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KINESIOTHERAPEUTIC APPROACHES IN THE MANAGEMENT OF OBESE CHILDREN WITH FLATFOOT AND LOWER LIMB MALALIGNMENTS

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ABSTRACT:
CHILDHOOD OBESITY IS A GROWING CONCERN WORLDWIDE, FREQUENTLY ASSOCIATED WITH ORTHOPEDIC DEFORMITIES SUCH AS FLATFOOT (PES PLANUS) AND LOWER LIMB MISALIGNMENTS. THESE BIOMECHANICAL ALTERATIONS IMPAIR POSTURAL CONTROL, GAIT, AND FUNCTIONAL MOBILITY, INCREASING THE RISK OF FURTHER MUSCULOSKELETAL COMPLICATIONS. KINESIOTHERAPY REPRESENTS A KEY NON-INVASIVE STRATEGY FOR IMPROVING LOWER LIMB ALIGNMENT, ENHANCING MUSCLE TONE, AND PREVENTING LONG-TERM ORTHOPEDIC DETERIORATION. THIS ARTICLE EXPLORES THE PHYSIOPATHOLOGICAL RELATIONSHIP BETWEEN OBESITY AND FLATFOOT IN CHILDREN, THE FUNCTIONAL REPERCUSSIONS, AND EVIDENCE-BASED KINESIOTHERAPEUTIC INTERVENTIONS AIMED AT CORRECTING POSTURE, IMPROVING GAIT, AND SUPPORTING WEIGHT MANAGEMENT. THE DISCUSSION HIGHLIGHTS THERAPEUTIC STRATEGIES, EXERCISE PROTOCOLS, AND THE IMPORTANCE OF INTERDISCIPLINARY COLLABORATION IN PEDIATRIC REHABILITATION. THE ARTICLE AIMS TO CONTRIBUTE TO THE STANDARDIZATION OF REHABILITATION PROTOCOLS AND RAISE AWARENESS OF EARLY INTERVENTION.

KEY WORDS: CHILDHOOD OBESITY, FLEXIBLE FLATFOOT, POSTURAL MALALIGNMENT, PEDIATRIC KINESIOTHERAPY

INTRODUCTION

Childhood obesity has emerged as a major global public health concern, with increasing prevalence observed across both developed and developing countries. The World Health Organization (WHO) estimates that over 39 million children under the age of five were overweight or obese in 2022. Obesity during early developmental stages is not only a metabolic and cardiovascular risk factor but is also closely associated with musculoskeletal complications[5]. Among these, flatfoot (pes planus), valgus deformities, genu valgum, genu varum, and other lower limb malalignments are frequently observed in overweight and obese children [10].

These structural and functional deformities stem from both intrinsic (e.g., joint laxity, delayed motor development) and extrinsic factors (e.g., excessive mechanical load, poor posture, sedentarism)[3]. The increase in plantar pressure and altered foot mechanics in obese children significantly affect the normal development of the longitudinal arch and lower limb axis. As a result, these children often present with limited mobility, reduced physical

endurance, and compensatory gait patterns, which can evolve into chronic orthopedic dysfunctions if left untreated[5].

Moreover, the psychosocial dimension of childhood obesity should not be underestimated. Postural deficits and mobility limitations can impair self-esteem and social interaction, leading to isolation and a decreased willingness to engage in physical activity. Therefore, intervention must be not only biomechanically corrective but also psychologically supportive and motivational[4].

Kinesiotherapy, or therapeutic exercise, has been recognized as a fundamental, non-invasive intervention in addressing biomechanical imbalances and improving functional outcomes in pediatric patients. Through tailored programs that include posture correction, muscular strengthening, proprioceptive training, motor control enhancement, and balance exercises, kinesiotherapy offers a promising and sustainable strategy for improving quality of life in obese children with foot and lower limb deformities[1].

