

## Original Research Article

# Anthropometric nutrition outcomes of children under 5 years undergoing cleft palate repair at CoRSU rehabilitation hospital Uganda; trends, patterns and determinants

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### ABSTRACT

**Background:** Objective of the study was to assess the prevalence and determinants of postoperative malnutrition and compare the preoperative and postoperative trends and patterns of malnutrition among children under 5 years undergoing cleft palate repair at CoRSU rehabilitation hospital in Uganda.

**Methods:** A cross-sectional analytical study done between March 2018 and March 2019 at CoRSU rehabilitation hospital; a tertiary rehabilitation hospital offering free comprehensive cleft care to patients from Uganda and beyond. We consecutively enrolled 115 non-syndromic children under 5 years who had undergone complete cleft palate repair at CoRSU hospital at least 3 months previously. Children's anthropometric parameters; weight for age Z score, height for age Z score and weight for height Z score were obtained and compared at initial, preoperative and postoperative visits.

**Results:** The prevalence of wasting was 53.0% versus 12.7% versus 4.4% that of stunting was 44.4% versus 41.7% versus 48.7% that of underweight was 57.4% versus 34.8% versus 15.7% while that of overweight was 0.0% versus 5.2% versus 9.6% at initial, preoperative and postoperative visits respectively. Postoperative stunting was independently associated with age groups 12-23 months ( $p=0.013$ ) and 24-59 months ( $p=0.006$ ), residing in Eastern ( $p=0.021$ ) and Western ( $p=0.033$ ) regions and being stunted ( $p=0.000$ ) or wasted ( $p=0.028$ ) preoperatively.

**Conclusions:** Postoperatively, the prevalence of both wasting and underweight reduced by 10- and 3- fold respectively; prevalence of stunting remained critically high while that of overweight increased nearly 10-fold. Surgery improves the nutrition status of children with cleft palate.

**Keywords:** Cleft palate, Underweight, Wasting, Stunting

### INTRODUCTION

Craniofacial congenital anomalies such as cleft lip and palate are among the most important contributors to the global burden of oral disease.<sup>1</sup> In 2008, the World Health Organization included cleft lip and palate in the global burden disease (GBD), as these birth defects lead to significant infant mortality and childhood morbidity.<sup>2</sup> Cleft lip and palate are common congenital anomalies occurring in 1.34 per 1000 live births worldwide.<sup>3</sup> However, the incidence varies tremendously worldwide

being lowest in Africans 0.18-1.67 per 1000 live births.<sup>4</sup> In Uganda, the incidence of cleft lip and palate is 0.73 to 1.34 per 1000 live births.<sup>5,6</sup> Regardless of the size, a cleft palate makes it difficult or impossible for the infant to breastfeed; the infant is unable to seal the oral cavity to generate suction, which negatively affects milk transfer.<sup>7</sup> As a result, children with cleft palate use a lot of energy to suckle and swallow more air than breast milk. On the other hand, they are prone to recurrent respiratory tract infections due to spillage of feeds through the nose, recurrent aspiration during feeding and inability to balance

middle ear pressures resulting in middle ear infections. These result in high energy expenditure predisposing these children to a risk of early onset malnutrition right from birth. At time of initial presentation, majority are already malnourished and without intervention, they may die due to malnutrition related complications.<sup>8,9</sup> Nutrition rehabilitation is thus mandatory for majority prior to the complex and definitive surgical repair. Surgical repair is presumed to adequately overcome the feeding challenges and it is expected that they should catch up growth. However the high prevalence of preoperative malnutrition among children with cleft lip and palate at CoRSU rehabilitation hospital as seen from previous studies which was 68% and the occurrence of such postsurgical complications like palatal fistula whose frequency at CoRSU rehabilitation hospital is 35% may hinder these children from catch up growth.<sup>10,11</sup> There is significant lack of data about nutrition outcomes following cleft palate repair in resource limited settings. Therefore, we aimed to assess the prevalence and determinants of postoperative malnutrition and compare the preoperative, and postoperative trends and patterns of malnutrition among children under 5 years undergoing cleft palate repair at CoRSU rehabilitation hospital in Uganda.

## METHODS

### *Study design, period and setting*

This was a cross-sectional study done between March 2018 and March 2019 at comprehensive rehabilitation service in Uganda [CoRSU] Hospital which is a tertiary hospital with specialized plastic, reconstructive and orthopaedics hospital located along Entebbe road 18 kilometres from Kampala the Capital city of Uganda. It offers free comprehensive cleft care and it receives patients from all over Uganda and beyond including but not limited to Democratic Republic of Congo, Sudan and South Sudan.

