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2021
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CHARACTERISTICS AND OUTCOMES IN CHILDREN AGED 6 TO 60 MONTHS ASSESSED AS BEING MALNOURISHED BY COMMUNITY HEALTH WORKERS IN TLOKWE

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of M Med: Family Medicine

Johannesburg, 2019.

Declaration

I, Jurgens Staats, student number 345462, declare that this report is my own, unaided work. It is being submitted for the Degree of M Med: Family Medicine at the University of the Witwatersrand, Johannesburg. It has not been submitted previously for any degree or examination at any other University.



Signature of Student…….....Date 02 December 2020

Name of Primary Supervisor: Dr Carien Lion-Cachet

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Nomenclature

ARI:	Acute Respiratory Infection
CFR:	Case Fatality Rate
CHC:	Community Health Worker
CHW:	Community Health Worker
CMAM:	Community-based Management of Acute Malnutrition
MUAC:	Mid-upper-arm Circumference
OTL:	Outreach Team Leader
PHC:	Primary Health Care
SAM:	Severe Acute Malnutrition
TB:	Tuberculosis
Hb:	Haemoglobin
WHO:	World Health Organisation
WHZ:	Weight for Height

Clinical Outcomes in Children admitted for malnutrition in Tlokwe municipality, North West province: A comparative study of referral sources

A submissible article according to the style guide and requirements of the African Journal of Primary Health Care & Family Medicine (PHCFM)

Abstract

Background

Severe acute malnutrition (SAM) is a common problem with severe and long-lasting effects. As part of the primary health care re-engineering team, community health workers (CHWs) are well placed to screen for and refer SAM patients at an early stage. Few studies have investigated the role of CHWs in SAM referrals and clinical outcomes in South Africa, and none in the North West province.

Aim

To compare the outcomes of admission between children referred by CHW to Potchefstroom hospital for SAM and those by other healthcare workers

Setting

This study was conducted in a primary healthcare setting in JB Marks subdistrict, Tlokwe municipal area, North West Province, South Africa

Methods

A cross-sectional study that analysed 71 medical records of children admitted with SAM from 1 April 2016 to 31 March 2018 was conducted. Referral forms from outreach teams to clinics were used to establish CHW involvement in the referral of patients with SAM. Chi squared, t-tests and ANOVA determined associations between referral sources and outcomes. The effect size of differences in outcome were calculated to determine the practical significance.

Results

Only 5 out of 71 (7.04%) SAM patient admissions were due to CHW referrals from the community. Patients referred by CHWs showed statistically significant higher Hb levels compared to other sources of referral (p 0.044). No deaths were associated with CHW-referred patients compared to six in the clinic-referred group and three in the other-referred group. Other outcomes were not statistically different.

Conclusion

This study found that community health worker referrals contributed to a small proportion of SAM admissions, implying that they did not consistently screen for malnutrition in this community.

Introduction

Severe Acute Malnutrition (SAM) has serious and long-lasting effects on developmental, economic, social and medical aspects among individuals, families, communities and countries.[1–4] It is estimated that 45% of deaths globally in children under five are related to undernutrition.[1] Those who survive SAM face numerous long term challenges due to developmental delays,[5,6] poor performance in school with subsequent lower earning capacity,[3,7] and development of non-communicable diseases like diabetes and hypertension.[8]

In South Africa, SAM occurs commonly with an incidence of 2.2/1000 in children under the age of five years. There were 11280 admissions and 806 deaths because of malnutrition in 2018, resulting in a national case fatality rate (CFR) of 7.1%. During the same time, North West Province reported a higher than average incidence of 4.0/1000 children under 5 comprising 1100 admissions, 125 deaths and a CFR of 9.3%.[9]

Community-based interventions involving community health workers (CHWs) are one of the strategies to combat SAM. Defined as workers who are selected and trained to work in the community as the first line of support between communities and various health and social development services,[10] CHWs have been described as the most promising health workforce.[11] In South Africa, the Primary Health Care (PHC) re-engineering strategy initiated in 2011 included the employment of ward-based primary care outreach teams to address the quadruple burden of disease[12] with child health as one of the focus areas.[13] CHWs have been involved in various intervention strategies including health education, screening for malnutrition and community-based management of acute malnutrition (CMAM).