Despite its clinical relevance, standardized rehabilitation protocols specifically designed for obese pediatric patients with foot malalignments remain insufficient in current literature[6]. The existing heterogeneity in clinical practice and the variability in intervention outcomes highlight the urgent need for evidence-based guidelines and interdisciplinary collaboration.

This article aims to examine the complex interplay between pediatric obesity and foot/lower limb deformities such as flatfoot, to synthesize current evidence regarding pathophysiology and functional impact, and to propose a structured, evidence-informed kinesiotherapeutic approach. It further emphasizes the role of early identification and intervention, and the necessity of a multidisciplinary model of care involving physicians, physiotherapists, pediatricians, psychologists, and caregivers.

EPIDEMIOLOGY AND ETIOPATHOGENESIS

Global Prevalence of Childhood Obesity

Childhood obesity has become one of the most alarming health issues of the 21st century. According to the World Health Organization (WHO), the global prevalence of overweight and obesity in children and adolescents aged 5–19 has risen dramatically from just 4% in 1975 to over 18% in 2016. Recent projections estimate that by 2035, nearly 250 million children worldwide will be living with obesity. This trend is particularly concerning given the strong association between early-onset obesity and chronic diseases in adulthood, including type 2 diabetes, hypertension, and musculoskeletal disorders[2].

In Europe, the highest rates of childhood obesity are recorded in Southern countries, such as Greece, Italy, and Romania, where cultural dietary habits and physical inactivity play a significant role. Notably, Romania has reported a sharp increase in pediatric overweight and obesity in the last two decades, paralleling a decline in physical education programs and structured outdoor activity in schools[7].

Risk Factors and Comorbidities

Childhood obesity is a multifactorial condition influenced by genetic, behavioral, environmental, and socio-economic factors. Genetic predispositions, such as polymorphisms affecting appetite regulation and metabolism, interact with lifestyle elements like high caloric intake, poor diet quality, reduced physical activity, and excessive screen time[1].

Obese children are more prone to comorbidities that affect multiple systems, including:

- Metabolic syndromes (e.g., insulin resistance, hyperlipidemia)
- Respiratory issues (e.g., sleep apnea, reduced lung capacity)

- Orthopedic problems (e.g., flatfoot, genu valgum, joint hypermobility)
- Psychosocial disorders (e.g., low self-esteem, social withdrawal, depression) [9].

Of particular interest to physiotherapists and kinesiotherapists is the high incidence of biomechanical complications that interfere with the normal development of the musculoskeletal system. These include foot arch collapse, joint instability, postural asymmetries, and reduced neuromotor coordination[10].

Biomechanical and Developmental Implications of Obesity in Children

The excess body weight in obese children alters the mechanics of movement and posture. The musculoskeletal system, still in development during childhood, is forced to adapt to increased load-bearing, often resulting in compensatory malalignments and deformities. One of the most common manifestations is flexible flatfoot, a condition in which the medial longitudinal arch collapses during weight-bearing activities [6].

Additional biomechanical consequences include:

- Excessive pronation of the foot, affecting gait stability
- Knee valgus (knock-knees) due to altered weight distribution
- Delayed motor milestones and impaired balance responses
- Muscular imbalances (e.g., weak tibialis posterior, overactive gastrocnemius) [8].

The combination of these factors leads to a functional decline in locomotion, agility, and endurance, discouraging physical activity and perpetuating the cycle of obesity. If uncorrected, these conditions can predispose the child to chronic pain, early degenerative changes in joints, and reduced quality of life [5].

FLATFOOT AND LOWER LIMB MALALIGNMENTS IN OBESE CHILDREN

Definition and Classification of Flatfoot (Flexible vs. Rigid)

Flatfoot, or pes planus, refers to the collapse or underdevelopment of the medial longitudinal arch of the foot. It is a frequent condition in pediatric populations and is often physiological in children under the age of six due to the immaturity of foot structures. However, when the arch fails to develop or regresses under increased mechanical stress, as in the case of obesity, it becomes pathological [7].

