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Neurodevelopment in preschool idiopathic toe-walkers☆

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KEYWORDS
Toe-walkers;
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Assessment;
Neurodevelopment;
Early detection

Abstract
Introduction: Idiopathic toe walking, a differential diagnosis for neurological and orthopaedic disorders, has been associated with neurodevelopmental alterations. Neurodevelopmental assessment at early ages using specific tests may improve management and follow-up of these patients. The aim of our study is to analyse the neurodevelopmental characteristics of preschool idiopathic toe-walkers (ITW) by comparing them to a control group.
Method: Our descriptive cross-sectional study compared possible risk factors, neurodevelopmental characteristics, and scores on the Child Neuropsychological Maturity Questionnaire (CUMANIN) between a group of 56 ITWs aged 3-6 and a control group including 40 children.
Results: The proportion of males was significantly higher in the ITW group ($P = .008$). The percentage of patients with a family history ($P = .000$) and biological risk factors during the perinatal period ($P = .032$) was also higher in this group. According to the parents' reports, motor coordination in ITWs was significantly poorer (59%; $P = .009$). ITWs scored significantly lower on CUMANIN subscales of psychomotricity ($P = .001$) and memory ($P = .001$), as well as in verbal development ($P = .000$), non-verbal development ($P = .026$), and overall development ($P = .004$). Foot preference was less marked in the ITW group ($P = .047$).

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Conclusions: The neurodevelopmental characteristics of our sample suggest that idiopathic toe walking is a marker of neurodevelopmental impairment. However, further studies are necessary to confirm these findings.

PALABRAS CLAVE
Andadores de puntillas;
Marcha de puntillas;
Preescolares;
Valoración;
Desarrollo neuromadurativo;
Detección precoz

Desarrollo neuromadurativo en andadores de puntillas de edad preescolar

Resumen
Introducción: La marcha de puntillas idiopática, considerada un diagnóstico de exclusión de alteraciones neurológicas y ortopédicas, se ha relacionado con alteraciones en diversas áreas del desarrollo neuromadurativo. La evaluación del neurodesarrollo en edades tempranas mediante un test específico podría mejorar el seguimiento y el abordaje terapéutico de estos niños. El objetivo de este trabajo es analizar las características neuromadurativas de los andadores de puntillas (AP) de edad preescolar en relación con un grupo control (GC).
Método: Mediante un estudio descriptivo transversal se han comparado los posibles factores de riesgo, las características del neurodesarrollo y los resultados del Cuestionario de Madurez Neuropsicológica Infantil (CUMANIN) de un grupo de 56 AP de entre 3 y 6 años con un GC de 40 niños.
Resultados: Entre los AP había un mayor porcentaje de varones (p = 0,008) y este grupo presentaba un porcentaje significativamente mayor de antecedentes familiares (p = 0,000) y de factores de riesgo biológico durante el período perinatal (p = 0,032). Los padres manifestaron que los AP mostraban una torpeza motriz significativamente superior (59%; p = 0,009). Los AP obtuvieron en el CUMANIN puntuaciones significativamente inferiores en las escalas de psicomotricidad (p = 0,001) y memoria (p = 0,001), y en el desarrollo verbal (p = 0,000), no verbal (p = 0,026) y total (p = 0,004), además de una menor definición de la lateralidad podálica (p = 0,047).
Conclusiones: Los AP de la muestra estudiada presentan características neuromadurativas específicas que apoyan la consideración de la marcha de puntillas como marcador de problemas del desarrollo, aunque son necesarios más estudios.

Introduction

Children who display a symmetrical toe-toe gait pattern from the time they start walking are called toe walkers.[1–6] These children may, however, achieve initial heel strike when asked to do so or when they concentrate on gait.[6–8] Idiopathic toe walking seems to be voluntarily modifiable when there is no significant retraction of the gastrocnemius—soleus complex. Retraction is affected by emotional and cognitive factors.[6,7,9,10]

Although a diagnosis of idiopathic toe walking is currently considered to rule out neurological and orthopaedic disorders,[2,4,6,11] this condition has been associated with alterations in different areas of child development in several studies.[3,5,6,9,12,13] Furthermore, idiopathic toe walking has also been associated with different complications occurring during pregnancy, delivery, and the postpartum period[2,4,14] and 10% to 88% of cases have a family history of the condition. This suggests central nervous system (CNS) involvement.[15,16]

Therefore, presence of toe walking points to the need for a thorough assessment of neurodevelopmental disorders.[1,2,17–19] The unique features of toe walkers have led researchers to consider idiopathic toe walking as a syndrome, given that it reflects delayed neuromotor acquisition and maturation aggravated by secondary retraction of the triceps surae.[17]

Following this line of reasoning, several researchers have hypothesised that idiopathic toe walking is a motor expression of minimal cerebral dysfunction (MCD).[2,5,6] Some studies including series of toe walkers have detected alterations in motor control, visual perception, spatial perception, and language.[2,18,19] Accardo et al.[19] evaluated 163 children attending an ambulatory paediatric clinic and found lower language quotients in toe walkers than in children with normal gait patterns, especially in the group of preschool children. Likewise, Shulman et al.[2] reported a high frequency of attention deficits, hypo- and hyperactivity, articulation and language organisation errors, deficits in fine and gross motor control, and visuomotor problems in a series of 13 toe walkers. In 2010, Williams et al.[15] suggested that toe walking was associated with sensory processing dysfunction, defined as an alteration in ''the neurological process that organises sensation from one's own body and