With the re-engineering strategy implemented only eight years ago, studies on CHW interventions in South Africa are limited. Investigations on health promotion and CMAM have provided evidence of successful CHW programmes against SAM,[14–17] but no studies exist that examine outcomes of SAM, because of community screening in South Africa.[18] This study would therefore be the first to explore this topic.

CHWs are trained to screen for malnutrition using mid-upper-arm circumference (MUAC) measurements less than 11.5cm[19] as it has been validated in patients aged 6 to 60 months as a screening tool to detect SAM in community settings.[20,21] The value in screening for SAM lies in the detection of disease with severe consequences with effective treatment if detected at an

early stage.[22] Even though not all patients referred by CHWs may end up in the hospital, the majority of hospitalised SAM patients should ideally be referred from the first contact opportunity, which is the community. It was expected that CHW-referred patients may be associated with more favourable outcomes compared to patients referred from other sources. To the best of the authors' knowledge, this hypothesis has not been tested previously in the study setting. In addition, current evidence on this topic is at the level of expert opinion[18], therefore this study adds value by investigating community-based screening of SAM by CHWs and related outcomes.

The aim of this study was to compare the clinical outcomes between children referred to Potchefstroom hospital for SAM by CHWs and those referred by other healthcare workers
The objectives were:

- To determine the proportion of SAM patients admitted to the hospital that was initiated by CHW referrals.
- To compare anthropometric measurements of patients referred by CHW and those referred by others
- To compare the prevalence of comorbidities between patients referred by CHW and those referred by others
- To compare the length of admission between patients referred by CHW and those referred by others
- To compare mortality rates between patients referred by CHW and those referred by others

Research Methods and Design

Study Design

This was a retrospective cross-sectional design with analytical components.

Setting

This study was conducted in the Tlokwe area of the JB Marks subdistrict in the North West Province of South Africa. JB Marks subdistrict came into existence in August 2016 because of the merger between Tlokwe and Ventersdorp municipalities. Tlokwe has a population of 162 762 inhabitants (of which 6289 are younger than five years old) comprising 54 650 households.

Potchefstroom Hospital has 330 beds of which 37 are available in the paediatric ward. The hospital receives direct referrals from two CHC's (Community Health Centres) and eight clinics as well as problematic cases admitted to Ventersdorp CHC (Previously Ventersdorp District Hospital). Services provided at Potchefstroom Hospital include a comprehensive multi-professional health care team.

The CHC's and clinics each dispose of a compliment of outreach team leaders (OTL's) who supervise CHWs. These outreach teams are responsible for household registrations, health promotion activities and identifying community members in need of health and social services. Patients in need of health services are referred to their local clinic using a standardised referral form. There are 26 OTL's and 115 CHWs employed in Tlokwe.

Study Population and Sampling Strategy

The study population included medical records of patients admitted to Potchefstroom hospital from 1 April 2016 to 31 March 2018 as this corresponded with the time frame used to compile annual statistics. Patients were selected using consecutive sampling, i.e. every available patient file matching inclusion criteria was selected as the subject pool was limited. A sample size was not determined, therefore it is not possible to emphatically say whether the sample size was large enough. All patients aged 6 to 60 months admitted with SAM at Potchefstroom Hospital from 1 April 2016 to 31 March 2018 were included in this study. Lost patient files, multiple admissions, and files of patients not within the prescribed age range were excluded from this study. In case of multiple admissions, data from the first admission was used as these patients are actively managed after discharge.

