Intrinsic Foot Muscle Training on Balance, Physical Activity and Quality of Life in Down's Syndrome (DS) Children and Adult Population - A Scoping Review., *Educational Administration: Theory and Practice*, 30(10) 607-612
Doi: 10.53555/kuey.v30i10.8490

ARTICLE INFO

ABSTRACT

Introduction: Down's syndrome (DS) is one of the commonest chromosome related condition in children, which is caused by an abnormal additional presence of the 21st chromosome. The foot muscle exercises proved to improve the individuals with flat foot problems states several studies but not with individuals with DS.

Aim of this study: This scoping review specifically aims to bring effectiveness of intrinsic foot muscle strengthening in DS individuals improving their balance and gross motor functions.

Method: Recent published literature in English between 2019 and 2024 was collected from five available databases: Google Scholar, PubMed, Science Direct, PubMed and EMBASE. Articles were eligible for inclusion in this review if they described intrinsic foot muscle training on balance, physical activity, and quality of life in DS children and adult population. 7 out of total 374 articles, observational, interventional, randomized control trials and systematic reviews were included from that period for analysis in this scoping review.

Results and Dissemination: Seven articles were selected for inclusion in this review. Two of these articles were systematic review. The remaining studies included two randomized control trials, one systematic review and meta analysis, one comparative study and one experimental study. Of the 8 included articles, effectiveness of intrinsic foot muscle training on balance, physical activity and quality of life in DS children and adult population were identified.

Conclusion: Considering the effects of intrinsic foot muscle training on adult populations with various foot functional abnormalities, it may have significant effect on DS children. Outcomes of this scoping review opens up specific treatment intervention of intrinsic foot muscle training effects on DS children with foot dysfunction.

Keywords: Intrinsic foot muscle training, Down's syndrome, Balance, Physical activity, Quality of life, scoping review.

Introduction:

Down's syndrome (DS) is one of the commonest chromosome related condition in children, which is caused by an abnormal additional presence of the 21st chromosome. As a result of that, intellectual disability like non hereditary mental retardation, and other several problems like developmental delay, hearing problems, vision problems and respiratory dysfunctions also arise in those children[1]. The global incidence of DS is around 1 in 800 births.[2] Nearly 95% of DS cases are caused by meiotic non disjunction of full chromosome 21 and results in 21 trisomy, 2 to 3% are caused by Robertsonian translocation between acrocentric chromosomes such as 13, 14, 15, 21, and 22, while mosaicism is the reason for the remaining 2 to 3%. The increase in maternal age more than 30 increases the risk of having a child with trisomy 21.[3]
Out of the other foot related disorders nearly 30 percent of musculoskeletal disorders reported are mostly related to pes planus (flat foot). Though flat foot remains most common problem in DS it still remains least addressed.[4] The impact of flat foot is broadly focused on three key areas.1) Balance, 2) Physical activity, 3) Quality of life. Whatever the type of adapted physical activity programs for people with DS they are beneficial in multiple ways. Regular physical activity facilitates muscle tone, strength, balance, and motor skills, promoting autonomy and independence in activities of daily living.[5] So the children with DS can benefit from several types of interventions of exercise which improve their motor co ordination, balance and muscle strength. These exercises may be balance exercises, muscle strength programs, general physical activities, and combinations of all these.[6] There is a significant change in the quality of life of children with DS in the major five domains. Findings of published literature stated that significant implications were made for early interventions designed specifically for the need of every individual, but that requires the support from parents and guidance from professionals in healthcare, education, and the community.[7] The foot muscle exercises proved to improve the individuals with flat foot problems states several studies but not with individuals with DS. So, this study specifically works for the intrinsic foot muscle strengthening in DS individuals improving their balance and gross motor functions. [8]

Methodology:

Identifying relevant studies:
Recent published literature in English between 2019 and 2024 was collected from five available databases: Google Scholar, PubMed, Science Direct, PubMed and EMBASE. A key term search strategy was employed using the words "intrinsic foot muscle training", "balance", physical activity", "quality of life" and "Down's syndrome". The terms "intrinsic foot muscle training" and "Down's syndrome" were selected to find effectiveness intrinsic foot muscle training methods on balance, physical activity and quality of life in DS children in order to identify effectiveness of intrinsic foot muscle training on DS children. Observational, interventional, randomized control trials and systematic reviews were included from that period for analysis in this scoping review.

Study selection:
Articles were eligible for inclusion in this review if they described intrinsic foot muscle training on balance, physical activity, and quality of life in DS children and adult population. Full text articles published since 2019 and written in English were eligible for inclusion in this scoping review. Articles were excluded if they did not pertain to intrinsic foot muscle training, DS and adult population. If available articles were representative of the inclusion criteria, the articles went through two full-text independent reviews by three authors (R. Muthupandikumar, Vijaya Kumar K and M. Premkumar). If disagreements once arose, a third party reviewer would be consulted.

