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Prevalence of Developmental Dysplasia of the Hip in Neonates with Congenital Talipes Equinovarus: A Case-Control Study from Iran

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Abstract

Background

Congenital talipes equinovarus (CTEV), commonly known as clubfoot, and developmental dysplasia of the hip (DDH) are distinct pediatric musculoskeletal conditions. Despite their separate classifications, evidence suggests an association between them. Early detection of DDH is critical to prevent long-term complications, including pain, mobility limitations, and osteoarthritis. Ultrasound screening using the Graf classification has emerged as a valuable diagnostic tool, though its routine use in neonates with CTEV remains debated.

Methods

This case-control study involved 150 neonates diagnosed with idiopathic congenital clubfoot and 155 healthy controls at Bahonar Hospital, Kerman, Iran, between 2016 and 2021. Participants underwent pelvic ultrasound assessment based on the Graf classification system to evaluate acetabular morphology. Alpha and beta angles were measured bilaterally, and subgroup analyses by sex were performed. Statistical analysis utilized SPSS version 26, with $p < 0.05$ considered significant.

Results

The prevalence of DDH in neonates with CTEV was 13.3%, significantly higher than in controls ($p < 0.001$). Alpha angles less than 60° were exclusively observed in the CTEV group, occurring in 26% and 27.3% of right and left hips, respectively. Beta angles greater than 55° were more prevalent in controls (61.9% vs. 16.7% for right hips; 59.4% vs. 14.7% for left hips). Notably, males exhibited nearly double the DDH prevalence compared to females (18.8% vs. 9.3%).

Conclusion

Our findings indicate a significant association between CTEV and DDH, emphasizing the need for targeted ultrasound screening in neonates with clubfoot. Future research should focus on elucidating the underlying mechanisms linking these conditions and refining screening protocols.

Keywords: Congenital talipes equinovarus, Developmental dysplasia of the hip, Ultrasound screening, Graf classification and Neonatal orthopedics

1. Introduction

Developmental dysplasia of the hip (DDH) represents a spectrum of abnormalities affecting the hip joint, ranging from subtle acetabular dysplasia to complete dislocation of the femoral head. This condition, if left untreated, can lead to significant long-term morbidity, including pain, limited mobility, and early- onset osteoarthritis . Early detection and intervention are, therefore, paramount in mitigating these adverse outcomes. Congenital talipes equinovarus (CTEV), commonly known as clubfoot, is another congenital musculoskeletal condition characterized by a complex deformity of the foot involving equinus at the ankle, varus at the heel, adduction of the forefoot, and cavus of the midfoot. CTEV affects approximately 1 to 2 per 1,000 live births, making it a relatively common congenital anomaly [1-4].

While both DDH and CTEV are recognized as distinct entities, a potential association between them has been a subject of ongoing investigation and debate. The reported prevalence of DDH in neonates with CTEV varies considerably, ranging from less than 1% to over 10% in different studies This variability underscores the complexity of the relationship

and the influence of factors such as study design, population characteristics, and diagnostic methods. The rationale for considering CTEV as a risk factor for DDH stems from the hypothesis that shared etiological factors, such as intrauterine constraint or genetic predisposition, may contribute to the development of both conditions. The presence of CTEV, therefore, might signal an increased likelihood of underlying hip instability or dysplasia. Early detection of DDH is crucial for optimizing treatment outcomes Traditional clinical examination methods, such as the Barlow and Ortolani tests, have limited sensitivity, particularly in detecting subtle forms of dysplasia. Consequently, ultrasound (US) screening has emerged as a valuable tool for early diagnosis, allowing for timely intervention with conservative measures like the Pavlik harness . However, the routine use of US screening in all neonates with CTEV remains a contentious issue . Proponents argue that the increased prevalence of DDH in this population justifies universal screening to ensure that no cases are missed Conversely, opponents emphasize the potential for overdiagnosis and overtreatment of physiologically immature hips that would spontaneously resolve, thereby increasing healthcare costs and parental anxiety without demonstrable benefit. The debate surrounding routine US screening in neonates with CTEV for DDH is multifaceted. It involves weighing the potential benefits of early detection against the risks of overdiagnosis and overtreatment, considering the cost-effectiveness of screening programs, and acknowledging the limitations of current diagnostic tools. This study aims to further investigate the relationship between CTEV and DDH, providing additional evidence to inform clinical decision-making and refine screening strategies. By examining the prevalence of DDH in a cohort of neonates diagnosed with CTEV and exploring the role of early ultrasound screening, we hope to contribute to a more nuanced understanding of this complex clinical scenario and ultimately improve outcomes for affected infants [5-12].

