Do socioeconomic and demographic factors influence treatment outcomes in patients with idiopathic clubfoot in the Western Cape?

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Abstract

Background

Idiopathic clubfoot is a common congenital birth defect with a global incidence of 1.2 per 1 000 births. The Ponseti method is the gold standard of treatment for clubfoot and is reproducible and relatively cost effective, making it applicable to low- and middle-income countries (LMICs) such as South Africa. Studies from other LMICs demonstrated that certain socioeconomic and demographic factors influence treatment outcomes in children with clubfoot. Financial circumstances, transportation, waiting times and understanding of treatment were among the common barriers identified in these studies. Our study aims to assess the relationship between demographic and socioeconomic factors and treatment outcomes in patients treated for idiopathic clubfoot in South Africa.

Methods

A retrospective analysis of prospectively collected data was performed for patients with idiopathic clubfoot presenting to our clubfoot clinic from 1 May 2020 to 30 April 2022. Failure of treatment was defined as the need for repeat casting or tenotomy, or extensive soft tissue surgery. Data was collected on demographic variables such as age and sex; treatment variables such as number of casts, tenotomies and relapse; and socioeconomic variables including the Demographic and Health Surveys (DHS) wealth index, and transport-related variables. The relationship between the tested variables and treatment failure was analysed.

Results

Seventy-five patients, of whom 51 (68%) were male, were included. The average age at presentation was 60 days (5–834 days). Of the variables examined, defaulter status ($p = 0.006$) and age at first presentation ($p = 0.03$) were associated with failure of treatment. Of the socioeconomic variables, 'travel time' was weakly associated with treatment failure but did not reach statistical significance in the multivariate analysis.

Conclusion

In contrast to the findings of several studies performed in other LMICs, socioeconomic and demographic factors do not appear to influence treatment outcomes of idiopathic clubfoot treated with the Ponseti method in our setting.

Level of evidence: 3

Keywords: clubfoot, congenital talipes equinovarus, Ponseti method, socioeconomic, demographic, treatment outcomes

Introduction

Idiopathic clubfoot, also known as congenital talipes equinovarus, is one of the most common musculoskeletal congenital birth defects, accounting for 80% of all patients diagnosed with congenital clubfoot.[1] The global incidence of congenital clubfoot is 1.2 per 1 000 births and has a male to female ratio of 2.5:1.[2] The global incidence rates vary by ethnicity, and around 50% of cases are bilateral.[3]

When treated inadequately, patients often have residual deformities which can lead to chronic pain and limit function.[4] Disability can cause hardship for patients and affected families, create social obstacles, decrease patient mobility, threaten patient productivity, and decrease the chances of patients to progress to live as independent adults.[5] We can therefore acknowledge that determining factors which influence treatment outcomes are of utmost importance to ensure the needs of these patients are met during treatment, thus improving their chances of a positive outcome.

The Ponseti method has become the gold standard of treatment for idiopathic clubfoot [6] and consists of serial casting, percutaneous Achilles tenotomy and bracing. This method is associated with a

high success rate, low complication rate, reproducibility and cost effectiveness, thereby making it accessible to patients living in low- and middle-income countries (LMICs) such as South Africa.[5]

It is estimated that approximately 80% of children born with clubfoot each year reside in LMICs.[7,8] There is, however, very little data regarding barriers to treatment and the socioeconomic factors that may influence treatment outcomes of patients diagnosed with idiopathic clubfoot in South Africa.

Intrapersonal factors, such as carer income, travel cost, income lost because of taking time off work, and interpersonal factors such as paternal involvement, were all found to be potential barriers to clubfoot treatment in LMICs in Africa, Asia, and South America.[9] Our study aims to assess the relationship that various demographic and socioeconomic factors have on treatment outcomes in patients diagnosed with idiopathic clubfoot in the Western Cape, South Africa.

Methods

Following approval from the institutional research ethics committee, we performed a retrospective analysis of prospectively collected data captured on a national clubfoot database.