Charting data:
If a full test article was eligible for inclusion in this study, data related to the effectiveness of intrinsic foot muscle training on balance, physical activity and quality of life in DS children and adult population presented in the article was extracted by the lead author and reviewed by other 4 authors. Data extracted from the reviewed effectiveness of intrinsic foot muscle training on balance, physical activity and quality of life in DS children was entered into data extraction records and synthesized in summary format. Data were systematically charted using the data charting form developed in Microsoft Excel. Information on authorship, article type, population, and intrinsic foot muscle training were recorded on this form. Information on intrinsic foot muscle training in DS children and adult population, number of studies reviewed and key findings were recorded on this form.

Collating, summarizing and reporting results:
Information that was organized on the data charting forms was employed to collate and report the articles' approaches towards achieving effectiveness of intrinsic foot muscle training on balance, physical activity and quality of life in DS children and adult population.

Results:

From an original hit total of 374 articles, 202 articles on duplication of publication were excluded from different data base. 124 articles were excluded after reading the article title and abstract, addition to those 39 articles were excluded after they were read fully (Figure 1). Seven articles were selected for inclusion in this review. Two of these articles were systematic review. The remaining studies included two randomized control trials, one systematic review and meta analysis, one comparative study and one experimental study. Of the 8 included articles, effectiveness of intrinsic foot muscle training on balance, physical activity and quality of life in DS children and adult population were identified (Table 1).

