Check for updates

RESEARCH ARTICLE

# Healthcare utilization by children with neurological impairments and disabilities in rural Kenya: a retrospective cohort study combined with secondary analysis of audit data [version 1; peer review: awaiting peer review]

Jonathan Abuga[1,2*], Lucy Mwangi[1*], Joyce Ndolo[3], Symon Kariuki[1,4], Charles Newton[1,4]

[1]Clinical Research (Neurosciences), KEMRI-Wellcome Trust Research Programme, Kilifi, Kilifi, Po Box 230-80108, Kenya
[2]Public Health Department, Kisii University, Kisii, Kisii, Po Box 408-40200, Kenya
[3]Occupational Therapy Department, Kilifi County Hospital, Kilifi, Kilifi, Po Box 9-80108, Kenya
[4]Department of Psychiatry, University of Oxford, Oxford, Oxford, OX3 7JX, UK

[*] Equal contributors

**v1** **First published:** 09 Nov 2022, **7**:278
https://doi.org/10.12688/wellcomeopenres.18405.1
**Latest published:** 09 Nov 2022, **7**:278
https://doi.org/10.12688/wellcomeopenres.18405.1

## Abstract

**Background**: There is a paucity of data on healthcare utilization by children with neurological impairments (NI) in sub-Saharan Africa. We determined the rate, risk factors, causes, and outcomes of hospital admission and utilization patterns for rehabilitative care among children with NI in a defined rural area in Kenya.

**Methods**: We designed two sub-studies to address the primary objectives. Firstly, we retrospectively observed 251 children aged 6–9 years with NI and 2162 age-matched controls to determine the rate, causes and outcomes of hospitalization in a local referral hospital. The two cohorts were identified from an epidemiological survey conducted in 2015 in a defined geographical area. Secondly, we reviewed hospital records to characterize utilization patterns for rehabilitative care.

**Results**: Thirty-four in-patient admissions occurred in 8503 person-years of observation (PYO), yielding a crude rate of 400 admissions per 100 000 PYO (95% confidence interval (CI): 286–560). The risk of admission was similar between cases and controls (rate ratio=0.70, 95%CI: 0.10–2.30, p = 0.31). The presence of electricity in the household was associated with reduced odds of admission (odds ratio=0.32, 95% CI: 0.10–0.90, p < 0.01). Seizures and malaria were the main causes of admission. We confirmed six (0.3%) deaths during the follow-up period. Over 93% of outpatient paediatric visits for rehabilitative care were related to cerebral palsy and intellectual

**Open Peer Review**

**Approval Status** *AWAITING PEER REVIEW*

Any reports and responses or comments on the article can be found at the end of the article.

developmental delay. Health education (87%), rehabilitative exercises (79%) and assistive technology (64%) were the most common interventions.

**Conclusions**: Surprisingly, the risk of hospitalization was not different between children with NI and those without, possibly because those with severe NI who died before this follow-up were under seclusion and restraint in the community. Evidence-based and tailored rehabilitative interventions are urgently required based on the existing secondary data.

## Keywords

Children; neurological impairments and disability; hospitalization; admission; healthcare; rehabilitation; Kenya; LMICs.

**Corresponding author:** Jonathan Abuga (abugajn@gmail.com)

**Author roles: Abuga J**: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Mwangi L**: Conceptualization, Formal Analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – Original Draft Preparation; **Ndolo J**: Investigation, Methodology, Project Administration, Resources, Supervision, Validation, Writing – Review & Editing; **Kariuki S**: Conceptualization, Formal Analysis, Investigation, Methodology, Project Administration, Resources, Supervision, Validation, Writing – Review & Editing; **Newton C**: Conceptualization, Formal Analysis, Funding Acquisition, Investigation, Methodology, Resources, Supervision, Validation, Writing – Review & Editing

**Competing interests:** No competing interests were disclosed.

**Grant information:** The epidemiological surveys and the Kilifi Health & Demographic Surveillance System were supported by the Wellcome Trust. Jonathan and Lucy were funded through the DELTAS Africa Initiative Grant No. 107754/Z/15/Z-DELTAS Africa SSACAB and from DELTAS Africa Initiative [DEL-15-003]. The DELTAS Africa Initiative is an independent funding scheme of the African Academy of Sciences (AAS)'s Alliance for Accelerating Excellence in Science in Africa (AESA) and supported by the New Partnership for Africa's Development Planning and Coordinating Agency (NEPAD Agency) with funding from the Wellcome Trust [107769/Z/10/Z] and the UK government. SMK was funded by MQ: Transforming Mental Health (MQF17-18 Kariuki) and by the EDCTP2 Programme supported by the European Union (TMA2017CDF-1903).
*The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.*



**How to cite this article:** Abuga J, Mwangi L, Ndolo J *et al.* **Healthcare utilization by children with neurological impairments and disabilities in rural Kenya: a retrospective cohort study combined with secondary analysis of audit data [version 1; peer review: awaiting peer review]** Wellcome Open Research 2022, **7**:278 https://doi.org/10.12688/wellcomeopenres.18405.1

**First published:** 09 Nov 2022, **7**:278 https://doi.org/10.12688/wellcomeopenres.18405.1

## Introduction

Over 300 million children and adolescents have some form of neurological impairment or disability (NI), which accounts for 19.9% of the years lived with disability (YLD) from all causes in these age-groups globally (Olusanya *et al.*, 2020). The prevalence is higher in low-and middle-income countries (LMICs) due to a higher incidence of risk factors such as adverse perinatal events (Kumar *et al.*, 2013; Mung'ala-Odera *et al.*, 2006), infections of the brain (Abubakar *et al.*, 2009; Carter *et al.*, 2005; Kariuki *et al.*, 2011), malnutrition (Asferaw *et al.*, 2017; Roncagliolo *et al.*, 1998) and socio-economic disadvantage (Banks *et al.*, 2017). Affected children from LMICs are unlikely to access regular preventive, curative, and rehabilitative care due to societal stigma, high user-fee costs, geographical barriers, and poorly funded healthcare systems (Ensor & Cooper, 2004; Mwangi *et al.*, 2021a; WHO, 2011). Reducing the overall burden, including adverse social outcomes, related to NI largely depends on the quality and coverage of primary healthcare.

Current scientific evidence from high-income countries (HICs) suggests that children with NI have additional healthcare needs compared to their peers without NI (Meehan *et al.*, 2015; Yuan *et al.*, 2017). A study conducted in the United States reported that children with seizures, traumatic brain injury, and meningitis had three times greater use of intensive care unit services, with a significantly longer hospital stay, than other paediatric patients at the initial events (Moreau *et al.*, 2013). Similarly, children with cerebral palsy received more medical procedures and had a higher probability of referral or recommendation for homecare (Murphy *et al.*, 2006). Respiratory, musculoskeletal, and digestive problems were the most common causes of admission in these studies (Moreau *et al.*, 2013; Murphy *et al.*, 2006). There is a scarcity of empirical evidence on patterns of promotive, preventive, curative and rehabilitative care for children with NI in LMICs.