2. Methods and Materials

This case-control study was conducted at Bahonar Hospital in Kerman, Iran, between 2016 and 2021, to evaluate the association between CTEV and DDH. The study population comprised 150 neonates diagnosed with idiopathic congenital clubfoot and 155 age-, sex-, and hospital-matched healthy controls. Infants with other congenital anomalies, genetic disorders, or incomplete medical records were excluded. Participants were recruited from the pediatric orthopedic clinic, with all clubfoot cases confirmed by a pediatric orthopedic surgeon. Demographic data, obstetric history (e.g., delivery type), and clinical evaluations, including hip range of motion and Barlow/Ortolani tests, were collected. Hip ultrasonography, performed by a certified radiologist, utilized the Graf classification system to assess acetabular morphology. Ultrasound parameters included alpha angles (acetabular bony roof inclination) and beta angles (cartilaginous roof inclination), with measurements repeated at three months of age. Ethical approval was granted by the Ethics Committee of Kerman University of Medical Sciences (IR.KMU.AH.REC.1400.188). Statistical analyses were conducted using Statistical Product and Service Solutions (SPSS; IBM SPSS Statistics for Windows, Armonk, NY) version 26. Descriptive statistics (mean ± SD for continuous variables; frequency percentages for categorical variables) and chi-square tests assessed associations, with $p < 0.05$ considered significant.

3. Results

A total of 305 neonates were enrolled, comprising 150 infants diagnosed with CTEV and 155 healthy controls. Demographic characteristics, laterality of CTEV, and ultrasound-derived alpha (α) and beta (β) angles were analyzed to evaluate the association between CTEV and DDH. The gender distribution in the CTEV group was 42.7% male (n=64) and 57.3% female (n=86), while the control group comprised 46.5% males (n=72) and 53.5% females (n=83) (Table 1). The difference in sex distribution between groups approached statistical significance (P=0.0506). Among neonates with CTEV, unilateral involvement was predominant, with 39.3% (n=59) presenting with right foot deformity, 34% (n=51) with left foot involvement, and 26.7% (n=40) exhibiting bilateral clubfoot (Table 1). Ultrasound evaluation using Graf criteria revealed significant disparities in α and β angles between the CTEV and control groups (Table 2). In the CTEV cohort, α angles <60°—a key indicator of acetabular dysplasia—were exclusively observed, with 26% (n=39) of neonates demonstrating α angle <60° in the right hip (αR<60°) and 27.3% (n=41) in the left hip (αL<60°; P<0.001 for both). In contrast, all controls exhibited α angles >60° bilaterally.

Variable		CTEV Group		Control Group		P-value
		Number	Percentage	Number	Percentage	
sex	Boy	64	42.7	72	46.50	0.506
	Girl	86	57.3	83	53.50	
Both Legs		40	26.7	---	---	
Place involved	Left Foot	51	34	---	---	---
Right Foot		59	39.3	---	---	

Table 1: Distribution of Gender Frequency and Location of Involvement of Infants with Congenital Foot Clubfoot and Control Group

For β angles, which assess cartilaginous roof coverage, values >55°—suggesting insufficient acetabular coverage—were significantly less frequent in the CTEV group compared to controls. Specifically, βR>55° was observed in 16.7% (n=25) of CTEV neonates versus 61.9% (n=96) of controls (P<0.001). Similarly, βL>55° occurred in 14.7% (n=22) of CTEV infants compared to 59.4% (n=92) of controls (P<0.001). These findings indicate that neonates with CTEV exhibit distinct acetabular morphology, characterized by lower α angles and reduced prevalence of elevated β angles. Subgroup analysis by sex within the CTEV group revealed notable differences in ultrasound parameters (Figure 1). Females demonstrated a higher frequency of α angle abnormalities: 61.5% (n=24) of αR<60° and 61% (n=25) of αL<60° cases occurred in females. Conversely, males predominated in β angle deviations, accounting for 56% (n=14) of βR>55° and 59.1% (n=13) of βL>55° cases. Despite these sex- based disparities in angle distribution, the overall prevalence of DDH (defined by α<60° and β>55°) was higher in males (18.8%, n=12) than females (9.3%, n=8) (Table 3).