Data available from previous years suggested a range of 50 to 80 SAM patients per year. Because the study size was limited by the number of SAM patients admitted over two years, the number of patients was finite. All eligible patients were consecutively included. For the period mentioned above, 103 files were identified, of which 71 were eligible for review - 14 files were lost, two patients had multiple admissions, and 16 patients were younger than six months old (Figure 1)

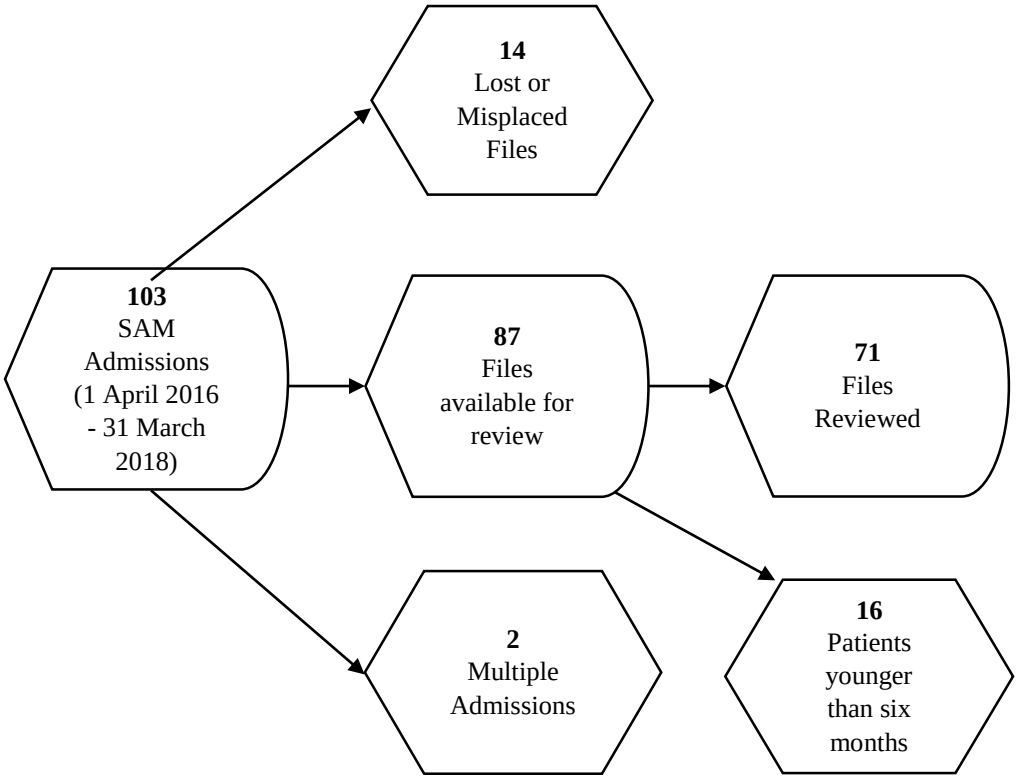

Figure 1 File Selection Process.

Data Collection

Data was collected over one month on June 2019 and analysed during August 2019. Information needed to retrieve files (name, surname, date of birth, deceased) were sourced from admission records in the paediatric ward as well as the dietetics department at Potchefstroom Hospital as they take part in research studies on SAM. Identifying details were kept in a delinked file in a secure place. The selected files were retrieved from the filing room and morgue, then audited for relevant information which was entered to a data collection sheet developed by the researcher and organised into 6 categories:

1. Sociodemographic data: sex and age
2. Anthropometry: weight, height and z-score

3. Comorbidities: diarrhoea, acute respiratory infection (ARI), tuberculosis (TB), anaemia (Hb), HIV
4. Length of stay: number of days admitted in hospital
5. Mortality: deceased yes/no
6. Source of Referral: CHW, clinic, other

The second phase of data collection occurred at the PHC facilities surrounding Potchefstroom Hospital. Referral forms from outreach teams to healthcare providers and hospitals kept in files at each facility were scrutinised, focussing on patients under five years of age. Identification details from these records were used to match records of patients admitted to Potchefstroom Hospital.

Sex was recorded as male or female. Age was recorded in months as on the first date of admission to hospital.

Weight and length were copied as they were recorded in the file. In cases of multiple entries, preference was given to the notes made by dieticians as they were more consistent in measuring the length and in many instances: theirs were the only documented measurements. The z-score was calculated using World Health Organisation (WHO) Child Growth Standards tables.[23]

Since these are clinical diagnoses, pneumonia and diarrhoea were recorded if observed in the problem list of progress notes. TB diagnosis was based on positive GeneXpert, culture or documented empirical diagnosis of TB. Clinical notes reporting that the patient was already on treatment for TB was also accepted. Where no evidence of investigation for TB was found, no value was allocated to the data collection sheet.