Rehabilitation services are critical for children with NI in terms of reducing activity limitations, enhancing community participation, improving quality of life, and ultimately increasing the chances of survival (WHO, 2011; WHO, 2018). However, there is an acute shortage in coverage and capacity for rehabilitative care in LMICs (Bright *et al.*, 2018; Bunning *et al.*, 2014; Njelesani *et al.*, 2011). For instance, between 5–15% of people with NI need assistive devices, yet insufficient resources are currently available to acquire these devices in LMICs (WHO, 2011). Further, for every 100 000 people residing in sub-Saharan Africa (SSA), on average, there is less than one rehabilitation doctor (Haig *et al.*, 2009), less than one psychologist (Saxena *et al.*, 2007), less than one ophthalmologist (Resnikoff *et al.*, 2020), and less than one neurologist (WHO, 2018) to consult for rehabilitation needs of the affected children. The World Federation of Occupational Therapists reports that most countries in SSA do not meet the recommended international average ratio of two Occupational Therapists for every 10 000 people (WFOT, 2020).

The International Classification of Functioning, Disability and Health (ICF) defines NI as deficits in the structure or functioning of the central nervous system consequent to a disease (WHO, 2001). It also provides a common language and framework for the care and research involving children with NI and disabilities, globally. Healthcare coordination for children with NI and disabilities is largely understudied in LMICs (Peterson *et al.*, 2019). Based on the Donabedian model (Donabedian, 2005), healthcare coordination for children with NI will involve three closely related concepts: (i) structures, for example, the presence of trained personnel, availability of appropriate facilities/equipment and payment options for the care of children with NI; (ii) processes, for instance, the coordination and referral processes which promotes utilization of preventive, curative and/or rehabilitative services for these children; and (iii) outcomes of care such as recovery, permanent disability or even death (McDonald *et al.*, 2007).

This study had three main objectives that targeted children with NI in a defined rural setting in Kenya. First, we estimated the rate of in-patient admissions to a local referral hospital between 2015 and 2019 among older children diagnosed with NI compared to an age-matched sample of controls identified from the same baseline survey conducted in 2015. Secondly, we identified the causes and outcomes of in-patient admissions of children with NI compared with those without NI. Finally, we describe utilization patterns for rehabilitative care by children younger than 19 years visiting the physiotherapy, occupational therapy, and orthopaedic technology departments of the same regional referral hospital over the same period.

## Methods

### Study setting

We conducted this study in the Kilifi Health and Demographic Surveillance System (KHDSS) located around Kilifi County (district) Hospital (KCH) in Kenya (https://kemri-wellcome.org/programme/health-research-linked-to-a-demographic-surveillance-system/). Since 2001, this integrated surveillance system linking laboratory, clinical and community-based research platforms has been used to define the incidence and prevalence of common infections such as malaria, behavioural/emotional problems and epilepsy in a population of about 280 000 individuals (Scott *et al.*, 2012). Vital statistics such as births, migrations, and deaths are updated two to three times a year based on a household census (Scott *et al.*, 2012). Children younger than 15 years constitute approximately half of the population under surveillance (Scott *et al.*, 2012). KCH offers rehabilitative services across three departments, namely physiotherapy, occupational therapy, and orthopaedic technology (Bunning *et al.*, 2014). The defined geographical area is among the poorest in Kenya, with subsistence farming being the main economic activity in this rural setting.

### Study design

We designed two sub-studies to address the primary objectives of this study. The first sub-study was a retrospective cohort design involving a follow-up of children who previously participated in a two-phase epidemiological survey conducted in 2015 (Figure 1). The second sub-study entailed an analysis of audit data obtained from routine care in three rehabilitative departments in Kilifi County Hospital, details which we provide below.

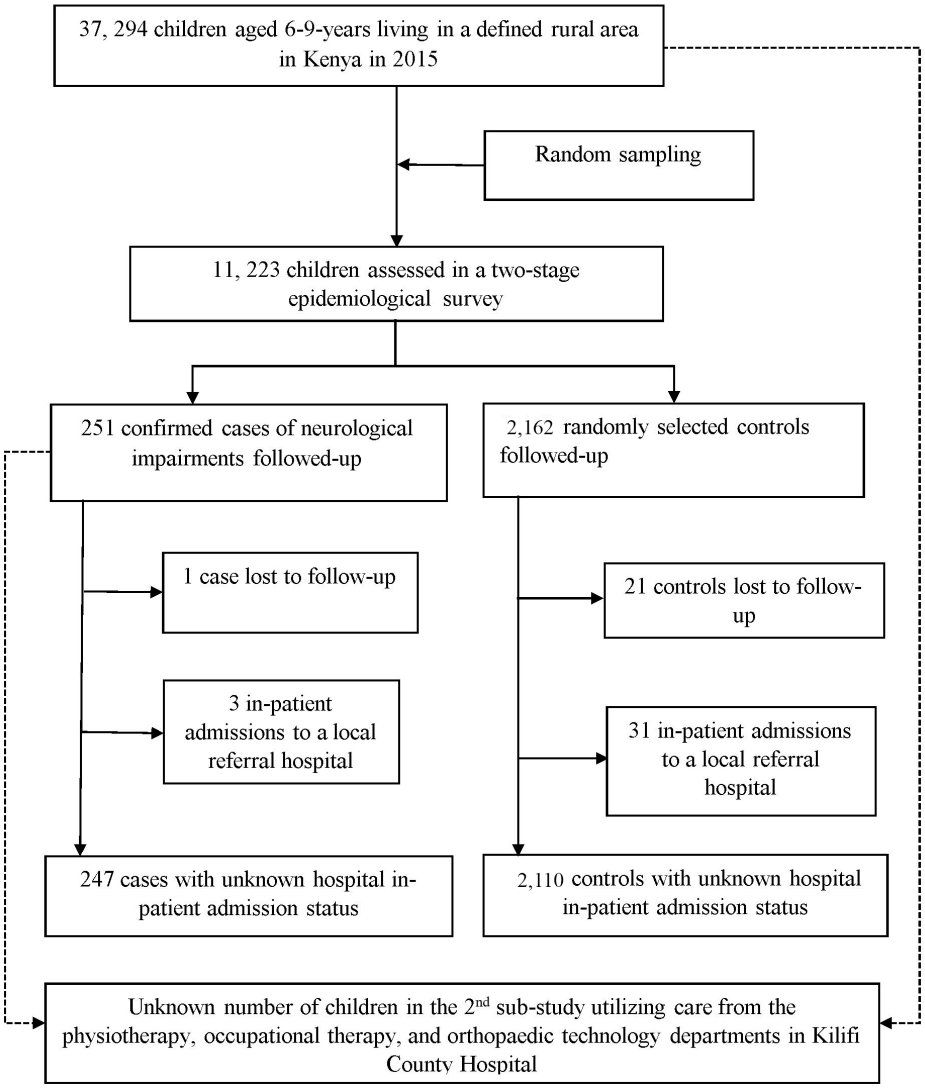


**Figure 1. Identification and follow-up of children with and without neurological impairments to determine in-patient hospitalization and rehabilitation in Kilifi County Hospital.**