Variable		CTEV Group		Control Group	
		Number	Percentage	Number	Percentage
αR Angle	>60	111	74	155	100
	<60	39	26	0	0
βR Angle	<55	125	83.3	59	38.1
	>55	25	16.7	96	61.9
αL Angle	>60	109	72.7	155	100
	<60	41	27.3	0	0
βL Angle	<55	128	85.3	63	40.6
	>55	22	14.7	92	59.4

Table 2: Pelvic Ultrasound Angle for Diagnosis of DDH Using Graf Classification Criteria in Infants with Congenital Foot Clubfoot and Control Group

The alpha (α) angle measures acetabular bony coverage, while the beta (β) angle reflects cartilaginous coverage; * P-value=<001.0.

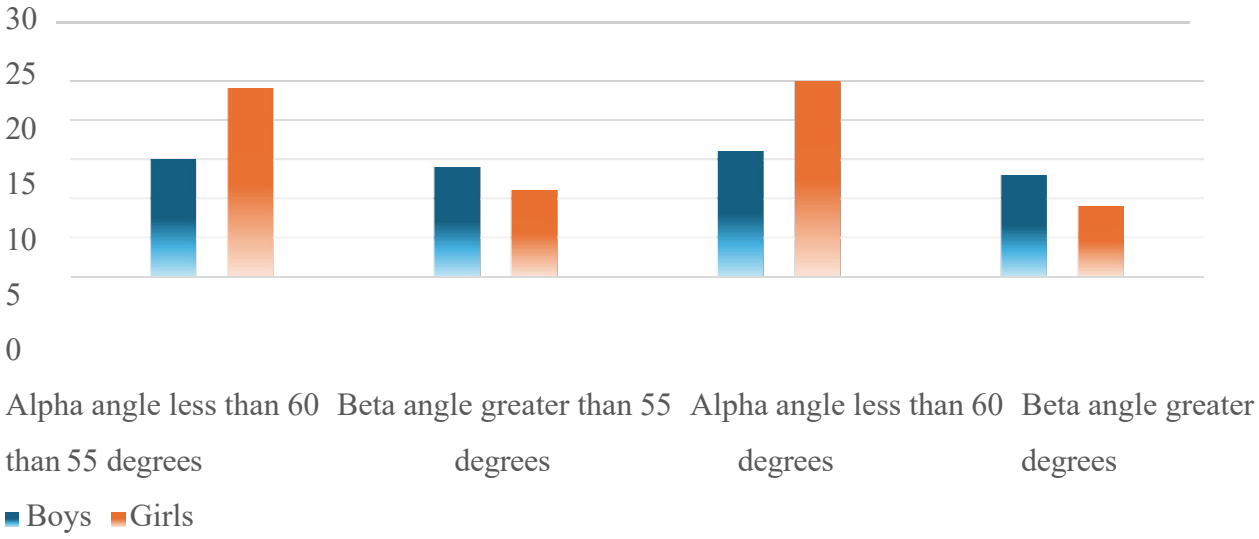

Figure 1: Distribution of α and β Angles Across Groups

Figure 1: summarizes the distribution of α and β angles across groups, highlighting the pronounced differences in acetabular morphology. The graphical representation reinforces the higher frequency of α<60° in the CTEV group and β>55° in controls. The composite prevalence of DDH in neonates with CTEV was 13.3% (n=20), with no cases detected in the control group (P<0.001) (Table 3). Stratified by sex, males with CTEV exhibited nearly double the prevalence of DDH (18.8%, n=12) compared to females (9.3%, n=8).