Figure 1: Scoping review process

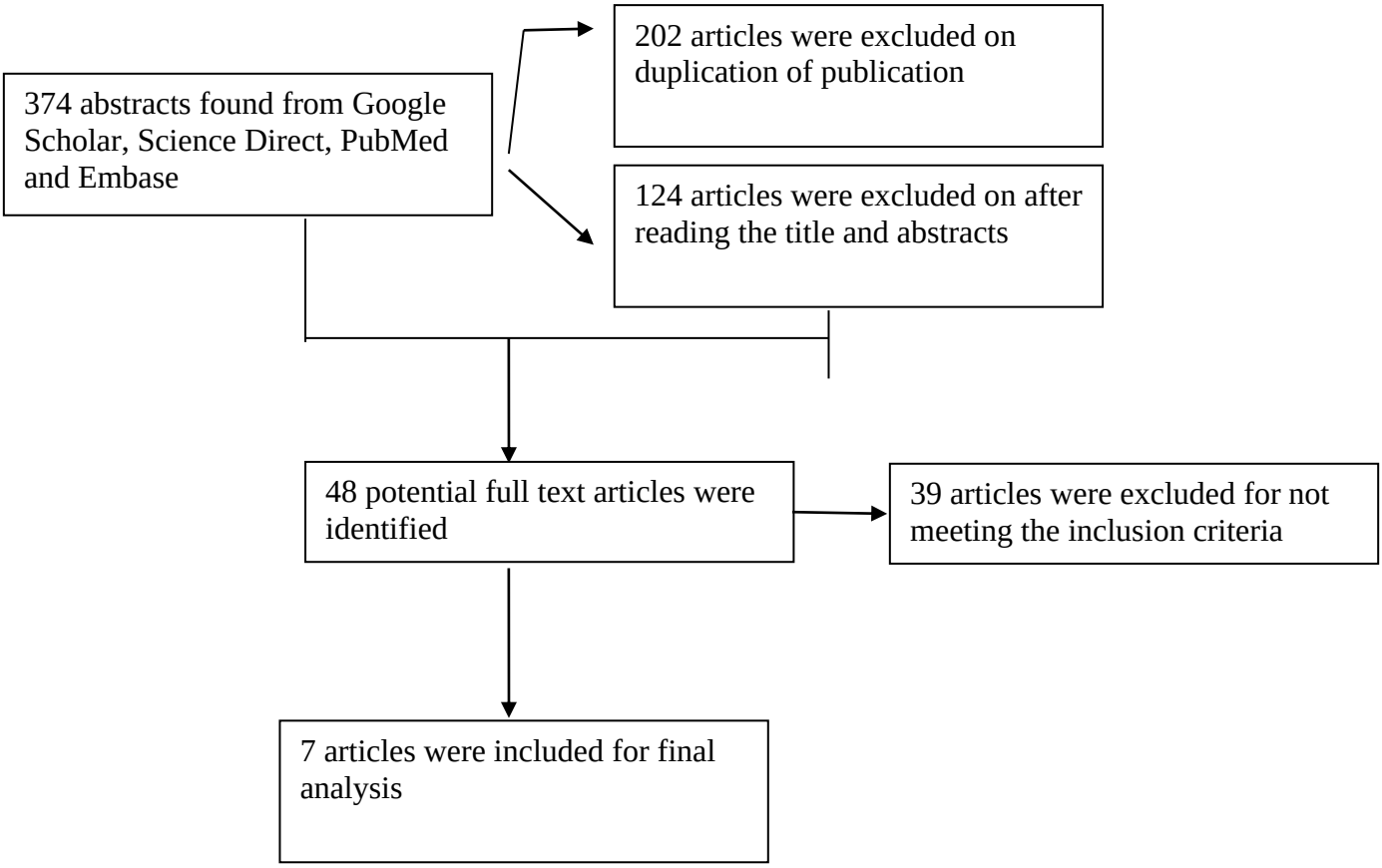

Table 1: Scoping review included articles

Author	Article type	Study population	Intervention	Conclusion
Nazia Adeeb etal[8]	Randomized controlled trial	Down's syndrome	A novel approach with foot exercise	Can be used as alternative to conventional method
Shayan Quinlan etal[9]	Systematic review	Adult population	Toe flexor Muscle strengthening	Toe flexor strength contributes to postural balance
Dong-Rour Lee et al[10]	Comparative study	Adult population with chronic ankle instability	Foot exercise therapy	IFM exercises improves functions and balance and ability.
Raf Dejonghe et al[11]	Randomized controlled trial	Adult population with asymptomatic flexible flat foot	Toe flexor strengthening	Toe flexor strength has increased significantly

Lydia Willemse et al[12]	Systematic review	Adult population	Plantar intrinsic foot muscle training	Foot muscle training improves foot function and balance.
Zhen Wei et al[13]	Systematic review & Meta analysis	Adult population	Intrinsic foot muscle training	Improves biomechanical effects and dynamic postural balance
Riddhi Kate et al[14]	Experimental study	Adult population - obese individuals with pes planus	Intrinsic foot muscle training	Effective on foot Pronation reduces FPI scores

Data Analysis and Dissemination:

Content analysis of effectiveness of intrinsic foot muscle training on balance, physical activity and quality of life in DS children and adult population included in this review revealed that intrinsic foot muscle training, toe flexor strengthening, plantar intrinsic muscle strengthening on DS children and adult population are proven in their study conclusion to gain improvement in balance, physical activity and quality of life in adult population as well as in DS children.

Discussion:

This scoping review provides an overview of how intrinsic foot muscle training is emerging in the current literature on lines to treat foot abnormalities like pes planus (flat foot), or obliteration of longitudinal arch in foot, weakness in foot musculature, and changes in toe muscles functions in DS children and adult populations with various foot problems which are going to limit physical activity, affect balance and overall quality of life in those populations. Management of foot muscle dysfunction in those conditions is growing challenge in the field of physiotherapy rehabilitation. While some of the articles reviewed effectiveness of intrinsic foot muscle training pertained to specific target populations like DS children or adult populations with various clinical conditions which has a toll on overall foot functions, this specific scoping review shall provide time bound inputs to overcome the adverse effects of foot related problems in balance, physical activity and quality of life in DS children and adult populations.

These problems were clearly addressed by authors, which made common physiotherapy interventions to improve balance, physical activity, and quality of life in those specific populations. Even though the literature of effectiveness of intrinsic foot muscle training on these outcomes in DS are very scarce, this scoping review throws a ray of hope in the treatment plan which is very essential in special populations like DS children.

Nazia Adeeb etal found a efficacy of novel approach of foot muscle exercise in their randomized control trial in DS children in order to gain benefits in functions related to affected foot musculature. They suggested these exercises can be used as able alternative method to treat foot related functional problems.[8]

Shayan Quinlan etal demonstrated in their published literature review, the beneficial effects of toe muscle exercise to improve physical functioning of foot muscles to improve balance, postural dysfunctions, and gait of life in adult population with foot functional abnormalities.[9] Two more systematic reviews with meta analysis on effectiveness of intrinsic foot muscle training to improve balance, physical activity and overall quality of life in adult populations with various foot functional abnormalities.[12.13]

Limitations and Future recommendations:

Even though there are numerous literatures available on foot orthosis and assistive devices on improvement of foot functions in adult populations, still the availability of sporadic published literature on effectiveness of specific intrinsic foot muscle training in special DS children, drive the need related to this specific need wide opens proposed interventional studies to address this issue and bring robust solutions related to balance, physical activity and quality of life in DS children.

Conclusion:

Analysis and dissemination of this scoping review opens a path of physiotherapy and rehabilitative treatment interventions in the form of intrinsic foot muscle training on balance, physical activity and quality of life in DS children. Considering the effects of intrinsic foot muscle training on adult populations with various foot functional abnormalities, it may have significant effect on DS children. Outcomes of this scoping review

opens up specific treatment intervention of intrinsic foot muscle training effects on DS children with foot dysfunction.

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