### *Study population*

A total of 158 children who had undergone cleft palate repair at least 3 months previously and were less than 5 years were contacted by phone call. Of these 131 children turned up and 115 children met the inclusion criteria while 6 children with associated syndromes and 10 children with missing data were excluded. We obtained informed consent from caretakers and consecutively enrolment was done.

### *Data collection*

We administered a pretested questionnaire to capture the demographic characteristics of both study participants and their caretakers, medical, surgical and nutritional characteristics of study participants. A general physical exam focusing on peripheral stigmata of malnutrition and an oral exam focusing on complications of cleft palate repair were done. Their height/length and weight at the

postoperative visit were measured using a length measuring board (less than 2 years) or a wall mounted measuring tape (above 2 years) and a digital weighing scale according to standard operating procedures and recorded to the nearest 0.1 cm and 0.01 kg respectively. We retrospectively obtained the weight, length/height and age of each study participant at both initial and preoperative visits. Using the WHO anthropometric calculator, corresponding WHZ, WAZ and HAZ at each visit were computed using the WHO anthropometric calculator. Individual Z-scores for each indicator of type of malnutrition at initial, preoperative and postoperative visits were recorded in each patient questionnaire.

### *Assessment of nutritional status of children*

We used the WHO classification of malnutrition to determine presence or absence of the different types of malnutrition per study participant at initial, preoperative and postoperative hospital visits. Each study participant was classified as wasted if their WHZ was  $<-2$  SD from the mean, stunted if their HAZ was  $<-2$  SD from the mean, underweight if their WAZ was  $<-2$  SD from the mean and overweight if their WHZ was  $>+2$  SD from the mean. The proportion of wasted, stunted, underweight and overweight children was then computed at initial, preoperative and postoperative hospital visits.

To determine the severity of the different types of malnutrition amongst the study participants at initial, preoperative and postoperative hospital visits, we used the WHO classification of severity of malnutrition. All children with the different types of malnutrition at initial, preoperative and postoperative hospital visits were categorized as moderately or severely wasted, stunted or underweight if their WHZ, HAZ or WAZ were between  $<-2$  to  $-3$  SD or below  $-3$  SD from the mean respectively. Overweight children were also categorized as moderately or severely overweight at initial, preoperative and postoperative hospital visits if their WHZ was between  $>+2$  to  $+3$  SD or above  $+3$ SD from the mean respectively. The proportion of both moderately and severely wasted, stunted, underweight and overweight children at initial, preoperative and postoperative hospital visits was computed.

### *Data analysis*

All baseline characteristics were expressed as proportions and are summarized in Table 1. At univariate analysis, the association between each factor and postoperative stunting was assessed using chi square test and logistic regression. Corresponding crude odds ratios, p values and 95% confidence intervals are reported. The association between different factors and wasting, underweight and overweight could not be assessed due to small numbers of children with outcome of interest. All the factors with p value  $<0.1$  were assessed for assumptions of the multiple regression and included in the final model using the stepwise backward selection method. Corresponding adjusted odds

ratios, p values and 95% confidence intervals were reported. A significance level  $p < 0.05$  was considered.

## RESULTS

### Child and caretaker demographic characteristics

The average age of study participants was 24 months; male to female ratio was 1.7:1. Greater than 50% of the study participants originated from the central region of the country and 74.8% had cleft palate surgery at  $\geq 6$  months and 68.4% were reviewed at  $\geq 6$  months after surgery.

Majority of the caretakers were mothers (79.1%), aged predominantly (50.4%) between 25 to 34 years, majority of whom were married (74.8%), residing in rural (59.1%) central (57.4%) Uganda, dependent on peasantry (41.7%) and had attained at least primary level education (40.9%) (Table 1).

### Child medical, nutrition and surgical factors

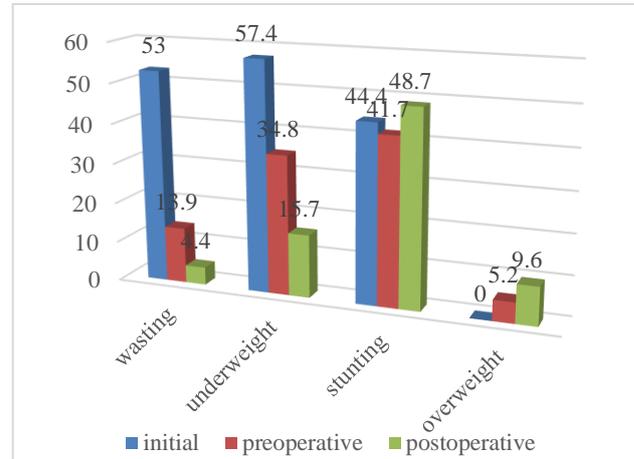
A total 41 children (35.7%) had an illness at time of assessment with flu and cough being the most reported symptoms, 60 children (53.6%) had had an illness in the previous one month while only 2 (1.8%) children had a chronic illness (one had sickle cell disease and the other had a small patent foramen ovale). Nearly all children whose HIV sero-status was known were HIV negative 103 (89.6%), only one (0.9%) child was HIV positive.