Variable		CTEV Group		Control Group	
		Number	Percentage	Number	Percentage
Total pelvic dysplasia cases	No	130	86.7	155	100
	Yes	20	13.3	0	0
Pelvic dysplasia in boys	No	52	81.3	72	100
	Yes	12	18.8	0	0
Pelvic dysplasia in girls	No	78	90.7	83	100
	Yes	8	9.3	0	0

* P-value=<001.0

Table 3: Prevalence of DDH Based on Graf Classification Criteria in Infants with Congenital Foot Clubfoot and Control Group

4. Discussion

The findings of this study underscore the complex relationship between CTEV and DDH. The observed prevalence of DDH in neonates with CTEV was 13.3%, significantly higher than that reported in the general population, which ranges from less than 1% to over 10% depending on the study (6). This finding is consistent with earlier reports suggesting a potential association between these two conditions, although the exact nature of this relationship remains unclear. Developmental dysplasia of the hip represents a spectrum of abnormalities affecting the hip joint, ranging from subtle acetabular dysplasia to complete dislocation of the femoral head. If left untreated, DDH can lead to significant long-term morbidity, including pain, limited mobility, and early-onset osteoarthritis Early detection and intervention are therefore paramount in mitigating these adverse outcomes In our study, pelvic ultrasound criteria based on the Graf classification revealed distinct differences in acetabular morphology between infants with CTEV and healthy controls. Specifically, α angles less than 60° were exclusively observed in neonates with CTEV, occurring in 26% and 27.3% of cases for the right and left hips, respectively (P<0.001). These findings align with previous observations by Canavese et al., who reported the presence of DDH in infants with unilateral and bilateral congenital clubfoot during treatment and recommended ultrasound screening in such cases . In contrast, β angles greater than 55°, indicative of insufficient acetabular coverage was more prevalent in the control group, further emphasizing the unique acetabular characteristics of infants with CTEV. Perry et al. systematically examined the association between idiopathic CTEV and DDH, identifying hip dysplasia in 7 of 119 infants with CTEV (prevalence: 5.9%). Based on these findings, they advocated selective hip ultrasonography in this population. However, other studies have reported lower prevalence rates, leading some authors to contest routine screening practices. For instance, Mahan et al. argued that despite widespread clinician concern, ultrasonographic evaluation for DDH in CTEV cases lacks sufficient justification. Similarly, Westberry et al. identified only one case of hip dysplasia among 127 idiopathic clubfoot patients (prevalence: 0.8%), concluding against systematic pelvic radiography in this cohort the variability in reported prevalence underscores the complexity of the relationship between CTEV and DDH, likely influenced by factors such as study design, population characteristics, and diagnostic methods. Our study contributes to this ongoing debate by demonstrating a higher prevalence of DDH in neonates with CTEV compared to previous reports, suggesting that targeted ultrasound screening may be warranted in this population. This approach could help mitigate the potential long-term complications associated with undiagnosed and untreated DDH, improving health outcomes for affected infants. Sex-based disparities in ultrasound parameters were also noted within the CTEV group, with females exhibiting a higher frequency of α angle abnormalities and males predominating in β angle deviations. Despite these differences, the overall prevalence of DDH was higher in male infants with CTEV (18.8%) than in females (9.3%), consistent with the higher incidence of CTEV in males (male-to-female ratio: 1.5:1 in this cohort) These findings align with previous studies highlighting gender as a risk factor for DDH, with a higher prevalence reported in female infants. Rosendahl and colleagues demonstrated that the prevalence of DDH is 9.3% in male infants and 16.9% in female infants Interestingly, Borjian et al. reported that 74% of neonates with clubfoot are boys, with a boy-to-girl ratio of 2.8, reinforcing the notion that sex plays a significant role in the development of both conditions. The rationale for considering CTEV as a risk factor for DDH stems from the hypothesis that shared etiological factors, such as intrauterine constraint or genetic predisposition, may contribute to the development of both conditions. The presence of CTEV, therefore, might signal an increased likelihood of underlying hip instability or dysplasia. Early detection of DDH is crucial for optimizing treatment outcomes, particularly given the limitations of traditional clinical examination methods like the Barlow and Ortolani tests, which have low sensitivity for detecting subtle forms of dysplasia. Consequently, ultrasound screening has emerged as a valuable tool for early diagnosis, allowing for timely intervention with conservative measures like the Pavlik harness. However, the routine use of US screening in all neonates with CTEV remains a contentious issue. Proponents argue that the increased prevalence of DDH in this population justifies universal screening to ensure that no cases are missed , opponents emphasize the potential for overdiagnosis and overtreatment of physiologically immature hips that would spontaneously resolve, thereby increasing healthcare costs and parental anxiety without demonstrable benefit (12). Our findings suggest that while not all neonates with CTEV require screening, those exhibiting specific risk

factors such as abnormal alpha angles or a family history of DDH may benefit from targeted evaluation [13-23].