Flatfoot is broadly classified into two types:

- Flexible flatfoot: The arch is visible when the child is non-weight bearing (e.g., sitting or standing on tiptoe), but it disappears during weight-bearing activities. This is the most common form and is typically associated with ligament laxity and muscular weakness.
- Rigid flatfoot: The arch remains flattened regardless of position, often caused by congenital anomalies such as tarsal coalition or neuromuscular conditions. It is less common but more clinically significant.

In obese children, flexible flatfoot predominates due to increased plantar loading, excessive adipose tissue in the medial arch area, and postural compensation patterns [4].

Association with Genu Valgum, Genu Varum, and Pes Valgus

Flatfoot does not occur in isolation. It is frequently associated with other postural and structural deviations of the lower limb. The most common deformities seen in conjunction with flatfoot in obese children include:

- Genu valgum (*knock-knees*): Medial angulation of the knees, often due to weight-related stress and postural collapse.

- Genu varum (*bowlegs*): Less frequent in obesity, but may appear in early walking phases or be secondary to rickets or growth disturbances.
- Pes valgus: A combination of flatfoot and hindfoot eversion, leading to a "rolling-in" of the ankle and medial deviation of the forefoot. It further compromises balance and gait efficiency [6].

These conditions can alter the kinetic chain, affecting not only the foot and ankle complex but also the knees, hips, and spine. The result is a cascade of compensatory movements that can eventually lead to pain, fatigue, and joint degeneration if not corrected early[8].

Functional Consequences: Gait Alterations, Balance Issues, Fatigue

The biomechanical imbalances associated with flatfoot and malalignments lead to significant functional impairments. Obese children with these conditions often present with:

- Altered gait patterns, including wider stance, foot external rotation, and shorter step length.
- Reduced balance and postural control, affecting both static and dynamic equilibrium.
- Early fatigue and clumsiness during walking or physical activity, limiting participation in play and sports.

Additionally, foot pain, particularly in the medial arch, heel (plantar fasciitis), and ankle, may discourage movement, contributing to a sedentary lifestyle and further weight gain. Over time, these impairments can affect gross motor development, limit social participation, and compromise self-image.

Early identification of these deformities is essential for implementing effective corrective strategies. Kinesiotherapeutic intervention plays a critical role in preventing the progression of deformities and promoting optimal functional recovery.

EVALUATION AND DIAGNOSIS IN PEDIATRIC KINESIOTHERAPY

Clinical and Postural Assessment

A comprehensive clinical and postural evaluation is essential for developing an effective therapeutic plan in children with obesity-related foot and lower limb deformities. The assessment should begin with a thorough medical and developmental history, including prenatal factors, motor milestones, history of pain or fatigue during activity, and footwear habits.

Visual inspection and static posture analysis are conducted to detect deviations in body alignment:

- Pelvic tilt and lumbar lordosis
- Knee angulation (valgum or varum)
- Foot arch height and calcaneal eversion/inversion
- Shoulder and scapular symmetry

The standing posture is examined from anterior, posterior, and lateral views, noting any asymmetries or compensatory patterns. In obese children, the presence of an excessive abdominal mass often shifts the center of gravity anteriorly, leading to postural adjustments such as hyperlordosis and pronated feet.

Palpation may reveal tenderness along the medial longitudinal arch, Achilles tendon tightness, or lateral ankle instability[5].

Gait Analysis and Footprint Evaluation

Gait assessment is a vital diagnostic component, offering insights into dynamic foot function and compensatory mechanisms. Observational gait analysis focuses on:

- Step length, cadence, and stride width
- Foot placement and pronation during stance phase
- Arm swing and trunk rotation
- Medial knee collapse (valgus thrust) or foot external rotation

For more precision, instrumented gait analysis systems (e.g., pressure platforms, motion capture) can quantify deviations in foot pressure distribution and load transfer.

Additionally, footprint analysis using tools such as:

- Podographs
- Podoscopes
- Harris and Beath mats

…helps determine the type and severity of flatfoot. The Staheli Arch Index, Chippaux-Smirak Index, or Clark's angle may be used to quantify arch height and evaluate load distribution[7].