The commonest surgical technique used for cleft palate repair amongst the study participants was the Sommerlad technique in 81 children (70.4%). Eighty-six (86) children (74.8%) had had cleft palate repair at 6 months of age or more, 59 children (51.3%) had ever had a complication of surgery and only 32 children (27.8%) had ever been re-operated for a complication. Seventy-eight (78) children (68.4%) were 6 or more months post cleft palate repair at the time of enrolment. Whilst 69.6% of the infants had ever been breastfed but the average duration of breastfeeding was one month and only 4 children (3.5 percent) were able to breastfeed again after cleft palate repair. The commonest feeding techniques were use of a cup and own plate by 98 children (86.7 percent) and 94 children (85.5 percent) respectively. Nearly half of the children 56 (49.1 percent) were having less than or equal to 5 meals in a day while 65 children (57.0 percent) were having a minimum acceptable diet and 67 children (59.2 percent) were having a minimum dietary diversity. The commonest feeding problem was spillage of feeds through the nose reported in 77 children (67.0 percent) (Table 2).

### Prevalence trends of malnutrition at initial, preoperative and postoperative visit

At initial hospital visit, 61 children (53.0 percent) were wasted, 51 children (44.4 percent) were stunted and 66 children (57.4 percent) were under-weight. Preoperatively, 16 children (13.9 percent) were wasted, 48 children (41.7

percent) were stunted, 40 children (34.8 percent) were under-weight and 6 children (5.2%) were overweight. On the other hand, at postoperative assessment, 5 children (4.4%) were wasted, 18 children (15.7%) were under-weight, 56 children (48.7%) were stunted and 11 children (9.6%) were overweight (Figure 1).



**Figure 1: Trends in prevalence of different types of malnutrition at initial, preoperative and postoperative visits.**

The prevalence of both wasting and underweight reduced at different hospital visits while that of stunting remained nearly the same and that of overweight gradually increased from 0% at initial visit to approximately 10% at the postoperative visit.

### Trends in severity by type of malnutrition at initial, preoperative and postoperative hospital visits

A significant number of children recovered from wasting and underweight between their initial and postoperative visits with significant reduction to nearly negligible levels of both moderate and severe wasting and underweight.

The levels of both moderate and severe stunting remained high throughout the study period slightly increasing at the postoperative visit (Figure 2).

### Factors independently associated with postoperative stunting

From the univariate analysis, the following factors showed a statistically significant association ( $p < 0.05$ ) with post-operative stunting: age of the child, education level of the caretaker, ever had a complication following surgery, duration since operation, average number of meals per day, minimum acceptable diet, being stunted and underweight at initial hospital visit and being stunted, underweight or wasted preoperatively.

All the above-mentioned factors were assessed for assumptions of multiple regression then considered for final model building using backward stepwise selection

method. The factors that were independently associated with stunting in children under 5 years at least 3 months post complete cleft palate repair were; age categories (12-

23 months and 24-59 months), Eastern and Western region of residence, being stunted or wasted preoperatively (Table 3).

**Table 1: Demographic characteristics study participants of and caretakers (n=115).**

| Child demographic characteristics   | Frequency (%) |
|---|---------------|
| <b>Age group in months</b>  |               |
| 6-11  | 13 (11.3)     |
| 12-23   | 55 (47.8)     |
| 24/59   | 47 (40.9)     |
| <b>Gender, male</b>   | 72 (62.6)     |
| <b>Type of residence, rural</b>   | 68 (59.1)     |
| <b>Region of residence</b>  |               |
| Central   | 66 (57.4)     |
| Eastern   | 28 (24.4)     |
| Western   | 12 (10.4)     |
| Northern  | 9 (7.8)       |
| <b>Number of children in household under 5 years</b>                      |               |
| None  | 45 (39.1)     |
| 1   | 35 (30.4)     |
| 2-6   | 35 (30.4)     |
| <b>Number of people in household</b>                                      |               |
| Less than 4   | 26 (22.6)     |
| 4-5   | 41 (35.7)     |
| Greater than or equal to 6  | 48 (41.7)     |
| <b>Caretaker characteristics</b>  |               |
| <b>Age group in years</b>   |               |
| 18-24   | 26 (22.6)     |
| 25-34   | 58 (50.4)     |
| 35 and above  | 31 (27.0)     |
| <b>Gender, male</b>   | 12 (10.4)     |
| <b>Marital status</b>   |               |
| Single  | 5 (4.4)       |
| Married   | 86 (74.8)     |
| Separated   | 16 (13.9)     |
| Widowed   | 8 (7.0)       |
| <b>Relationship with child</b>  |               |
| Mother  | 91 (79.1)     |
| Father  | 10 (8.7)      |
| Other close relatives   | 14 (12.2)     |
| <b>Education level of caretaker</b>                                       |               |
| None  | 10 (8.7)      |
| Primary   | 47 (40.9)     |
| Secondary   | 39 (33.9)     |
| Tertiary  | 19 (16.5)     |
| <b>Family head's occupation</b>   |               |
| Peasant   | 48 (41.7)     |
| Business  | 21 (18.3)     |
| Professional  | 20 (17.4)     |
| Manual  | 18 (15.6)     |
| Transport   | 8 (7.0)       |
| <b>Source of drinking water, piped (borehole, tap water, spring well)</b> | 72 (62.6)     |
| <b>Sanitation facilities, latrine</b>                                     | 101 (87.8)    |
| <b>Presence of a bedridden patient in household</b>                       | 5 (4.4)       |