HIV status was confirmed by examining PCR results. If these were not available, a documented negative rapid HIV test on the mother was accepted as confirmation of non-exposure.

Haemoglobin levels were recorded from documented laboratory results. Unit of measurement used was g/dL.

Length of stay was calculated based on dates of admission and discharge. Mortality was recorded if clinical notes stipulated that the patient had demised.

Patients were classified as CHW referred, clinic-referred or other (self-referrals and GP referrals). To determine whether patients had been referred by CHWs, details of files audited were matched with information on outreach team referral forms (name, date of birth, date of referral and reason for referral). Clinic referrals were confirmed by scrutinising hospital files for clinic referral documents or notes in casualty admission forms. Where evidence for CHW and Clinic referral in the same patient was present, the referral was allocated to CHWs.

Data Analysis

Data was organised into descriptive frequency tables. With continuous data, testing for statistical significance was conducted via t-test and ANOVA. For categorical data, chi-square and Fisher's exact tests were used to test for statistically significant association at $p < 0.05$. Logistic binary regression was applied to those variables that showed statistical significance on test of associations. Effect sizes are useful in small samples and were used to complement testing for statistical significance, which may be dependent on larger sample sizes. Effect sizes (practical significance) were calculated to indicate the size of differences between groups. Cramer's V was used to calculate practical significance in categorical data sets. Effect sizes for categorical data were expressed as a w-value and interpreted as w=0.1 (small effect), w=0.3 (medium effect) and w=0.5 (large effect). A relationship with $w > 0.5$ was considered practically significant.[24]

Ethical Considerations

Ethical approval was granted by the Wits Human Research Ethics Committee (M180816). Permission was also obtained from the North West Department of Health and the involved health facilities.

Results

Descriptive data have been summarised in Tables I and II. A total of 71 files were audited. There was an equal distribution of sex with 35 male and 36 female patients. The mean age of patients was 14.86 months.

Table I summarises categorical descriptive data and shows that only five (7.04%) patients have been referred by CHWs compared to 50 (70.42%) by clinics and 16 (22.54%) by other sources. Nine (12.7%) patients demised, 13 (18.3%) were infected with HIV while nine (14.5%) had TB. The proportion of patients with diarrhoea was 38 (53.5%) while those with ARI was 46 (64.8%).

Table I Descriptive Statistics for Categorical Data

	N	%
Sex		
Male	35	49.3%
Female	36	50.7%
Referral Source		
CHW	5	7.04%
Clinic	50	70.42%
Other	16	22.54%
Clinical		
TB	9[a]	14.5%
HIV	13	18.3%
Diarrhoea	38	53.5%
ARI	46	64.8%
Outcome		
Deceased	9	12.7%

[a] – There was no documented investigation for TB in nine patients

The descriptive statistics for continuous data in Table II shows that the mean z-score was -2.54. The mean Hb level was 10.01g/dL which is below the reference value of 11g/dL for anaemia. The Hb of one patient was not recorded as the patient demised on day 0 of admission and no measurements were noted. The length of stay averaged 11.67 days with data from one patient not included due to being transferred to another facility.

Table II Descriptive Statistics for Continuous Data

	n	mean
Age	71	14.86 months
Z-score	68	-2.54
Hb	70	10.01g/dL
Length of stay	70	11.67 days

*The anthropometric measurements of 3, the Hb of one and the length of stay of one were not recorded and therefore not included in the analysis.

Table III and IV compared characteristics and outcomes of patients referred from CHWs, clinics and other.

As shown in Table III, there were no deaths in the CHW-referred group compared to 6 (12%) in the clinic-referred group and 3 (18.8%) in the other-referred group. The difference was not statistically significant (p 0.527) with a small effect size (w 0.134).

When comparing HIV infection rates, none of the CHW-referred group had HIV compared to 9 (18%) clinic-referred patients and 4 (25%) other-referred patients. The difference between the groups was not statistically significant (p 0.449) although the measured effect size was small (0.156)

Comparison of other comorbidities in admitted SAM patients found no significant differences in terms of diarrhoea (p 0.752; w 0.090), ARI (p 0.293; w 0.186), and TB (p 0.319; w 0.192).