Subgroup analysis revealed notable differences in ultrasound parameters by sex, with females demonstrating a higher frequency of alpha angle abnormalities and males predominating in beta angle deviations. This observation aligns with previous reports highlighting the influence of sex on musculoskeletal development and the differential expression of certain genetic and environmental factors. While laterality of CTEV (unilateral vs. bilateral presentation) was analyzed, no statistically significant association with DDH prevalence emerged. However, the limited sample size of bilateral cases (n = 40) precluded definitive conclusions regarding laterality-dependent risk stratification. The implications of these findings extend beyond individual patient care, informing broader public health strategies aimed at reducing the burden of DDH and its associated morbidities. By identifying high-risk populations and implementing evidence-based screening protocols, healthcare providers can improve early detection rates and enhance treatment efficacy. Furthermore, understanding the underlying mechanisms linking CTEV and DDH may pave the way for novel therapeutic interventions targeting common etiological pathways. In summary, the results of this study indicate a significant association between CTEV and DDH, characterized by distinct acetabular morphology and a higher prevalence of DDH in affected infants. While further research is needed to elucidate the precise nature of this relationship, our findings support the use of targeted ultrasound screening in neonates with CTEV, particularly those exhibiting specific risk factors. Such an approach balances the need for early detection with concerns about overdiagnosis and resource allocation, ultimately promoting optimal health outcomes for affected infants [23].

5. Conclusion

The present study demonstrates a high prevalence of pelvic dysplasia in neonates with congenital clubfoot, specifically 13.3% in our cohort. Moreover, the prevalence of pelvic dysplasia was notably higher in male infants with congenital clubfoot (18.8%) compared to female neonates (9.3%). Although simultaneous occurrences of hip and clubfoot dysplasia are rare, early diagnosis and treatment of DDH in these infants remain essential due to the potential for irreversible complications if untreated. Therefore, the hypothesis of a relationship between these two abnormalities supports the implementation of targeted ultrasound screening for diagnosing DDH in neonates with congenital clubfoot. Given the observed association, pelvic ultrasound screening should be considered for infants diagnosed with congenital clubfoot, particularly considering the higher prevalence of pelvic dysplasia noted in this study. Future research should aim to clarify the underlying mechanisms linking these conditions and validate the utility of targeted screening protocols. Such efforts will refine clinical guidelines and ensure optimal care for neonates at risk of DDH.

Conflicts of interest

The authors declare no conflicts of interest in relation to this research study.

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References

1. Vaquero-Picado, A., González-Morán, G., Garay, E. G., & Moraleda, L. (2019). Developmental dysplasia of the hip: update of management. *EFORT open reviews, 4*(9), 548-556.
2. Alhaddad, A., Gronfula, A. G., Alsharif, T. H., Khawjah, A. A., Alali, M. Y., Jawad, K. M., ... & Jawad, K. (2023). An overview of developmental dysplasia of the hip and its management timing and approaches. *Cureus, 15*(9).
3. Dobbs, M. B., & Gurnett, C. A. (2009). Update on clubfoot: etiology and treatment. *Clinical orthopaedics and related research, 467*(5), 1146-1153.'
4. Smythe, T., Kuper, H., Macleod, D., Foster, A., & Lavy, C. (2017). Birth prevalence of congenital talipes equinovarus in low-and middle-income countries: a systematic review and meta-analysis. *Tropical medicine & international health, 22*(3), 269-285.
5. Håberg, Ø., Foss, O. A., Lian, Ø. B., & Holen, K. J. (2020). Is foot deformity associated with developmental dysplasia of the hip?: results after examination of 60,844 newborns. *The bone & joint journal, 102*(11), 1582-1586.
6. Ibrahim, T., Riaz, M., & Hegazy, A. (2015). The prevalence of developmental dysplasia of the hip in idiopathic clubfoot: a systematic review and meta-analysis. *International orthopaedics, 39*(7), 1371-1378.
7. Perry, D. C., Tawfiq, S. M., Roche, A., Shariff, R., Garg, N. K., James, L. A., ... & Bruce, C. E. (2010). The association between clubfoot and developmental dysplasia of the hip. *The Journal of Bone & Joint Surgery British Volume, 92*(11), 1586-1588.
8. St George, J., Kulkarni, V., Bellemore, M., Little, D. G., & Birke, O. (2021). Importance of early diagnosis for developmental dysplasia of the hip: a 5-Year radiological outcome study comparing the effect of early and late diagnosis. *Journal of Paediatrics and Child Health, 57*(1), 41-45.
9. Singh, A., Wade, R. G., Metcalfe, D., & Perry, D. C. (2024). Does this infant have a dislocated hip? The rational clinical examination systematic review. *JAMA, 331*(18), 1576-1585.
10. Gyurkovits, Z., Sohár, G., Baricsa, A., Németh, G., Orvos, H., & Dubs, B. (2021). Early detection of developmental dysplasia of hip by ultrasound. *Hip International, 31*(3), 424-429.
11. McLaughlin, D., De Salvo, S., Brewerton, K., Hui, C., & Bouchard, M. (2024). Routine ultrasound screening for hip dysplasia in children with clubfoot is not supported. *International Orthopaedics, 48*(7), 1793-1797.