N=population size, n=number of children with outcome of interest, %=percentage

**Table 2: Medical, nutrition and surgical factors of study participants (n=115).**

| Child's medical characteristics                         | Frequency (%) |
|---|---------------|
| <b>Any current illness, yes</b>                         | 41 (35.7)     |
| <b>Recent illness in last one month, yes</b>            | 60 (52.2)     |
| <b>Presence of a chronic illness, yes</b>               | 2 (1.7)       |
| <b>HIV sero-status</b>                                  |               |
| Negative  | 103 (89.6)    |
| Positive  | 1 (0.9)       |
| Don't know  | 11 (10.3)     |
| Medical insurance cover of the child, Yes               | 7 (6.1)       |
| <b>Child's nutritional factors</b>                      |               |
| Child ever breastfed, yes                               | 80 (69.6)     |
| Reinitiated of breastfeeding after surgery, yes         | 4 (3.5)       |
| <b>Current feeding problems</b>                         |               |
| Refusal to feed   | 19 (16.7)     |
| Regurgitation of feeds                                  | 2 (1.8)       |
| Spillage of feeds through the nose                      | 77 (67.0)     |
| Choking on feeds  | 15 (13.3)     |
| <b>Average number of meals per day</b>                  |               |
| 5 or less   | 56 (48.7)     |
| 6-8   | 43 (37.4)     |
| Above 8   | 15 (13.0)     |
| Minimum acceptable diet, yes                            | 65 (57.0)     |
| Poor minimum dietary diversity, yes                     | 46 (40.7)     |
| <b>Malnutrition at initial CoRSU visit</b>              |               |
| Wasted  | 61 (53.0)     |
| Stunted   | 51 (44.4)     |
| Underweight   | 66 (57.4)     |
| <b>Preoperative malnutrition</b>                        |               |
| Wasted  | 16 (13.9)     |
| Stunted   | 48 (41.7)     |
| Underweight   | 40 (34.8)     |
| Overweight  | 6 (5.2)       |
| <b>Surgical factors</b>                                 |               |
| <b>Nature of surgical repair</b>                        |               |
| Cleft palate repair no muscle dissection                | 24 (20.9)     |
| Sommerlad repair  | 81 (70.4)     |
| Other   | 10 (8.7)      |
| Age at complete cleft palate repair in months, $\geq 6$ | 86 (74.8)     |
| Ever had any complication of surgery, yes               | 59 (51.3)     |
| Ever been re-operated, yes                              | 32 (27.8)     |
| <b>Duration since operation</b>                         |               |
| 3-5 months  | 36 (31.6)     |
| 6 and more  | 78 (68.4)     |