## The retrospective cohort analyses of survey data (first sub-study)

*Identification of study participants from the baseline survey (Figure 1):* We identified participants for the cohort study from a two-phase epidemiological survey, initially designed to determine the prevalence and risk factors for NI in children aged 6–9 years in 2015 (Abuga *et al.*, 2022). A random sample of 11 223 eligible children, out of the total population of 37 294 (30.1%), was screened in the households by trained field workers in the community using the Ten Question Questionnaire (TQQ) (Belmont, 1984; Durkin *et al.*, 1995; Zaman *et al.*, 1990) in stage one of the 2015 baseline survey. In stage two, all children screening positive on the TQQ, and a random sample that screened negative were invited for comprehensive neuropsychological assessments conducted by neurodevelopmental experts using pretested and validated tools (Kitsao-Wekulo *et al.*, 2019; Mung'ala-Odera *et al.*, 2006; Thurman *et al.*, 2011; WHO, 2011). In this survey, we defined NI as a central nervous system deficit resulting in functional limitation in five domains: epilepsy and cognitive, hearing, vision, and motor impairments. The severity of NI was classified as mild, moderate, or severe based on the World Health Organization's (WHO) recommendations. We also assessed potential risk factors for NI and subsequent hospitalization in the baseline survey. We collected individual-level data on age, sex, school attendance, and family-level information such as the mother's education and income, as well as past medical history including unique events during pregnancy and birth, head injuries, immunization and anthropometric measures of nutritional status.

*Sample size determination for the cohort sub-study*: Assuming that NI cases have a two-fold increased risk of in-patient hospital admission compared with controls (Glover *et al.*, 2019; Lee & Chen, 2012), and the rate of admission is 13.1%

among cases (Lee & Chen, 2012), a cohort study of independent cases matched to 5 controls requires 79 cases and 395 control cases to reject the null hypothesis that the relative risk of hospitalization equals one with 80% power at 95% confidence level (CI). Therefore, our study with 251 cases (children diagnosed with at least one NI in the five domains) and 2162 randomly selected age-matched controls was sufficiently powered to detect differences in the risk of admission between the groups.

*Methods of follow-up.* This retrospective cohort study utilized data linkage between the 2015 NI survey's database and the KCH paediatric admissions database, and between the 2015 NI survey's database and the general KHDSS databases to determine the primary and secondary outcomes, respectively. The primary outcome of the follow-up study was admission to the paediatric department at KCH. The secondary outcome was the number of deaths occurring among the study participants during the follow-up period. Unique personal identification numbers (PIDs) are usually assigned to all study participants in the KHDSS [including all children participating in surveys and those admitted to the paediatric wards in KCH] for follow-up studies (Scott *et al.*, 2012). We linked the 2015 NI baseline survey's database with the hospital's paediatric in-patient database and the KHDSS databases using these unique identifiers to determine the number of admissions and deaths, respectively. The primary and secondary outcome events were restricted within the study period which was between 30th June 2015 and 30th June 2019. Cases and controls from the baseline survey entered the risk pool on their respective dates of the household survey in 2015 and exited at the end of the follow-up study (30th June 2019), or the date of hospital admission, out-migration, or death; whichever came first. We linked all available cases and age-matched controls using the PIDs with the two databases to prevent bias due to incomplete data linkage.

### Analysis of audit data on rehabilitative care (second sub-study)

It was not possible to link the 2015 NI survey participants to the rehabilitative departments at KCH because (i) comprehensive patient-level data were unavailable in these departments, and (ii) in-patient hospital visits to these departments are not linked to the KHDSS. Consequently, we could only conduct a secondary analysis of routine medical-care data characterizing rehabilitation services offered by the selected departments. We therefore reviewed the available patient registers and monthly reports of rehabilitative services utilized by children younger than 19 years visiting the occupational therapy, physiotherapy, and orthopaedic technology departments between January 2015 and December 2019. We retrieved information on the number of visits per month, diagnostic categories issued by attending clinicians/specialists, and the interventions offered by these departments. We considered six main diagnostic categories namely: cerebral palsy (CP), intellectual developmental delay (IDD), epilepsy, hearing disorders, vision disorders, and learning disorders. CP was defined as a group of permanent motor disorders that appear early in childhood caused by abnormal brain development (Blair *et al.*, 2001). IDD referred to the failure of a child to reach one or more expected developmental stages at the expected age (Choo *et al.*, 2019). Learning disorders described difficulties in processing and comprehension of information at home or school (Kommu, 2009). We compared summary data obtained from compiled monthly reports with that retrieved from available patient registers for consistency. Health education, in this context, referred to a structured or semi-structured session between the attending occupational therapist or physiotherapist and the caregivers of children with NI, aimed at providing additional support information for the care of the affected child. Passive exercises refer to selected techniques such as muscle stretching usually performed on patients by physiotherapists (Pin *et al.*, 2006).

### Statistical analyses for the two sub-studies

We exported linked retrospective data on paediatric in-patient admissions and secondary data on rehabilitative care from the hospital to Stata version 14 (StataCorp, 2015). Missing data due to incomplete data linkage was minimal (<2%) and therefore we analysed all completely linked data. We determined the rates for in-patient admission for NI cases and controls separately, with the numerator being the number of admissions and the denominator person-years of observation (PYO), using the linked retrospective data. We then calculated the admission rates ratio (RR) and their 95% confidence intervals (95% CI) to compare admission rates for the two groups. We also determined and compared the number of deaths among children with and without NI over the follow-up period. Potential independent predictors for hospital admission included child and family characteristics, and the medical history of the child which were initially assessed in the baseline survey. We used binary logistic regression in risk factor analysis for in-patient admissions and estimated odds ratios (OR) and their 95% CI. For the second sub-study, we analysed the frequency of outpatient visits and the interventions offered for each diagnostic category in the three rehabilitative departments in KCH between 2015 and 2019.

### Ethical considerations

We obtained approval for this study from the KEMRI/Scientific and Ethics Review Unit (Ref: KEMRI/SERU/CGMRC-C/125/3701). We sought written consent from the parents/guardians/caretakers of the study participants before data collection in the baseline survey and the cohort study. We obtained permission to conduct an audit of the files from the hospital administration, which was accompanied by an approved protocol by a peer review committee. All secondary data was de-identified or anonymised by stripping off all the identifying features before analyses. All data were kept confidential and anonymous.

## Results

### The retrospective cohort analysis of survey data (first sub-study)

A total of two hundred fifty-one children aged between 6–9 years with NI, of whom 137 (54.6%) were boys, were identified in the 2015 baseline survey and followed up until 2019 (Table 1). Similarly, 2162 boys and girls without NI were identified from

the same survey in 2015 and followed up until 2019 (Table 1). Two hundred and fifty out of 251 (99.6%) cases and 2149 (99.4%) out of 2162 controls completed the follow-up study. The median (range) follow-up duration was 3.8 years (inter-quartile range [IQR] = 3.4–4.2) and 4.0 years (IQR = 3.4–4.8) for cases and controls, respectively. The proportions lost to follow up for cases (0.4%) and controls (0.3%) were not significantly different ($p$ = 0.10). Study participants lost to follow-up, who were excluded from the main analyses, were similar to those completing the study in terms of sex ($p$ = 0.23) and age ($p$ = 0.24). There were no differences in proportions comparing cases and controls at the baseline of the cohort study in terms of sex ($p$ = 0.50) and age ($p$ = 0.93; however, cognition and epilepsy domains were overrepresented in the sample of cases (Table 1). The full dataset can be accessed upon request under *Underlying data* (Mwangi *et al*., 2021b).