We included patients who presented to our orthopaedic hospital's clubfoot clinic from 1 May 2020 to 30 April 2022. Only patients diagnosed with idiopathic clubfoot were included. Patients with syndromic or neurological clubfoot were excluded, as well as those who transferred out after receiving initial management at our clubfoot clinic.

As surrogate markers for treatment failure, we determined the incidence of recurrence (either repeat tenotomy or repeat casting) and the need for extensive soft tissue releases that are not considered part of the Ponseti method (non-Ponseti surgery). For the purpose of this study, an Achilles tenotomy or open Achilles tendon lengthening in older children, and a tibialis anterior tendon transfer were classified as Ponseti surgery. Any other surgeries such as a posterolateral and posteromedial release were classified as non-Ponseti surgery. These procedures are comprehensively described elsewhere.

We collected data on demographic variables (age at presentation, laterality of the clubfoot, sex and nationality) and socioeconomic variables (Demographic and Health Surveys [DHS] wealth index,[10] distance and duration and cost of travel to the clubfoot clinic, number of children in the household, and caregiver status).

The DHS wealth index uses several variables such as education, employment and access to amenities to calculate a score, where 0–5 indicates a low socioeconomic status, 6–12 a medium and > 12 a high socioeconomic status.

Clinical variables collected were the initial and total number of casts applied, whether an Achilles tenotomy was performed and how many times, and whether the patient required surgery, either Ponseti or non-Ponseti. We also collected data on patient defaulter status; patients who missed more than two clinic follow-ups were considered to have defaulted.

Statistical analyses

All analyses were conducted in SPSS version 28, with the threshold for statistical significance set at p = 0.05. Data are reported as means and standard deviation for continuous variables, and as frequencies and proportions for categorical variables.

Univariate analyses (independent sample t-tests, one-way ANOVAs, Pearson's correlations and chi-squared analyses) were conducted to determine predictors of total casts, recurrence, tenotomy, and non-Ponseti surgery. Predictors found to be significant were entered into regression models for the multivariate analysis.

Results

Seventy-five patients were included in our study. Presenting demographic and socioeconomic data is summarised in *Table I.*

The mean age at presentation to the clubfoot clinic was 60 days (SD = 120). The mean number of initial casts applied was 6.5 (SD = 3), and 32 patients (43%) had one or more Achilles tenotomies.

Recurrence

In the univariate analysis, Ponseti surgery (p = 0.006), initial and total number of casts (p = < 0.001), number of tenotomies (p = 0.001) and defaulter status (p = 0.004) were significantly

Table I: Demographic, clinical and socioeconomic details

Characteristic	Mean (range; SD)
Patients (n = 75)	
Laterality Left (n = 17) Right (n = 28) Bilateral (n = 30)	
Age at presentation (days)	60 (5–834; 120)
Sex Male (n = 51) Female (n = 24)	
Nationality South African (n = 64) Foreign (n = 11)	
Number of children in household	2.9 (1–11; 2.03)
Caregiver status Both parents (n = 51) Other (n = 24)	
Cost of travel (ZAR)	71.3 (0–300; 65.78)
Travel time to clinic (minutes)	110.6 (25–310; 70.04)
Distance travelled (km)	27.2 (9–150; 21.87)
Asset index	10.4 (2–16; 3.37)

Table II: Results of univariate analysis for the outcome measure 'recurrence'

Variable	No recurrence n (%)	Recurrence n (%)	p-value
Laterality			
Right (n = 28)	19 (44)	9 (28)	
Left (n = 17)	10 (23)	7 (22)	
Bilateral (n = 30)	14 (33)	16 (50)	0.262
Ponseti surgery			
Yes (n = 13)	3 (7)	10 (31)	
No (n = 62)	40 (93)	22 (69)	0.006
Defaulter			
Yes (n = 18)	5 (12)	13 (41)	
No (n = 57)	38 (88)	19 (59)	0.004
Sex			
Female (n = 24)	16 (37)	8 (25)	
Male (n = 51)	27 (63)	24 (75)	0.262
Nationality			
South African (n = 64)	38 (88)	26 (81)	
Non-RSA (n = 11)	5 (12)	6 (19)	0.389
Lives with			
Both parents (n = 54)	30 (70)	24 (75)	
Other (n = 21)	13 (30)	8 (25)	0.618