N=population size, n=number of children with outcome of interest, %=percentage

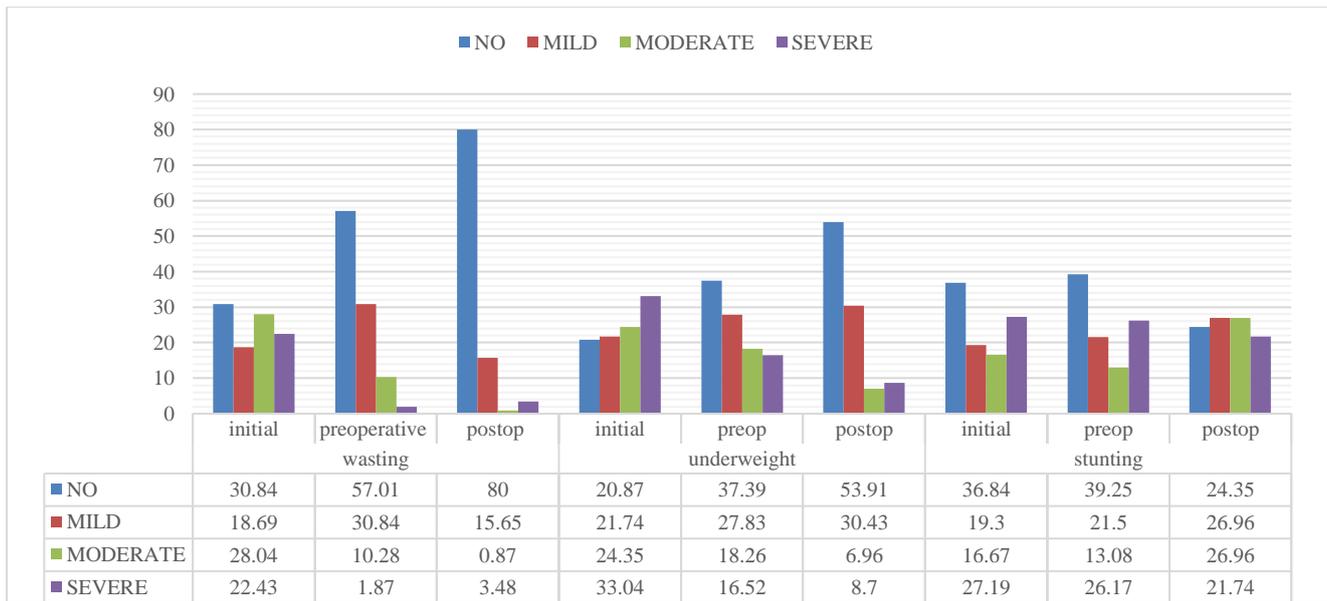
**Table 3: Results of univariate and multivariate analysis for factors associated with stunting among children under 5 years at least 3 months post cleft palate repair.**

| Variable                      | No stunting<br>n (%) | Stunting<br>n (%) | Unadjusted<br>OR (95% CI) | Adjusted<br>OR (95% CI) | P value |
|-------------------------------|----------------------|-------------------|---------------------------|-------------------------|---------|
| <b>Age of child in months</b> |                      |                   |                           |                         |         |
| 6-11                          | 12 (92.31)           | 1 (7.69)          | 1.00                      | 1                       |         |
| 12-23                         | 29 (52.73)           | 26 (47.27)        | 10.75 (1.30-88.52)        | 30.94 (1.94-491.38)     | 0.015   |
| 24-59                         | 18 (38.30)           | 29 (61.70)        | 19.3 (2.31-161.56)        | 20.45 (1.35-308.92)     | 0.029   |

Continued.