A total of 34 in-patient hospital admissions occurred in 8503 person-years of observation (PYO), yielding a crude admission rate of 400 per 100 000 PYO (95% CI: 286–560). Of these admissions, three (1.2%) were cases of NI and 31(1.6%) age-matched controls. Among cases, the admission rate was 294 per 100 000 PYO (95% CI: 95–911) and 414 per 100 000 PYO (95% CI: 291–589) among controls. There was no significant difference in hospital admission rates comparing cases and controls (RR = 0.70, 95% CI: 0.10–2.30, $p$ = 0.31). Six (0.3%) deaths, two (<0.1%) among cases and four (<0.1%) among controls, were confirmed in the follow-up study.

Having electricity in the household was associated with a 68% reduction in the risk of hospital admission (univariable OR = 0.32, 95% Cl: 0.1–0.9, $p$ = 0.03). However, the sex of the child, maternal education, income-generating activity, medical history, and nutritional status at the study baseline were not associated with hospital admission at the univariable level (Table 2). Three leading causes of admission regardless of NI status were malaria with 10 (29.4%) cases, trauma or fractures with five (14.7%) cases, and snake bites with four (12.9%) cases (Table 3). Two of the three children with NI were admitted because of epileptic seizures while one child had malaria.

## Analysis of audit data on rehabilitative care (second sub-study)

A total of 14 765 visits by children aged 0–18 years were recorded in the occupational therapy department between 2015 and 2019, of which 7 005 (47.4%) and 6 773 (45.8%) were related to CP and IDD diagnoses, respectively. Fewer visits were related to hearing disorders (n = 710, 4.8%), learning disorders

**Table 1. Demographic characteristics and the distribution of neurological impairments by domain for the cohort study participants in the Kilifi Health & Demographic Surveillance System in Kenya.**

| Characteristic of study participant | Cases (%) | Controls (%) | Total (%) |
|---|---|---|---|
| *Sex* | | | |
| Girls | 114 (45.4) | 922 (48.2) | 1036 (47.9) |
| Boys | 137 (54.6) | 989 (51.8) | 1126 (52.1) |
| *Age*† | | | |
| 6 years | 42 (16.7) | 295 (15.4) | 337 (15.6) |
| 7 years | 82 (32.7) | 652 (34.1) | 734 (34.0) |
| 8 years | 80 (31.9) | 631 (33.0) | 711 (32.9) |
| 9 years | 47 (18.7) | 333 (17.4) | 380 (17.6) |
| *Domain of impairment* | | | |
| Lifetime epilepsy | 98 (39.0) | 0 | 98 (39.0) |
| Cognition | 148 (59.0) | 0 | 148 (59.0) |
| Hearing | 18 (7.2) | 0 | 18 (7.2) |
| Motor | 18 (7.2) | 0 | 18 (7.2) |
| Vision | 14 (5.6) | 0 | 14 (5.6) |
| *Total* | 251 | 1911 | 2162 |

†Age of the child at the baseline survey of the cohort study

**Table 2. Risk factors for paediatric in-patient hospital admission for neurological impairment cases and controls in Kilifi Health and Demographic Surveillance System in Kenya (N = 34).**

| Risk factors | Odds ratio (95% confidence intervals) | *p* value |
|---|---|---|
| ***Child characteristics*** | | |
| Female | 0.65 (0.30–1.30) | 0.24 |
| School attendance | 0.43 (0.13–1.45) | 0.22 |
| ***Maternal characteristics*** | | |
| Education mothers | 0.57 (0.13–2.52) | 0.51 |
| Income generating activity | 0.39 (0.10–1.50) | 0.21 |
| Electricity in the household | 0.32 (0.10–0.90) | <0.01 |
| ***Past medical history*** | | |
| Seizures in the family | 0.70 (0.30–1.80) | 0.54 |
| Abnormal pregnancy | 0.90 (0.30–2.30) | 0.83 |
| Abnormal delivery | 0.22 (0.03–1.60) | 0.13 |
| History of head injury | 0.48 (0.1–3.52) | 0.51 |
| Previous hospital admission | 0.47 (0.20–1.20) | 0.11 |
| Incomplete immunization | 0.50 (0.10–2.00) | 0.32 |
| Weight for age Z scores | 0.91 (0.70–1.10) | 0.44 |
| Height for age Z scores | 0.96 (0.70–1.30) | 0.80 |

(n = 214, 1.4%), vision disorders (n = 58, 0.4%), and epilepsy (n = 5, <0.10%). The number of visits related to CP and IDD increased by 36.8% and 62.2% between 2015 and 2019, respectively, while those related to hearing disorders had a three-fold increase (Table 4). The highest number of visits by patients with learning and vision disorders was recorded between 2016 and 2017. A total of 78 146 health education sessions, 5 859 treatment sessions for physical disability, 4 896 community rehabilitation sessions, and 1 180 splints were provided over the study period in this department (Table 4).

A total of 704 visits by NI patients younger than 10 years were recorded in the physiotherapy department between 2015 and 2019, of which 546 (77.6%) were related to CP (Table 5). The highest number of CP, IDD, and epilepsy-related visits were recorded in 2015 and 2016. Over the study period, interventions in this department included 518 rehabilitation exercises, 135 passive exercises, and three chest treatments. Chest physiotherapy and postural drainage were rare interventions in this department (Table 5).

A total of 617 visits were recorded mainly from children younger than 19 years with CP in the orthopaedic technology department. An average of 152 visits per annum (VPA) was recorded in 2018–2019 compared with 104 VPA between 2015 and 2017. Only three visits were related to epilepsy, one in

**Table 3. Causes of in-patient admission for cases and controls of neurological impairment followed-up between 2015 and 2019 in Kilifi Health and Demographic Surveillance System in Kenya.**

| Causes of admission | Cases (%) | Controls (%) | All admissions (%) |
|---|---|---|---|
| Malaria | 1 (33.3) | 9 (29.0) | 10 (29.4) |
| Trauma/ fracture | 0 | 5 (16.1) | 5 (14.7) |
| Snakebites | 0 | 4 (12.9) | 4 (12.9) |
| Upper respiratory infection | 0 | 2 (6.5) | 2 (5.9) |
| Seizures | 2 (66.7) | 0 | 2 (5.9) |
| Others causes† | 0 | 11 (35.5) | 11 (32.4) |
| Total | 3 (100) | 31 (100) | 34 (100) |

†Others causes include meningitis, anaemia, accidents, lower respiratory infection, gastroenteritis, neonatal jaundice, cellulitis, measles, malnutrition, elective surgery, bronchitis.