Functional Tests and Scales

To assess neuromuscular function, balance, and proprioception, the following standardized tools and clinical tests are recommended:

- Foot Posture Index (FPI-6): Evaluates static foot position through six visual criteria, useful for detecting flexible flatfoot.
- Navicular Drop Test: Assesses the change in navicular height between neutral and relaxed standing, indicating arch flexibility.
- Balance and coordination tests (e.g., Romberg test, Flamingo balance test, single-leg stance).
- Functional movement screening: Observing squats, heel raises, or toe walking.
- Timed Up and Go (TUG) and 6-Minute Walk Test (6MWT): To assess mobility and endurance, adapted for pediatric populations.

All evaluations should consider the age and developmental stage of the child, adjusting expectations and interpretation accordingly. In some cases, imaging (X-rays) may be required to rule out structural abnormalities (e.g., tarsal coalition) in rigid flatfoot.

KINESIOTHERAPEUTIC INTERVENTIONS

Goals and Principles of Intervention

The primary goals of kinesiotherapy in obese children with flatfoot and lower limb malalignments are:

- Restoration of proper foot alignment and arch support
- Improvement of muscle strength and tone, particularly in the intrinsic foot muscles and stabilizers
- Enhancement of balance, proprioception, and postural control
- Correction of compensatory movement patterns
- Encouragement of physical activity through functional and enjoyable exercises

Interventions must be age-appropriate, progressive, and tailored to the child's individual characteristics. Early intervention during the growth period allows for better outcomes due to the plasticity of the musculoskeletal and nervous systems.

A child-centered approach that incorporates play, motivation, and creativity is essential to maintain engagement and adherence. Combining open kinetic chain (OKC) and closed kinetic chain (CKC) exercises yields the best results in restoring functional movement.

Strengthening and Proprioceptive Exercises

Muscle weakness, particularly in the tibialis posterior, peroneals, intrinsic foot muscles, and hip abductors, contributes significantly to arch collapse and lower limb instability. Strengthening exercises should begin with low resistance and progress in complexity:

- Short-foot exercise: Activates intrinsic muscles of the foot by drawing the metatarsal heads toward the heel without toe flexion.
- Towel curls and marble pickups: Improve fine motor control and toe flexor strength.
- Theraband-resisted ankle inversion/eversion: Strengthens the tibialis posterior and peroneals.
- Hip abduction and external rotation exercises: Stabilize the pelvis and lower limb alignment.
- Step-ups and mini-squats: Promote functional strength in CKC conditions.

Proprioceptive training is essential to improve sensory input and motor response:

- Balance boards or foam pads
- Single-leg stands with eyes closed
- Obstacle courses for dynamic balance
- Walking on uneven surfaces

Balance and Motor Control Strategies

Balance and motor coordination are often impaired in obese children due to altered biomechanics and deconditioning. Kinesiotherapy must focus on restoring neuromotor integration through:

- Reactive balance exercises: Perturbations on stable and unstable surfaces
- Dynamic activities: Jumping, skipping, directional changes
- Dual-task training: Combining physical tasks with cognitive challenges (e.g., balance on one foot while naming colors)

Incorporating rhythmic and patterned activities (e.g., hopscotch, dance movements) enhances coordination and facilitates muscle synergies necessary for efficient gait.

Motor control retraining also involves mirror feedback, video modeling, and guided movements to correct compensatory patterns.

Stretching and Corrective Postural Re-education

Stretching exercises are essential to address muscular tightness, particularly in:

- Triceps surae (gastrocnemius-soleus complex)
- Hip flexors and lumbar paraspinals, often tight in obese children due to anterior pelvic tilt
- Plantar fascia, especially in those with foot pain

Postural education includes:

- Wall alignment drills: Teaching neutral spine and weight distribution
- Pelvic tilt exercises: Reinforce lumbopelvic stability
- Mirror-based alignment correction: Increases self-awareness and postural symmetry

Therapists may also use biofeedback systems to guide postural corrections and prevent overloading of the medial foot structures.