| Variable   | No stunting<br>n (%) | Stunting<br>n (%) | Unadjusted<br>OR (95% CI) | Adjusted<br>OR (95% CI) | P value |
|--|----------------------|-------------------|---------------------------|-------------------------|---------|
| <b>Region of residence</b>                                   |                      |                   |                           |                         |         |
| Central  | 40 (60.61)           | 26 (39.39)        | 1.00                      | 1                       |         |
| Eastern  | 11 (39.29)           | 17 (60.71)        | 2.37 (0.96-5.87)          | 5.18 (1.28-21.01)       | 0.021   |
| Western  | 3 (25.00)            | 9 (75.00)         | 4.61 (1.14-18.65)         | 8.06 (1.18-54.93)       | 0.033   |
| Northern   | 5 (55.56)            | 4 (44.44)         | 1.23 (0.39-5.01)          | 0.62 (0.07-5.31)        | 0.669   |
| <b>Number of people in household</b>                         |                      |                   |                           |                         |         |
| <4   | 17 (65.38)           | 9 (34.62)         | 1.00                      |                         |         |
| 4-5  | 21 (51.22)           | 20 (48.78)        | 1.79 (0.65-4.95)          |                         |         |
| ≥6   | 21 (43.75)           | 27 (56.25)        | 2.42 (0.90-6.52)          |                         |         |
| <b>Education level of caretaker</b>                          |                      |                   |                           |                         |         |
| None   | 3 (30.00)            | 7 (70.00)         | 8.74 (1.53-50.11)         |                         |         |
| Primary  | 21 (44.68)           | 26 (55.32)        | 4.64 (1.34-16.10)         |                         |         |
| Secondary  | 20 (51.28)           | 19 (48.72)        | 3.56 (1.00-12.67)         |                         |         |
| Tertiary   | 15 (78.95)           | 4 (21.05)         | 1                         |                         |         |
| <b>Occupation of family head</b>                             |                      |                   |                           |                         |         |
| Peasant  | 20 (41.67)           | 28 (58.33)        | 2.80 (0.95-8.19)          |                         |         |
| Business   | 14 (66.67)           | 7 (33.33)         | 1                         |                         |         |
| Professional   | 12 (60.00)           | 8 (40.00)         | 1.33 (0.37-4.76)          |                         |         |
| Manual   | 11 (61.11)           | 7 (38.89)         | 1.27 (0.34-4.72)          |                         |         |
| Transport  | 2 (25.00)            | 6 (75.00)         | 5.99 (0.95-37.76)         |                         |         |
| <b>Complication of surgery</b>                               |                      |                   |                           |                         |         |
| No   | 36 (64.29)           | 23 (38.98)        | 1                         |                         |         |
| Yes  | 20 (35.71)           | 36 (48.70)        | 2.81 (1.32-6.00)          |                         |         |
| <b>Duration since complete cleft palate repair in months</b> |                      |                   |                           |                         |         |
| 3-5  | 24 (66.67)           | 12 (33.33)        | 1                         |                         |         |
| ≥6   | 35 (44.30)           | 44 (55.70)        | 2.51 (1.10-5.72)          |                         |         |
| <b>Average number of meals per day</b>                       |                      |                   |                           |                         |         |
| ≤5   | 21 (37.50)           | 35 (62.50)        | 6.66 (1.68-26.39)         |                         |         |
| 6-8  | 26 (60.47)           | 17 (39.53)        | 2.61 (0.64-10.66)         |                         |         |
| >8   | 12 (80.00)           | 3 (20.00)         | 1                         |                         |         |
| <b>Minimum acceptable diet</b>                               |                      |                   |                           |                         |         |
| No   | 19 (38.46)           | 31 (62.00)        | 2.61 (1.22-5.57)          |                         |         |
| Yes  | 40 (61.54)           | 25 (38.46)        | 1                         |                         |         |
| <b>Minimum dietary diversity</b>                             |                      |                   |                           |                         |         |
| Good   | 39 (58.21)           | 28 (41.79)        | 1                         |                         |         |
| Poor   | 19 (41.30)           | 27 (58.70)        | 1.97 (0.92- 4.23)         |                         |         |
| <b>Stunted at initial visit</b>                              |                      |                   |                           |                         |         |
| No   | 44 (68.75)           | 20 (31.25)        | 1                         |                         |         |
| Yes  | 15 (29.41)           | 36 (70.59)        | 5.28 (2.36-11.76)         |                         |         |
| <b>Underweight at initial visit</b>                          |                      |                   |                           |                         |         |
| No   | 31 (63.27)           | 18 (36.73)        | 1                         |                         |         |
| Yes  | 28 (42.42)           | 38 (57.58)        | 2.33 (1.09-4.99)          |                         |         |
| <b>Stunted preoperatively</b>                                |                      |                   |                           |                         |         |
| No   | 51 (76.12)           | 16 (23.88)        | 1                         |                         |         |
| Yes  | 8 (16.67)            | 40 (83.33)        | 15.93 (6.19-40.97)        | 22.79 (6.86-75.70)      | 0.000   |
| <b>Wasted preoperatively</b>                                 |                      |                   |                           |                         |         |
| No   | 54 (54.55)           | 45 (45.45)        | 1                         |                         |         |
| Yes  | 5 (31.25)            | 11 (68.75)        | 2.64 (0.85-8.16)          | 6.13 (1.21-31.09)       | 0.028   |
| <b>Underweight preoperatively</b>                            |                      |                   |                           |                         |         |
| No   | 52 (69.33)           | 23 (30.67)        | 1                         |                         |         |
| Yes  | 7 (17.50)            | 33 (82.50)        | 10.65 (4.11-27.61)        |                         |         |

N=population size, n=number of children with outcome of interest, %=percentage, 95% CI=95% confidence interval, OR=odds ratio



**Figure 2: Trends in severity by type of malnutrition at initial, preoperative and postoperative hospital visits.**

**DISCUSSION**

This study is the first of its kind to describe and compare the prevalence trends and pattern of the different types of malnutrition at 3 different hospital visits of children under 5 years in a resource limited setting like CoRSU rehabilitation hospital and also most importantly discusses the nutrition outcomes post complete cleft palate repair underpinning the role played by surgery.

**Prevalence of malnutrition at different visits**

The prevalence of wasting was 53.0% versus 12.7% versus 4.4% at initial, preoperative and postoperative visit respectively. The prevalence threshold for wasting gradually decreased from very high levels [ $\geq 15\%$ ] at initial visit to high levels [ $10- < 15\%$ ] at the preoperative visit to low levels [ $2.5- < 5\%$ ] at the postoperative visit. Compared with findings from a previous study among children with cleft lip and or palate at CoRSU rehabilitation hospital, there has been remarkable reduction in the prevalence of preoperative moderate to severe wasting from 56.8% to 12.7%.<sup>10</sup> This is generally attributed to the multidisciplinary team approach involving nutritionists, paediatrician, speech and language pathologists, plastic surgeons, nurses and residents in active assessment and care for these children.