Table III: Results of univariate analysis for the outcome measure 'non-Ponseti surgery'

Variable	Non-Ponseti surgery n (%)	Non-Ponseti surgery n (%)	p-value
	No	Yes	
Laterality			
Right (n = 28)	26 (41)	2 (18)	
Left (n = 17)	15 (23)	2 (18)	
Bilateral (n = 30)	23 (36)	7 (64)	0.204
Recurrence			
Yes (n = 32)	22 (34)	10 (91)	
No (n = 43)	42 (66)	1 (9)	< 0.001
Defaulter			
Yes (n = 18)	14 (22)	4 (36)	
No (n = 57)	50 (78)	7 (64)	0.299
Sex			
Female (n = 24)	22 (34)	2 (18)	
Male (n = 51)	42 (66)	9 (81)	0.288
Nationality			
South African (n = 64)	55 (86)	9 (82)	
Non-RSA (n = 11)	9 (14)	2 (18)	0.721
Lives with			
Both parents (n = 54)	46 (72)	8 (73)	
Other (n = 21)	18 (28)	3 (27)	0.954

associated with the incidence of recurrence. *(Table II)* Of these variables, only Ponseti surgery (OR = 0.16, p = 0.012) and defaulter status (OR = 0.18, p = 0.006) remained statistically significant in the multivariate analysis.

Non-Ponseti surgery

In the univariate analysis, the number of initial casts (p = 0.003), age at first presentation (p < 0.001) and time spent travelling to the clinic (p = 0.041) were significantly associated with the need for non-Ponseti surgery (*Table III*). In the multivariate analysis, only number of initial casts (OR = 1.66, p = 0.019) and age at first presentation (OR = 1.02, p = 0.030) remained statistically significant predictors for non-Ponseti surgery.

Discussion

The aim of this study was to determine whether demographic and socioeconomic factors played a role in the treatment outcomes of patients born with idiopathic clubfoot, and if so, what these factors were. Our study was conducted at a dedicated clubfoot clinic in Cape Town, South Africa.

The mean number of casts used to achieve correction in our cohort was 8.13. Comparatively, Chu et al. found a mean of 5.1 casts used to achieve correction in their study reviewing the correlation between clubfoot classification and Ponseti cast treatment.[11] This represents a significant 37% increase in the number of casts needed to obtain correction in our study. This could possibly be attributed to the age at which the Ponseti method was initiated. All patients in their study were enrolled before 60 days of age with a mean age of 15.3 days, compared to our study's mean age of enrolment of 60.1 days. In a recent study published in 2024, Khurana et al. set out to determine if the age of initiation of Ponseti casting can predict the number of casts, affect treatment duration, and affect overall outcomes. They recommend starting casting within the first month of life as it is associated with the need for fewer casts and a shorter treatment duration. It did, however, not affect the overall outcome of treatment.[12]

Alam et al. reviewed the barriers that caregivers face during the treatment of clubfoot in Bangladesh. They listed four main barriers: financial circumstances, transportation, waiting times and understanding of treatment.[13] Seventy-eight per cent of their patients lived more than 11 km away from a clinic, and they found that a shorter travel distance resulted in higher compliance rates. A study by Bent et al. looked at the association between clubfoot clinic adherence and social disadvantages, including transportation insecurity. They found that 12% of missed clinic dates were solely due to transportation insecurity. Longer distances to clinic, increased travel time to clinic or not having a personal vehicle were listed as examples of transport insecurity which delayed care, resulting in poorer outcomes.[14] Our study showed a correlation between time spent travelling to the clinic and the need for non-Ponseti surgery, but this variable was not statistically significant in the multivariate analysis.