**Table 4. Number of visits and interventions by Kilifi County Hospital's Occupational Therapy Department for children aged 0–18 years with neurological impairments between 2015 and 2019.**

| Year | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---|---|---|---|---|---|---|
| ***Diagnostic category (domain)*** | | | | | | |
| Cerebral palsy | 1102 | 1303 | 1594 | 1498 | 1508 | 7005 |
| Intellectual developmental delay | 1057 | 1216 | 1236 | 1550 | 1714 | 6773 |
| Epilepsy | - | - | 2 | 2 | 1 | 5 |
| Hearing disorders | 50 | 98 | 160 | 193 | 209 | 710 |
| Learning disorders | - | 162 | 3 | 20 | 29 | 214 |
| Vision disorders | 1 | 1 | 46 | 3 | 7 | 58 |
| ***Interventions*** | | | | | | |
| Number of health education sessions | 6055 | 7330 | 18980 | 14950 | 20416 | 78146 |
| Number of treatment sessions for those with physical disability | 775 | 1190 | 749 | 1305 | 1840 | 5859 |
| Number of community rehabilitation sessions | - | 328 | 698 | 460 | 3410 | 4896 |
| Number of splints | 4 | 257 | 204 | 245 | 470 | 1180 |

**Table 5. Number of visits and interventions by Kilifi County Hospital's Physiotherapy Department for children aged 0–10 years with neurological impairments between 2015 and 2019.**

| Year of study | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---|---|---|---|---|---|---|
| ***Diagnostic category (domain)*** | | | | | | |
| Cerebral palsy | 182 | 77 | 59 | 112 | 116 | 546 |
| Intellectual developmental delay | 34 | 35 | 15 | 15 | 23 | 122 |
| Epilepsy | 11 | 7 | 1 | 9 | 8 | 36 |
| ***Interventions*** | | | | | | |
| Number of rehabilitation exercise sessions | 179 | 75 | 69 | 99 | 96 | 518 |
| Number of passive exercise sessions | 13 | 18 | 21 | 46 | 37 | 135 |
| Chest therapy | 1 | - | 2 | - | - | 3 |
| Postural drainage | - | - | 1 | - | - | 1 |

2015 and two in 2016. A total of 416 assistive devices, 153 knee ankle-foot orthoses, 53 lumbar corsets, and 19 neck collars were fabricated for these children. Ankle foot orthoses (n = 6), hand splints (n = 2), and surgery (n = 1) were less frequent interventions in this department.

## Discussion

There was no significant difference in the rate of paediatric in-patient admission between children with NI and those without (IRR = 0.70, 95% CI: 0.10–2.30, $p$ = 0.31). The presence of electricity in the household was associated with a 68% reduction in the odds of hospital admission. Overall, the three leading causes of admission were malaria (29%), trauma/fractures (15%), and snakebites (13%). Epilepsy and malaria were the main causes of admission among children with NI. Few deaths were confirmed among children with NI and those without during the study's follow-up period. About half of the visits for rehabilitative care were related to CP, while 44% of visits were related to IDD. Rehabilitative exercises, assistive devices, and health education sessions were the three rehabilitative departments' most common forms of therapy.

The risk of in-patient hospital admission was similar for NI cases and controls, contrary to a study in the US where the risk was much higher among cases than controls [16.9% versus 0.2%] (Berry *et al.*, 2012). Children with severe NI, such as non-ambulatory cases with CP, have recorded far higher admission rates than children of the same age group from the general populations in HICs (Carter *et al.*, 2021; Meehan *et al.*, 2015; Yuan *et al.*, 2017). Children with severe NI in LMICs might not survive into late childhood which might explain the low rate of hospitalization among the cases. The few deaths observed during the follow-up might not explain the similarity of in-patient hospital admissions compared to children with and without NI. The duration of follow-up in our study was short and perhaps long-term survival studies (Abuga *et al.,* 2019) among younger children might indicate a difference in future studies. It is also plausible that children with NI are marginalized, secluded, and restrained in their communities, and might lack access to formal healthcare due to social, financial, and geographic barriers, as is the case in many LMICs (Mwangi *et al.*, 2021a; Zuurmond *et al.*, 2019). Besides, some children (~23%) whose care providers did not seek formal healthcare (Ngugi *et al.,* 2017), were missed from this analysis, underestimating the risk of hospitalization of children with NI. Contrary to studies from HICs, which have established that children with NI experience more frequent hospitalization (Moreau *et al.*, 2013), inadequate data on premature mortality in younger age groups and gaps in the provision of healthcare prevent the ascertainment of the actual risk of hospitalization in LMICs.

A higher socio-economic status in the community might imply better health status and therefore fewer hospital admissions. The presence of electricity in the household, which might be an indicator of higher socioeconomic status, was associated with decreased risk of hospitalization. Abdullahi and others (Abdullahi *et al.*, 2020) have previously shown that poverty is associated with an increased risk of hospitalization of children with NI. Poverty is an underlying risk factor for disease and disability which manifests itself as families' inability to address one or more direct risk factors such as food security, hygiene/sanitation, or access to healthcare. Maternal characteristics such as education and income and past medical history were not associated with seeking hospital care. This contrasts with the knowledge that incomplete immunization and malnutrition weaken children's immunity increasing susceptibility to acute infections and the possibility of hospitalization (Prendergast, 2015).

Overall, the main causes of admission in this study were malaria, accident-related trauma/fractures, and snakebites. Malaria remains an important cause of hospitalization accounting for over 30% of all admissions among children in Kenya

(English *et al.*, 2003). Evidence from Mali indicates that almost half of paediatric hospital admissions are related to malaria and trauma mainly from road/traffic accidents (Campbell *et al.*, 2004). Acute seizures, the main cause of admissions among children with NI in the study area, are likely related to malaria (Bistervels *et al.*, 2016; Kariuki *et al.*, 2011). A study conducted in the defined rural area also established that epilepsy is an important cause of hospitalization which concurs with our findings (Kariuki *et al.*, 2015).

Most patient visits to the rehabilitation departments were related to CP perhaps due to the gross physical and functional incapacitation associated with the condition. The number of visits per diagnostic category was related to the nature of services offered by these departments. Some children may have been seen at a separate epilepsy clinic affiliated with the hospital (Ibinda *et al.*, 2014), which explains the low number of epilepsy-related visits to the rehabilitation departments. In 2019, this epilepsy clinic recorded 728 child visits of whom 60% were diagnosed with epilepsy and over 98% were on anti-seizure medications, mainly carbamazepine, phenobarbital, and sodium valproate. This epilepsy clinic has regularized online prospective capture of patient visits, a coordinated data capture process we recommend in the rehabilitation departments.

The number of visits to the orthopaedic and physiotherapy departments decreased from 2015 to 2019; whereas visits related to CP, IDD, and hearing disorders in the occupational therapy department increased. The prolonged healthcare workers' strike in 2017 affected the delivery of services across the three departments (Waithaka *et al.*, 2020). Additionally, the observed trends might be explained by trends in rehabilitation promotion activities/or referrals from other hospital departments and the catchment community. We hypothesize that other private or non-governmental organizations outside the formal healthcare system might be offering some form of healthcare and/or rehabilitation for children with NI in the study area. There is a need to map out such organizations to determine the unmet need and gaps for planning and quality improvement of all available rehabilitation services within the study area.