Table III Comparison of Characteristics and Outcomes in Categorical Data

	Diarrhoea		**ARI**		**TB**		**HIV**		**Deceased**	
	n	%	n	%	n	%	n	%	n	%
CHW (n=5)	2	40%	3	60%	1	20%	0	0%	0	0%
Clinic (n=50)	28	56%	30	60%	5	12%[b]	9	18%	6	12%
Other (n=16)	8	50%	13	81%	3	19%	4	25%	3	18%
***p-value*[c]**	*0.752*		*0.293*		*0.319*		*0.449*		*0.527*	
***w-value*[d]**	*0.090*		*0.186*		*0.192*		*0.156*		*0.134*	

b – There was no documented investigation of TB for nine patients in the clinic-referred group. Therefore, the percentage is calculated out of 41 instead of 50

c – p-value calculated according to numbers (not percentages).

d – w-value calculated according to numbers (not percentages).

As shown in Table IV, the Hb level of CHW-referred patients was significantly higher than patients in other groups (p 0.044). CHW-referred patients also had a higher mean z-score, although the difference was not statistically significant (p = 0.488). When comparing length of stay, CHW-referred patients stayed longer on average. The difference was not statistically significant (p = 0.336). No significant differences were found in respect of age (p = 0.958).

Table IV Comparison of Characteristics and Outcomes in Continuous Data

	Age (Months)	**Z-score**	**Hb (g/dL)**	**Length of Stay**
	Mean	**Mean**	**Mean**	**Mean**
CHW	15.60	-2.20	11.40	16.00
Clinic	14.94	-2.52	10.04	10.69

Others	14.38	-2.73	9.48	13.31
p-value	*0.958*	*0.488*	*0.044*	*0.336*

Discussion

This study set out to determine whether patients referred from the community by CHWs were associated with different characteristics and outcomes compared to patients referred from clinics or other sources. Furthermore, the study determined the proportion of SAM admissions referred by CHWs. As the first line of support between communities and healthcare facilities, it would be reasonable to expect CHWs to have referred the most SAM patients. The fact that only five (7.04%) of the 71 patients were referred by CHWs was not expected and implies that they did not consistently screen for SAM in this community. Although no studies were found to compare this finding to, there is evidence to suggest that referral compliance[25], inadequate training, lack of supportive supervision, essential resources and inconsistent job descriptions[26] may impact on their performance in referring SAM patients. A review of the implementation of CHWs in screening for SAM in this community as well as performance factors is warranted as there is much room for improvement. Further studies in different districts and provinces are needed to confirm generalisability.

Although CHW-referred patients constituted the minority of this study population, there were a few clinically important differences that distinguished them from the other groups:

Despite the difference not being statistically significant, the finding that CHW-referred patients were associated with higher z-scores (-2.20) versus clinic-referred (-2.52) and other-referred (-2.73) patients has important clinical implications. Evidence has shown that z-scores have an 84% sensitivity for mortality in SAM patients.[27] This would suggest that, based on their higher z-scores, CHW-referred patients in this study may be associated with a lower mortality rate. MUAC, however, has been found to be a better predictor for mortality with a sensitivity of 95.5%.[27,28] Comparison of MUAC was not possible in this study as it was not used at all levels of health care and therefore not consistently documented. Future studies should consider inclusion of MUAC measurements prospectively to ensure availability.

Another important clinical finding was that CHW-referred patients had significantly higher Hb levels compared to patients referred from clinics and other sources. With an Hb level threshold of 11g/dL for diagnosing anaemia, the CHW-referred group was the only one with a mean Hb 11.4g/dL. Evidence of anaemia as a poor prognostic factor in SAM is well documented[29,30] as its management is part of the WHO ten steps, suggesting that the patients referred by CHWs may be associated with a favourable survival rate compared to the other groups in this study due to ealy recognition and referral.