Prevalence of stunting was 44.4% versus 41.7% versus 48.7% at initial, preoperative and postoperative visit respectively. The prevalence threshold for stunting remained very high [ $\geq 30\%$ ] throughout the study at all the hospital visits. These levels of stunting at all the different hospital visits are too high compared to 21.3% reported in a case control study among Indian cleft group of children.<sup>12</sup> The observed difference is mainly attributed to the fact the children in the Indian study group were bottle feeding with formula milk right from birth. This is contrary

to children in our setting where diluted cow’s milk is the most easily accessible breast milk substitute moreover its quality in terms of preparation is very questionable and there is lack of access to special feeding bottles, inadequate nutrition information given to mother’s right from birth and late presentation when stunting has already set in as found in this study. It has been shown that stunting is irreversible therefore it is not surprising that the levels of stunting remained nearly the same at the different hospital visits during this study. However previous studies among cleft children showed that following reparative surgery, catch up growth is shown by children with all cleft types and there is no lasting effect on either weight or attained height.<sup>13,14</sup> The observed differences in the results between these studies are most likely due to population differences as well as the post cleft palate repair protocols for example, in the study by Altweel et al study participants were given nutritional support both preoperatively and postoperatively unlike for the children in our study which may even explain an increase in postoperative stunting.

The prevalence of overweight was 0.0% versus 5.2% versus 9.6% at initial, preoperative and postoperative visit respectively. The prevalence threshold for overweight increased from very low levels [ $< 2.5\%$ ] to low levels [ $2.5- < 5\%$ ] to medium levels [ $5- < 10\%$ ] on subsequent visits. More in-depth analysis of this group of children showed that 72.7% of the overweight children were concurrently stunted. This co-existence of both overweight and stunting has been previously described as early as 1996 by Popkin and colleagues among children aged 3-6 and 7-9 years in national surveys in Russia, Brazil, South Africa and China. The prevalence of concurrent stunting and overweight in these studies ranged between 2.5% in china to 19% in South Africa.<sup>15</sup> The high prevalence of co-existing stunting and overweight in our study participants needs further study. It is hypothesized that food deprivation early on in life as occurs in children with cleft palate due to

feeding difficulties as evidenced by high rates of preoperative malnutrition can lead to metabolic changes that predispose to obesity and metabolic disease later in life.<sup>17</sup> More studies need to be done to ascertain the exact mechanisms that lead to this co-existence as well as the risk factors associated with it and the long-term effects of such a phenomenon.

The prevalence of underweight was 57.4% versus 34.8% versus 15.7% at initial, preoperative and postoperative visit respectively. However, the prevalence thresholds for underweight have not been quantified in literature nevertheless, there was an overall remarkable reduction in the prevalence of underweight at different visits respectively.

#### ***Trends in severity of different types of malnutrition***

As shown in figure 2, the prevalence of moderate wasting gradually decreased throughout the study period while severe wasting initially decreased at the preoperative visit and later slightly increased postoperatively. Similarly, there was marked reduction in the prevalence of moderate and severe underweight at the different hospital visits. The prevalence of moderate stunting initially decreased at the preoperative visit but later doubled positively while severe stunting gradually decreased from initial, preoperative to postoperative visit.

Despite the reduction in severity of different types of malnutrition at different hospital visits but the postoperative prevalence of the different types of malnutrition still remained alarmingly higher than the severity at Uganda national level. Expressed as a percentage per category of malnutrition versus the severity at national level, 25 of the 56 stunted children (44.6%) were severely stunted compared to 9% severe stunting at national level and 3 of the 5 wasted children (60%) in this study were severely wasted compared to 30% severe wasting at national level.<sup>18</sup> The big difference in severity of the different types of malnutrition in this study compared to the national levels not only underpins the fact that children with cleft palate remain at higher risk of malnutrition even after cleft palate repair but also indicates that they are also at risk of severe forms of malnutrition despite the definitive surgery and thus need interventions beyond surgery. The exact cause of such a big difference in severity of different types of malnutrition could be because of some undetermined factors like hormonal deficiencies among children with cleft lip and palate and thus warrants further study.

#### ***Factors associated with postoperative malnutrition***

From previous studies among children with cleft lip and palate in our setting, the factors associated with malnutrition preoperatively are already known.<sup>8,10</sup> Therefore our study focused on the factors associated with the different types of malnutrition post cleft palate repair.