Evidence-based interventions were lacking in the rehabilitative departments, and therefore, limited access to adequate rehabilitative care to improve quality of life, reduce activity limitation, increase community participation, as well as increase chances of survival (WHO, 2011; WHO, 2018). The type of orthopaedic technology offered in the rehabilitation clinics such as knee-ankle-foot orthoses, lumbar supports, and neck collars, and the relatively few ankle-foot-orthoses, is quite different from what is commonly utilized in HICs. There is limited evidence on the effectiveness of passive exercises (Pin *et al.*, 2006), which were fairly often utilized in this hospital. The low quality of rehabilitative care typified by a lack of evidence-based interventions in this setting might highlight the need to lobby for adequate resources and training or development of local capacity.

A previous study (Bunning *et al.*, 2014) has shown that these departments usually focus on physical dysfunction and little attention is given to cognition and sensory needs among other specific needs such as adaptive skills training (Aydin *et al.*, 2016; Choo *et al.*, 2019; Wu *et al.*, 2011; Zwier *et al.*, 2010). The absence of comprehensive and need-based rehabilitation is also a major limitation in the few existing rehabilitative facilities in Kenya. Community-based rehabilitative services have been recommended by Kenya's Association of the Physically Disabled (APDK) in collaboration with the Kenyan Ministry of Health, which is reaching out to persons with disabilities (WHO, 2010). Health promotion combined with community outreach is essential to address a dearth of information about the existence and importance of rehabilitative services in hospitals and communities (Iemmi *et al.*, 2016).

To the best of our knowledge, this is the first study to investigate the rate of admissions among children with NI compared to controls and to describe utilization patterns for rehabilitative care in LMICs using audit data. However, our readers should consider the following study limitations. First, we possibly underestimated the risk of hospitalization because we could not adequately determine the hospitalization status of all cases and controls in the cohort study. Besides, this study did not consider those children seeking outpatient care in peripheral clinics. Secondly, there is a potential for residual confounding from unmeasured and changing risk factors for admissions during the follow-up period, e.g., nutritional status, since we measured the risk factors at the baseline of the cohort study. Third, there were several limitations to using audit data to investigate rehabilitative care for children with NI. The occupational therapy department recorded more patients because it had more therapists and received more children (0–19 years) as opposed to the physiotherapy department which mostly received older children (>10 years) and adults. Personal and family-related information was incomplete and, therefore, disaggregated analysis was not possible. Community and hospital-based quantitative and qualitative studies are required to identify barriers/facilitators to access and utilization of rehabilitative care to guide the design and implementation of effective and evidence-based interventions in LMICs. Also, our readers should consider the differences in the health and social care systems for children with NI and disabilities when comparing our data with evidence from HICs.

## Conclusions

In summary, the current study did not identify a difference in the rate of hospitalization comparing children with and those without NI. Overall, malaria and accidents were important causes of hospital admission, and seizures were the main cause of admission for children with NI. Most visits for rehabilitative care in three child clinics were related to cerebral palsy and intellectual developmental delay. Rehabilitative exercises, assistive devices, and health education were the most common interventions offered by rehabilitative clinics.

## Disclaimer

The views expressed in this publication are those of the author(s) and not necessarily those of AAS, NEPAD Agency, Wellcome Trust or the UK government.

## Data availability

### Underlying data

Harvard dataverse: The risk of in-patient admission and utilization of rehabilitative services by children with neurological impairments in rural Kenya. https://doi.org/10.7910/DVN/WVRQ3S. (Mwangi *et al*., 2021b)

This project contains the following underlying data:

- Admission_data.csv
- Inpatient data.do
- LucyM_Codebook.xlsx
- LucyM_ReadMe.txt
- Occupational therapy.tab
- Orthopedics 2017-2019.tab
- Orthopedics do file.do
- orthopedics therapy 2015-2017.tab
- OT16_2_Preliminary results.do
- Physiotherapy.tab



For ethical reasons and to comply with the language used to obtain informed consent from the participants and permission/license to use audit data from the hospital, access to these datasets is controlled for general research use. Please request access to any of the datasets by completing the data request forms provided in the repository, after which permission will be granted using procedures governed by the Data Governance Committee (DGC) of the Centre for Geographic Medicine Research Coast, Kenya Medical Research Institute. The data will available after approval by the KEMRI Wellcome Trust Research Programme Data Governance Committee, only where anonymization can be adequately achieved to protect the privacy and confidentiality of the participants/respondents and any mentioned individuals and institutions, and where the proposed use is considered relevant to the nature of the data. Where the DGC recommends approval, the national KEMRI Science and Ethics Review Unit may also be asked to approve the proposed use. Conditions for data sharing are outlined in a KWTRP Data Sharing Agreement, including that the requestor shall use the data only for the agreed purpose as stipulated in the application form; shall agree to keep the data strictly confidential and shall not in any way attempt to seek to discover the identity of data subjects, to compromise or infringe on their privacy and confidentiality of their information.

### Acknowledgements

We acknowledge Mr Collins Kipkoech for supporting data management during the entire lifecycle of the project.

## References

Abdullahi I, Wong K, de Klerk N, *et al.*: **Hospital admissions in children with developmental disabilities from ethnic minority backgrounds.** *Dev Med Child Neurol.* 2020; **62**(4): 470–476.
PubMed Abstract | Publisher Full Text

Abubakar A, Holding P, Newton CRJC, *et al.*: **The role of weight for age and disease stage in poor psychomotor outcome of HIV-infected children in Kilifi, Kenya.** *Dev Med Child Neurol.* 2009; **51**(12): 968–73.
PubMed Abstract | Publisher Full Text | Free Full Text

Abuga JA, Kariuki SM, Kinyanjui SM, *et al.*: **Premature mortality in children aged 6-9 years with neurological impairments in rural Kenya: a cohort study.** *Lancet Glob Health.* 2019; **7**(12): e1728–e1735.
PubMed Abstract | Publisher Full Text | Free Full Text

Abuga JA, Kariuki SM, Abubakar A, *et al.*: **Neurological impairment and disability in children in rural Kenya.** *Dev Med Child Neurol.* 2022; **64**(3): 347–356.
PubMed Abstract | Publisher Full Text | Free Full Text

Asferaw M, Woodruff G, Gilbert C: **Causes of severe visual impairment and blindness in students in schools for the blind in Northwest Ethiopia.** *BMJ Glob Health.* 2017; **2**(2): e000264.
PubMed Abstract | Publisher Full Text | Free Full Text

Aydin T, Taspinar O, Kepekci M, *et al.*: **Functional independence measure scores of patients with hemiplegia followed up at home and in university hospitals.** *J Phys Ther Sci.* 2016; **28**(2): 553–7.
PubMed Abstract | Publisher Full Text | Free Full Text

Banks LM, Kuper H, Polack S: **Poverty and disability in low- and middle-income countries: A systematic review.** *PLoS One.* 2017; **12**(12): e0189996.
PubMed Abstract | Publisher Full Text | Free Full Text

Belmont: **Final report of the international pilot study of severe childhood disability.** ed.^eds. Gertrude Sergievsky Center, Columbia University., New York, 1984.