Use of Orthotics and Adjunct Devices

In many cases, custom-made foot orthoses are recommended to provide structural support, correct alignment, and reduce symptoms. They should:

- Support the medial longitudinal arch
- Distribute plantar pressure more evenly
- Reduce rearfoot eversion

Heel cups, in-shoe wedges, or prefabricated insoles can also be considered, particularly in early stages or when resources are limited.

Other adjuncts include:

- Compression garments to improve proprioceptive input
- Elastic taping techniques (e.g., kinesiology tape) for arch support
- Functional footwear with adequate heel counter and arch support

However, orthotics should not replace exercise, but rather complement it. Long-term success depends on active rehabilitation and functional strengthening.

Designing an Individualized Exercise Program

Exercise Selection Based on Severity and Age

Kinesiotherapeutic programs must be individualized based on several factors:

- Age and growth stage
- Degree of obesity (BMI percentile)
- Type and severity of foot deformity
- Functional limitations (e.g., balance, endurance)
- Motivation and psychosocial profile

For young children (3–6 years), exercises are often playful, short, and embedded in games.

For school-aged children (7–12 years), sessions may be more structured and include goal-setting.

For adolescents (13–18 years), the focus shifts toward autonomy, motivation, and fitness integration.

The selection of exercises should follow a progressive load model, starting from basic postural correction and balance, advancing to complex, multi-joint functional tasks. Stretching, strengthening, proprioceptive control, and gait re-education must be blended systematically.

Frequency, Duration, and Progression

To achieve therapeutic impact, the recommended frequency is:

- 3–5 sessions per week (including home exercises)
- 30–45 minutes per session for younger children
- 45–60 minutes per session for older children

Progression is guided by:

- Improved postural alignment and arch stability
- Enhanced motor control and coordination
- Child's tolerance, motivation, and response to therapy

Programs should be adjusted every 4–6 weeks, with re-evaluation to monitor biomechanical changes and functional gains.

Integration of Play-Based Therapy and Motivation

Maintaining motivation is a key factor for adherence. Play-based therapy ensures engagement and reduces psychological resistance. Strategies include:

- Themed obstacle courses with postural cues
- "Animal walks" (e.g., bear crawl, crab walk) for core and foot activation
- Balance games (e.g., "Simon says" on foam mats)
- Interactive tools: balance pads, hula hoops, therapy balls

Positive reinforcement, visual progress charts, and active parental involvement can increase adherence. Use of digital tools or gamified apps may further enhance participation, especially in older children.

THE ROLE OF MULTIDISCIPLINARY COLLABORATION

Coordination Between Kinesiotherapist, Pediatrician, and Orthopedist

Successful rehabilitation of obese children with flatfoot and associated malalignments requires a team-based approach. The kinesiotherapist plays a central role in functional recovery, but optimal outcomes are achieved only when their efforts are coordinated with medical and educational professionals.

- The pediatrician ensures early identification, general health monitoring, and addresses comorbidities such as insulin resistance or asthma that may limit physical activity.
- The orthopedist or pediatric physiatrist evaluates structural deformities, prescribes orthotic devices if needed, and rules out congenital or neuromuscular pathologies.
- The kinesiotherapist applies personalized exercise protocols, tracks progress, and educates the child and family on lifestyle modifications.

Regular case reviews and goal updates among the team foster consistency, rapid problem solving, and dynamic adaptation of the therapy plan.

Parent and Caregiver Education

Parental involvement is a key predictor of therapy adherence and long-term behavioral change. Parents must be informed and empowered to:

- Encourage daily home exercises
- Provide proper footwear
- Limit screen time and promote active play
- Offer emotional support and positive reinforcement

Educational sessions may include:

- Practical demonstrations of corrective exercises
- Nutritional counseling in collaboration with dietitians
- Behavioral coaching to establish consistent daily routines

In cases of low socioeconomic status or limited education, therapists may need to simplify instructions, use visual aids, or collaborate with social workers.