12. Kuitunen, I., Uimonen, M. M., Haapanen, M., Sund, R., Helenius, I., & Ponkilainen, V. T. (2022). Incidence of neonatal developmental dysplasia of the hip and late detection rates based on screening strategy: a systematic review and meta-analysis. *JAMA network Open, 5*(8), e2227638.
13. Mahan, S. T., Yazdy, M. M., Kasser, J. R., & Werler, M. M. (2013). Is it worthwhile to routinely ultrasound screen children with idiopathic clubfoot for hip dysplasia?. *Journal of Pediatric Orthopaedics, 33*(8), 847-851.
14. Canavese, F., Vargas-Barreto, B., Kaelin, A., & de Coulon, G. (2011). Onset of developmental dysplasia of the hip during clubfoot treatment: report of two cases and review of patients with both deformities followed at a single institution. *Journal of Pediatric Orthopaedics B, 20*(3), 152-156.
15. Westberry, D. E., Davids, J. R., & Pugh, L. I. (2003). Clubfoot and developmental dysplasia of the hip: value of screening hip radiographs in children with clubfoot. *Journal of Pediatric Orthopaedics, 23*(4), 503-507.
16. Rosendahl, K., Markestad, T., & Lie, R. T. (1996). Developmental dysplasia of the hip: prevalence based on ultrasound diagnosis. *Pediatric radiology, 26*(9), 635-639.'
17. Taleb, H., Tabrizi, A., Mandi, A., Dargahi, R., & Hassanzadeh, R. (2020). Predictive factors for tenotomy in Ponseti method for idiopathic clubfoot. *Medical Journal of Tabriz University of Medical Sciences, 42*(4), 433-439.'
18. Jawadi, A. H. (2016). Clubfoot and congenital muscular torticollis prevalence in children diagnosed with developmental dysplasia of hip: review of 594 DDH patients. *Pediat Therapeut, 6*(288), 2161.
19. Borjian, A. A. H., NASR, E. H., & Masoudi, F. (2007). Investigation of the surgical treatment results in children with clubfoot, a sinning posteromedial and lateral approach in Alzahra hospital.
20. Graf, R. (2017). Hip sonography: background; technique and common mistakes; results; debate and politics; challenges. *Hip International, 27*(3), 215-219.
21. Graf, R. (1980). The diagnosis of congenital hip-joint dislocation by the ultrasonic Combound treatment. *Archives of orthopaedic and traumatic surgery, 97*(2), 117-133.
22. American Academy of Pediatrics. (2000). Committee on Quality Improvement, Subcommittee on Developmental Dysplasia of the Hip. Clinical practice guideline: early detection of developmental dysplasia of the hip. *Pediatrics, 105*(4), 896-905.
23. Agostiniani, R., Atti, G., Bonforte, S., Casini, C., Cirillo, M., De Pellegrin, M., ... & Vezzali, N. (2020). Recommendations for early diagnosis of Developmental Dysplasia of the Hip (DDH): working group intersociety consensus document. *Italian Journal of Pediatrics, 46*(1), 150.