Berry JG, Poduri A, Bonkowsky JL, *et al.*: **Trends in resource utilization by children with neurological impairment in the United States inpatient health care system: a repeat cross-sectional study.** *PLoS Med.* 2012; **9**(1): e1001158.
PubMed Abstract | Publisher Full Text | Free Full Text

Bistervels IM, Kariuki SM, Newton CRJC: **Risk of convulsive epilepsy following acute seizures in Kenyan children.** *Epilepsia Open.* 2016; **1**(3–4): 112–120.
PubMed Abstract | Publisher Full Text | Free Full Text

Blair E, Watson L, Badawi N, *et al.*: **Life expectancy among people with cerebral palsy in Western Australia.** *Dev Med Child Neurol.* 2001; **43**(8): 508–15.
PubMed Abstract

Bright T, Wallace S, Kuper H: **A Systematic Review of Access to Rehabilitation for People with Disabilities in Low- and Middle-Income Countries.** *Int J Environ Res Public Health.* 2018; **15**(10): 2165.
PubMed Abstract | Publisher Full Text | Free Full Text

Bunning K, Gona JK, Odera-Mung'ala V, *et al.*: **Survey of rehabilitation support for children 0-15 years in a rural part of Kenya.** *Disabil Rehabil.* 2014; **36**(12): 1033–41.
PubMed Abstract | Publisher Full Text | Free Full Text

Campbell JD, Sow SO, Levine SM, *et al.*: **The causes of hospital admission and death among children in Bamako, Mali.** *J Trop Pediatr.* 2004; **50**(3): 158–63.
PubMed Abstract | Publisher Full Text

Carter B, Bennett CV, Jones H, *et al.*: **Healthcare use by children and young adults with cerebral palsy.** *Dev Med Child Neurol.* 2021; **63**(1): 75–80.
PubMed Abstract | Publisher Full Text

Carter JA, Mung'ala-Odera V, Neville BGR, *et al.*: **Persistent neurocognitive impairments associated with severe falciparum malaria in Kenyan children.** *J Neurol Neurosurg Psychiatry.* 2005; **76**(4): 476–81.
PubMed Abstract | Publisher Full Text | Free Full Text

Choo YY, Agarwal P, How CH, *et al.*: **Developmental delay: identification and management at primary care level.** *Singapore Med J.* 2019; **60**(3): 119–123.
PubMed Abstract | Publisher Full Text | Free Full Text

Donabedian A: **Evaluating the quality of medical care. 1966.** *Milbank Q.* 2005;

**83**(4): 691–729.
PubMed Abstract | Publisher Full Text | Free Full Text

Durkin MS, Hasan ZM, Hasan KZ: **The ten questions screen for childhood disabilities: its uses and limitations in Pakistan.** *J Epidemiol Community Health.* 1995; **49**(4): 431–6.
PubMed Abstract | Publisher Full Text | Free Full Text

English M, Ngama M, Musumba C, *et al.*: **Causes and outcome of young infant admissions to a Kenyan district hospital.** *Arch Dis Child.* 2003; **88**(5): 438–443.
PubMed Abstract | Publisher Full Text | Free Full Text

Ensor T, Cooper S: **Overcoming barriers to health service access: influencing the demand side.** *Health Policy Plan.* 2004; **19**(2): 69–79.
PubMed Abstract | Publisher Full Text

Glover G, Williams R, Tompkins G, *et al.*: **An observational study of the use of acute hospital care by people with intellectual disabilities in England.** *J Intellect Disabil Res.* 2019; **63**(2): 85–99.
PubMed Abstract | Publisher Full Text

Haig AJ, Im J, Adewole A, *et al.*: **The practice of physical medicine and rehabilitation in subSaharan Africa and Antarctica: A white paper or a black mark?** *PM R.* 2009; **1**(5): 421–6.
PubMed Abstract | Publisher Full Text

Ibinda F, Mbuba CK, Kariuki SM, *et al.*: **Evaluation of Kilifi epilepsy education programme: a randomized controlled trial.** *Epilepsia.* 2014; **55**(2): 344–52.
PubMed Abstract | Publisher Full Text | Free Full Text

Iemmi V, Kuper H, Blanchett K, *et al.*: **Community-based rehabilitation for people with disabilities.** *3ie Systematic Review Summary.***4**: 2016; 37–37.
Reference Source

Kariuki SM, Ikumi M, Ojal J, *et al.*: **Acute seizures attributable to falciparum malaria in an endemic area on the Kenyan coast.** *Brain.* 2011; **134**(Pt 5): 1519–28.
PubMed Abstract | Publisher Full Text | Free Full Text

Kariuki SM, Chengo E, Ibinda F, *et al.*: **Burden, causes, and outcomes of people with epilepsy admitted to a rural hospital in Kenya.** *Epilepsia.* 2015; **56**(4): 577–84.
PubMed Abstract | Publisher Full Text | Free Full Text

Kitsao-Wekulo P, Holding PA, Kvalsvig JD, *et al.*: **Measurement of expressive vocabulary in school-age children: Development and application of the Kilifi Naming Test (KNT).** *Appl Neuropsychol Child.* 2019; **8**(1): 24–39.
PubMed Abstract | Publisher Full Text | Free Full Text

Kommu JVS: **Specific Learning Disorders.** *AP J Psychol Med.* 2009.
Reference Source

Kumar R, Bhave A, Bhargava R, *et al.*: **Prevalence and risk factors for neurological disorders in children aged 6 months to 2 years in northern India.** *Dev Med Child Neurol.* 2013; **55**(4): 348–56.
PubMed Abstract | Publisher Full Text

Lee WC, Chen TJ: **Quantifying morbidity burdens and medical utilization of children with intellectual disabilities in Taiwan: a nationwide study using the ACG case-mix adjustment system.** *Res Dev Disabil.* 2012; **33**(4): 1270–8.
PubMed Abstract | Publisher Full Text

McDonald KM, *et al.*: **AHRQ Technical Reviews.** In: *Closing the Quality Gap: A Critical Analysis of Quality Improvement Strategies (Care Coordination).* AHRQ Technical Reviews, ed.^eds. Agency for Healthcare Research and Quality (US), Rockville (MD). 2007; Vol 7.
Reference Source

Meehan E, Freed GL, Reid SM, *et al.*: **Tertiary paediatric hospital admissions in children and young people with cerebral palsy.** *Child Care Health Dev.* 2015; **41**(6): 928–37.
PubMed Abstract | Publisher Full Text

Moreau JF, Fink EL, Hartman ME, *et al.*: **Hospitalizations of children with neurologic disorders in the United States.** *Pediatr Crit Care Med.* 2013; **14**(8): 801–10.
PubMed Abstract | Publisher Full Text | Free Full Text

Mung'ala-Odera V, Meehan R, Njuguna P, *et al.*: **Prevalence and risk factors of neurological disability and impairment in children living in rural Kenya.** *Int J Epidemiol.* 2006; **35**(3): 683–8.
PubMed Abstract | Publisher Full Text