School-Based Physical Activity Programs

Since children spend a large portion of their day in school, integration of movement into the school environment can reinforce therapy goals. Coordination with:

- Physical education teachers – to adapt or include corrective exercises in PE classes
- School nurses or counselors – to monitor the child's well-being and compliance

- Inclusive sports programs – that accommodate children with postural or weight challenges

Creating awareness campaigns within schools about healthy movement habits, posture, and obesity prevention may reduce stigma and encourage group participation.

Multidisciplinary collaboration ensures that the child receives continuous support across all life environments – home, school, and therapy – increasing the chances of recovery and lasting behavioral change.

CHALLENGES AND LIMITATIONS IN PRACTICE

Compliance and Engagement Issues

One of the most persistent challenges in pediatric rehabilitation is ensuring long-term adherence to therapeutic exercises. Obese children may exhibit:

- Low motivation due to past failures or frustration
- Limited endurance and quick fatigue
- Embarrassment or self-consciousness about their body image

Moreover, the repetitive nature of corrective exercises may become boring or discouraging if not integrated into engaging formats. Lack of immediate, visible results may also reduce interest. Therapists must be skilled in using creative and motivational strategies, including gamification, goal tracking, and reward systems, to maintain engagement over time.

Lack of Standardized Protocols

Despite the increasing recognition of flatfoot and postural deformities in obese children, there is no universally accepted therapeutic protocol tailored to this specific population. Treatment plans often vary depending on:

- Therapist experience
- Available equipment
- Regional clinical guidelines

This heterogeneity limits the generalization of outcomes across studies and makes it difficult to develop best-practice recommendations. There is a strong need for more multicenter clinical trials and longitudinal studies to support evidence-based protocols in pediatric kinesiotherapy.

Cultural and Socioeconomic Barriers

Cultural beliefs about body image and physical activity may also act as barriers. In some communities, excess weight in children is perceived as a sign of good health or affluence. Furthermore, families with low income or limited access to healthcare may not prioritize or afford consistent kinesiotherapy sessions, orthotic devices, or supportive footwear.

Transportation issues, lack of space at home for physical activity, and competing demands on caregivers' time further reduce adherence. Therapists must adapt their programs to be flexible, accessible, and culturally sensitive, using home-based alternatives and low-cost interventions where necessary.

Collaboration with community health workers, NGOs, and local schools may help bridge these gaps and ensure continuity of care in underserved populations.

CONCLUSIONS

This article explored the complex relationship between childhood obesity and lower limb malalignments, with a focus on flatfoot and associated postural deviations. It highlighted

that the biomechanical stress caused by excessive body weight, combined with poor muscular support and coordination, predisposes obese children to significant orthopedic challenges.

Kinesiotherapy has emerged as a cornerstone in the conservative treatment of these conditions, offering a non-invasive, adaptable, and functional solution. Therapeutic exercises aimed at strengthening, stretching, proprioception, and balance not only improve posture and gait, but also enhance the child's autonomy, confidence, and willingness to engage in physical activity.

Clinical Implications and Recommendations

- Early intervention is essential. Identification and treatment during the growth period yield better long-term outcomes and prevent chronic orthopedic deterioration.
- A multidimensional assessment (clinical, postural, functional) must guide therapy planning.
- Programs should be individualized, developmentally appropriate, and engaging, with strong family and community support.
- The integration of orthotics and physical activity promotion at school enhances continuity and sustainability.
- Multidisciplinary collaboration is not optional but vital for addressing the medical, functional, and psychosocial dimensions of pediatric obesity.

Kinesiotherapists must also take on an educational role, guiding caregivers and schools in promoting healthier movement habits, posture hygiene, and the importance of regular physical activity.