#### ***Factors associated with stunting post cleft palate repair in children under 5 years***

Stunting has a multifactorial aetiology with no single factor being totally responsible. In this study, the following factors showed an independent association with stunting post complete cleft palate repair;

##### ***Age of the child***

The risk of stunting was 31 times higher for children aged 12-23 months ( $p=0.015$ ) however it reduced to 20 times for children aged 24-59 months of age ( $p=0.029$ ). This indicates children with cleft palate remain at high risk of stunting up to 59 months however the risk of stunting seems to decrease after the second year of life. This is supported by findings from previous studies that have shown that stunting levels increase from around 7 months and peak at around 26 months of age.<sup>19-21</sup> Studies done among children without cleft lip and palate have shown that stunting in developing countries often starts in utero and its severity increases until it reaches a plateau at about two years of age, a time period called the "1000 days".<sup>21</sup> In our study however, the risk of stunting was still high even beyond 24 months which indicates that children with cleft lip and palate most likely have a different plateau. This could probably be due to the early introduction of complementary feeds amongst children in our study were only 69.9% had ever breastfed moreover the average duration of breastfeeding was less than one month. Early introduction of complementary feeds has been linked with a high risk of stunting among children aged 6-23 months without cleft lip and palate in Indonesia.<sup>22</sup>

##### ***Preoperative nutrition status***

The risk of stunting post complete cleft palate repair increased by 23 times higher among children who were stunted preoperatively compared to those who were not stunted preoperatively ( $p=0.000$ ). Stunting in developing countries like Uganda often starts in utero and its severity increases until it reaches a plateau at about two years of age, and studies have shown that stunting is nearly irreversible therefore children who were stunted preoperatively were most likely to be stunted postoperatively.<sup>21</sup> On the other hand, preoperative wasting increased the risk of postoperative stunting by 6 times ( $p=0.028$ ). The findings of our study are contrary to findings from previous studies that showed that following cleft palate reparative surgery, children catch up growth in terms of both weight and height.<sup>13</sup>

The difference is likely to be due to difference in the cleft palate repair care protocols among the two study groups for example, in the study by Altweel et al study participants were given nutritional support both preoperatively and postoperatively unlike for the children in our study which may even explain an increase in postoperative stunting.

Therefore, chronic dietary impairments due to feeding difficulties, inability to breastfeed and recurrent respiratory tract infections among children with cleft palate in our study group resulted in long term nutritional stress that resulted in a lower height for age preoperatively which is slower to correct postoperatively yet it is prone to setbacks should further insults to the child's health or feeding occur.

### **Region of residence and stunting**

There were statistically significant regional variations in the prevalence of stunting after cleft palate repair. Children originating from the Western region of the country had 8 times increased risk for stunting ( $p=0.033$ ) while those from the Eastern region had 5 times risk for stunting ( $p=0.021$ ) and those from the Northern region had a 1.2 times risk of being stunted after cleft palate repair. These regional variations in stunting levels have also been documented in previous studies.<sup>23</sup> The exact cause of these regional variations in our study is unclear and warrants further study.

Previous studies have shown an association between stunting with low social economic status, caretaker education level, sanitary waste disposal and source of drinking water.<sup>23,24</sup> But in our study these did not show any independent association with postoperative stunting and it could be because all the caretakers had undergone several sessions of nutrition education and utilized the knowledge acquired. Similarly, majority of the children were living under similar conditions of low social economic status, sanitary waste disposal and sources of drinking water which did not permit detection of a possible effect of low social economic status on stunting.

The number of children who were wasted, overweight and underweight was small among our study participants. Therefore we could not determine factors associated with wasting, overweight and underweight in this study.

### **Limitations**

Failure to return for review due to wrong contacts, socioeconomic issues like parental divorce and long distances coupled with high transport costs. Also, some important variable such as birth weight, preceding birth intervals among others were not known to some caretakers. Self-reported variables like 24-hour dietary recall among others could have been subject to recall bias.

### **CONCLUSION**

Postoperatively, the prevalence of both wasting and underweight reduced by 10- and 3- fold respectively; prevalence of stunting remained critically high while that of overweight increased nearly 10-fold. The results underpin the role played by surgery in improving the nutrition status of children with cleft palate but as well reflect the need for timely intervention to prevent early

onset stunting which is almost irreversible despite the various interventions.

### **Recommendations**

We recommend that all health workers most specifically midwives timely refer all neonates born with cleft palate for timely comprehensive medical assessment, nutrition education and support to ensure timely cleft palate repair to overcome preoperative stunting and wasting among children with cleft palate. After cleft palate repair, there is need for longer duration of follow up, ongoing nutrition education and nutrition rehabilitation to prevent recurrence of malnutrition. Longitudinal prospective studies with sufficient numbers of study participants should be done to ascertain the determinants of wasting, overweight and underweight after cleft palate repair.

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