Kazibwe & Struthers reviewed barriers to treatment experienced by parents of children with clubfoot in Uganda. They found a significant association between compliance to clubfoot treatment and distance travelled to clinic and transport cost.[15] We found no statistically significant relationship between treatment failure and travel cost or between treatment failure and distance travelled to clinic. This may be explained by the fact that there is a reliable public interfacility transport system within the Western Cape.[16]

We used the DHS wealth index to determine the overall socioeconomic status of patients attending our clubfoot clinic. No study that we found looked specifically at the relationship between treatment failure in idiopathic clubfoot and socioeconomic status as determined by a validated score. Bent et al.[14] found that transport insecurity was associated with a lower Child Opportunity Index (COI), which is a zip-code related score of socioeconomic status based on 29 indicators covering aspects such as education, health and income. In our cohort, socioeconomic status, as determined by the DHS wealth index, was not associated with treatment failure in idiopathic clubfoot.

Dobbs et al. conducted a similar study with 51 patients, comparing patient characteristics and demographic variables with treatment outcomes. Of all the variables investigated by them, they found that only the educational level of the parents and noncompliance was associated with clubfoot recurrence.[17] These findings were duplicated in studies by Asuquo et al. in Nigeria,[18] and Dar et al. in India.[19] In our study, we did not assess the level of parental education specifically but as one of the components of the DHS wealth index, which was not related to treatment failure in our cohort.

A study by Poudel et al. investigating factors which affect compliance to clubfoot treatment in India found a statistically significant relationship between age and sex and the number of clinic appointments missed.[20] There was no relationship between sex and treatment failure in our cohort; however, we did not specifically assess the relationship between sex, compliance and the number of clinic appointments missed. However, gender equality varies significantly between countries and can influence access to medical care, empowerment and employment.[21]

Another demographic factor that we had assessed was the number of children in each household where our patients were living. We found no significant relationship between the number of children per household and treatment failure. In contrast, Pigeolet et al., found that the number of children in a household does have significant relationship with the risk of treatment defaulting. They specifically found an increased risk of defaulting in households with more than four children.[22]

In a scoping review evaluating the impact of socioeconomic factors affecting clubfoot treatment relapse and non-compliance in LMICs, also by Pigeolet et al., five significant associations

were identified, namely, relapse and living below the poverty line; relapse and caregivers with a lack of financial support; relapse and transport cost, non-compliance and travel distance of more than 9 km; and lastly, dropout and travel times to clinic of 6–12 hours.[23] Although we did not investigate a relationship between caregiver support and treatment failure, of the remaining associations, we only found a relationship between the need for non-Ponseti surgery, signifying Ponseti treatment failure, and travel time to clinic ($p = 0.041$).

There are several limitations to our study. Although data was prospectively and systematically collected, multiple healthcare providers completed the data collection forms, thereby compromising the consistency of assessment and accuracy of presenting data. Our cohort was relatively small, and our study was set in an urban area with relatively good healthcare facilities and support, potentially rendering our findings less applicable to other low- and middle-income settings. Furthermore, the relationship between treatment failure and caregiver social support as well caregiver insight and understanding should have been investigated in greater detail, as these two factors have been shown in previous literature to affect treatment outcomes.

Conclusion

We did not find a significant relationship between the investigated socioeconomic or demographic variables and treatment outcomes of patients with idiopathic clubfoot in our setting. Of all the variables examined, only time spent travelling to the clinic was weakly associated with the need for non-Ponseti surgery. This is in contrast with several studies performed in other LMICs. Multicentre studies, including sites in more rural areas, may shed more light on the barriers to clubfoot treatment in South Africa.

Ethics statement

The authors declare that this submission is in accordance with the principles laid down by the Responsible Research Publication Position Statements as developed at the 2nd World Conference on Research Integrity in Singapore, 2010.

Prior to commencement of the study, ethical approval was obtained from the Faculty of Health Sciences, University of Cape Town Human Research Ethics Committee (R014/2019). All procedures were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Consent was obtained from patients' parents/legal guardians for their data to be entered into the registry.

Declaration

The authors declare authorship of this article and that they have followed sound scientific research practice. This research is original and does not transgress plagiarism policies.

Author contributions

WG: data collection, first draft preparation and manuscript preparation

AH: study conceptualisation, design, data analysis, first draft preparation and manuscript preparation

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