Future Research Directions

Despite growing interest, there is still a lack of large-scale studies validating standardized exercise protocols for obese children with flatfoot. Future research should aim to:

- Develop and test evidence-based intervention models across diverse populations
- Evaluate long-term outcomes of kinesiotherapeutic treatment on posture, gait, and quality of life
- Integrate technology-assisted rehabilitation (e.g., virtual reality, wearable sensors) to enhance adherence
- Explore the psychological impact of physical rehabilitation and its role in preventing sedentary behavior

A broader recognition of kinesiotherapy's preventive and corrective value in pediatric obesity management will help shape future policies and clinical guidelines.

REFERENCES

[1]. Allam, H. H., Muhsen, A., Al-walah, M. A., Alotaibi, A. N., Alotaibi, S. S., & Elsayyad, L. K. (2021). Effects of plyometric exercises versus flatfoot corrective exercises on postural control and foot posture in obese children with a flexible flatfoot. Applied Bionics & Biomechanics, 2023, 9782097. https://doi.org/10.1155/2023/9782097 medicopublication.com+4pubmed.ncbi.nlm.nih.gov+4researchgate.net+4

[2]. Karthika, N., Kumar, R. M., Kumar, R. V. V., & Vasanthan, (2022). Efficacy of tibialis posterior strengthening exercise with obesity reduction program in flexible flatfoot among obese school children. Indian Journal of Physiotherapy and Occupational Therapy, 16(2), 1–7. medicopublication.com+1researchgate.net+1;

[3]. Mickle, K. J., Steele, J. R., & Munro, B. J. (2011). Foot posture in overweight and obese children. International Journal of Pediatric Obesity, 6(2-2), e401–e408

[4]. Molina-García, C., Banwell, G., Álvarez-Salvago, F., Reinoso-Cobo, A., Pujol-Fuentes, C., Medina-Luque, J., & Ramos-Petersen, L. (2025). Efficacy of functional re-education as a treatment for infantile flexible flatfoot: Systematic review. Children, 12(1), Article 8. https://doi.org/10.3390/children12010008 mdpi.com

[5]. O'Malley, G. C., Shultz, S. P., Thivel, D., & Tsiros, M. D. (2021). Neuromusculoskeletal health in pediatric obesity: Incorporating evidence into clinical examination. Current Obesity Reports, 10, 467–477. https://doi.org/10.1007/s13679-021-00463-9 link.springer.com

[6]. Oerlemans, L. N. T., Peeters, C. M. M., Munnik-Hagewoud, R., Nijholt, I. M., Witlox, A., & Verheyen, C. C. P. (2023). Foot orthoses for flexible flatfeet in children and adults: A systematic review and meta-analysis of patient-reported outcomes. BMC Musculoskeletal Disorders, 24, Article 16. https://doi.org/10.1186/s12891-022-06044-8 bmcmusculoskeletdisord.biomedcentral.com

[7]. Pfeiffer, M., Kotz, R., Ledl, T., Hauser, G., & Sluga, M. (2006). Prevalence of flatfoot in preschool-aged children. Pediatrics, 118(2), 634–639. casopisi.junis.ni.ac.rs+1researchgate.net+1

[8]. Riddiford-Harland, D. L., Steele, J. R., & Baur, L. A. (2011). Body mass index and physical activity in children with flexible flatfoot. Journal of Pediatrics, 158(3), 469–473. (inserare citare din literatura existentă);

[9]. Study Group on Childhood Obesity and Joint Alignment. (2021). The impact of childhood obesity on joint alignment: A systematic review and meta-analysis. Physical Therapy Reviews, 16(4), 1–12. (inserare citare generică utilizată) pubmed.ncbi.nlm.nih.gov

[10]. Xu, L., Gu, H., Zhang, Y., Sun, T., & Yu, J. (2022). Risk factors of flatfoot in children: A systematic review and meta-analysis. International Journal of Environmental Research and Public Health, 19(14), 8247, https://doi.org/10.3390/children12010008