Murphy NA, Hoff C, Jorgensen T, *et al.*: **Costs and complications of hospitalizations for children with cerebral palsy.** *Pediatr Rehabil.* 2006; **9**(1): 47–52.
PubMed Abstract | Publisher Full Text

Mwangi LW, Abuga JA, Cottrell E, *et al.*: **Barriers to access and utilization of healthcare by children with neurological impairments and disability in low-and middle-income countries: a systematic review [version 2; peer review: 2 approved].** *Wellcome Open Res.* 2021a; **6**: 61.
PubMed Abstract | Publisher Full Text | Free Full Text

Mwangi LW, Abuga JA, Ndolo JM, *et al.*: **The risk of in-patient admission and utilization of rehabilitative services by children with neurological impairments in rural Kenya.** Harvard Dataverse, V1, 2021b.
http://www.doi.org/10.7910/DVN/WVRQ3S

Ngugi AK, Agoi F, Mahoney MR, *et al.*: **Utilization of health services in a resource-limited rural area in Kenya: Prevalence and associated household-level factors.** *PLoS One.* 2017; **12**(2): e0172728.
PubMed Abstract | Publisher Full Text | Free Full Text

Njelesani J, Couto S, Cameron D: **Disability and rehabilitation in Tanzania: a review of the literature.** *Disabil Rehabil.* 2011; **33**(23–24): 2196–207.
PubMed Abstract | Publisher Full Text

Olusanya BO, Wright SM, Nair MKC, *et al.*: **Global Burden of Childhood Epilepsy, Intellectual Disability, and Sensory Impairments.** *Pediatrics.* 2020; **146**(1): e20192623.
PubMed Abstract | Publisher Full Text | Free Full Text

Peterson K, Anderson J, Bourne D, *et al.*: **Health Care Coordination Theoretical Frameworks: a Systematic Scoping Review to Increase Their Understanding and Use in Practice.** *J Gen Intern Med.* 2019; **34**(Suppl 1): 90–98.
PubMed Abstract | Publisher Full Text | Free Full Text

Pin T, Dyke P, Chan M: **The effectiveness of passive stretching in children with cerebral palsy.** *Dev Med Child Neurol.* 2006; **48**(10): 855–62.
PubMed Abstract

Prendergast AJ: **Malnutrition and vaccination in developing countries.** *Philos Trans R Soc Lond B Biol Sci.* 2015; **370**(1671): 20140141.
PubMed Abstract | Publisher Full Text | Free Full Text

Resnikoff S, Lansingh VC, Washburn L, *et al.*: **Estimated number of ophthalmologists worldwide (International Council of Ophthalmology update): will we meet the needs?** *Br J Ophthalmol.* 2020; **104**(4): 588–592.
PubMed Abstract | Publisher Full Text | Free Full Text

Roncagliolo M, Garrido M, Walter T, *et al.*: **Evidence of altered central nervous system development in infants with iron deficiency anemia at 6 mo: delayed maturation of auditory brainstem responses.** *Am J Clin Nutr.* 1998; **68**(3): 683–90.
PubMed Abstract | Publisher Full Text

Saxena S, Thornicroft G, Knapp M, *et al.*: **Resources for mental health: scarcity, inequity, and inefficiency.** *Lancet.* 2007; **370**(9590): 878–89.
PubMed Abstract | Publisher Full Text

Scott JA, Bauni E, Moisi JC, *et al.*: **Profile: The Kilifi Health and Demographic Surveillance System (KHDSS).** *Int J Epidemiol.* 2012; **41**(3): 650–7.
PubMed Abstract | Publisher Full Text | Free Full Text

StataCorp: **Stata Statistical Software: Release 14.** T.S.L. College Station, ed.^eds. 2015.

Thurman DJ, Beghi E, Begley CE, *et al.*: **Standards for epidemiologic studies and surveillance of epilepsy.** *Epilepsia.* 2011; **52 Suppl7**: 2–26.
PubMed Abstract | Publisher Full Text

Waithaka D, Kagwanja N, Nzinga J, *et al.*: **Prolonged health worker strikes in Kenya- perspectives and experiences of frontline health managers and local communities in Kilifi County.** *Int J Equity Health.* 2020; **19**(1): 23.
PubMed Abstract | Publisher Full Text | Free Full Text

WFOT: **World Federation of Occupational Therapists.** ed.^eds. 2020.
Reference Source

WHO: **International Classification of Functioning, Health and Disability (ICF).** ed.^eds. 2001.
Reference Source

WHO: **WHO Guidelines Approved by the Guidelines Review Committee.** In: *Community-Based Rehabilitation: CBR Guidelines.* WHO Guidelines Approved by the Guidelines Review Committee, C. Khasnabis, K. Heinicke Motsch, K. Achu, K. Al Jubah, S. Brodtkorb, P. Chervin, P. Coleridge, M. Davies, S. Deepak, K. Eklindh, A. Goerdt, C. Greer, K. Heinicke-Motsch, D. Hooper, V.B. Ilagan, N. Jessup, C. Khasnabis, D. Mulligan, B. Murray, A. Officer, F. Ortali, B. Ransom, A. Robert, S. Stubbs, M. Thomas, V. Balakrishna, R. Wabuge-Mwangi, N. Mattock, T. Lander, ed.^eds. World Health Organization, Copyright © World Health Organization 2010., Geneva, 2010.
Reference Source

WHO: **World Report on Disability.** ed.^eds. The World Bank, Geneva, Switzerland, 2011; **2020**.
Reference Source

WHO: **Access to rehabilitation in primary health care: an ongoing challenge.** ed.^eds. World Health Organization, Geneva, 2018.
Reference Source

Wu YN, Hwang M, Ren Y, *et al.*: **Combined passive stretching and active movement rehabilitation of lower-limb impairments in children with cerebral palsy using a portable robot.** *Neurorehabil Neural Repair.* 2011; **25**(4): 378–85.
PubMed Abstract | Publisher Full Text

Yuan JX, McGowan M, Hadjikoumi I, *et al.*: **Do children with neurological disabilities use more inpatient resources: an observational study.** *Emerg Themes Epidemiol.* 2017; **14**: 5.
PubMed Abstract | Publisher Full Text | Free Full Text

Zaman SS, Khan NZ, Islam S, *et al.*: **Validity of the 'Ten Questions' for screening serious childhood disability: results from urban Bangladesh.** *Int J Epidemiol.* 1990; **19**(3): 613–20.
PubMed Abstract | Publisher Full Text

Zuurmond M, Mactaggart I, Kannuri N, *et al.*: **Barriers and Facilitators to Accessing Health Services: A Qualitative Study Amongst People with Disabilities in Cameroon and India.** *Int J Environ Res Public Health.* 2019; **16**(7): 1126.
PubMed Abstract | Publisher Full Text | Free Full Text

Zwier JN, van Schie PE, Becher JG, *et al.*: **Physical activity in young children with cerebral palsy.** *Disabil Rehabil.* 2010; **32**(18): 1501–8.
PubMed Abstract | Publisher Full Text