Even though there were no significant differences, CHW-referred patients had a longer mean length of stay (16 days) compared to clinic-referred patients (10.69 days) and other-referred patients (13.31). This could also be related to mortality as some patients who demised did so on the first few days after admission. Similar findings have been made in other studies which found that SAM related deaths tend to occur early[31] with further evidence suggesting that a longer length of stay was associated with an improved recovery rate.[32] This may be clinically important as it suggests that CHW-referred patients were associated with an outcome related to better mortality rates.

With the abovementioned patient characteristics alluding to an expected better mortality rate in the CHW-referred group of this study, the appropriate next step is to confirm this by interpreting the data generated on documented deaths. Although not statistically significant, the fact that no deaths occurred in the CHW-referred group compared to six in the clinic-referred group and three in the other-referred group may be interpreted as clinically significant. Seeing that CHW-referred patients had characteristics associated with favourable outcomes, this finding supports the hypotheses mentioned above. Because no other studies were found looking at outcomes in SAM related to early referrals from the community, further research on this topic should be encouraged to validate this finding.

When comparing incidence of HIV, the CHW-referred group had no infections compared 9.18% in the clinic-referred group and 25% in the other-referred group. The negative effect of HIV on mortality is well known[33] and corresponds with the death rate of 0% in CHW-referred patients, 12% in clinic-referred patients and 18% in other-referred patients. Since other factors like CD4 percentage levels also play a role in the prognosis of SAM patients with HIV,[34] there is not enough detail to suggest that early referral by CHWs had an influence on mortality when considering this aspect. The fact that there were no patients with HIV in the CHW-referred group made it impossible to do such a comparison. Future studies should take CD4 percentage into account when the inclusion of HIV infection is considered.

When comparing the incidence of TB, ARI and diarrhoea, there were no significant differences between groups. Arguably, the percentages were similar and no clinical significance could be extracted. This could be a result of the small sample size. Because the incidence of ARI and diarrhoea was based on clinical acumen compared to laboratory results or measurements in other variables, consideration should be given to the consistency of data obtained. A study with prospective design may allow for direct observation of clinical decision making and improve reliability.

Strengths and Limitations

The small sample size limited statistical power and increased margin of error with a possible overestimation of associations. The conclusions made from this study can therefore not be accepted as representative of the population of this country, limiting generalisation. Extending criteria to include dates outside selection period was considered, but not practically possible. Inclusion of other sites like Ventersdorp would have led to information bias as referral systems and level of care influencing outcomes may differ. Future studies should consider inclusion of multiple sites with similar settings to obtain a larger sample size.

Consecutive sampling is often associated with selection bias, as the sample may not represent the true study population. Consecutive sampling, as a form of convenience sampling, used in this study limited selection bias as every patient who met selection criteria was included in this study.

ARI and diarrhoea were subject to the interpretation of the attending healthcare professional, possibly resulting in information bias. To limit information bias, all groups were clearly defined and similar in all aspects other than the source of referral in addition variables and outcomes were measured in the same way in each group

Recording two conditions in the same organ system; in this case, TB and ARI were mitigated by the fact that criteria for TB diagnosis were based mostly on laboratory investigations. The term ARI could be viewed as too broad and was probably a poor choice of variable.

Notwithstanding the associations found, some of the outcomes could be related to sociodemographic factors that were not measured in this study. This could have exposed confounders. It could also have provided context for the measured outcomes.

The documents audited for data collection was standard for PHC and regional hospital settings. This study could therefore be replicated in other South African facilities. The small sample size, study design and use of convenience sampling, however, limits the generalisability of this study.

Cross-sectional studies analyse exposure and outcome at the same time allowing one to find associations only. The absence of longitudinal data makes it difficult iin this study to prove true cause and effect. Data collection at a specific period means that it may not represent patients admitted during other periods.

Conclusion

This study assessed outcomes and characteristics of SAM patients admitted to Potchefstroom Hospital, taking CHW referrals into account. A low proportion of patients referred by CHWs implies that screening for SAM in this community was not done consistently during the period under review. Although not statistically significant, the fact that other groups had more deaths than CHW-referred patients signify the need to further empower the CHW program to effectively do community based screening and referral. Larger studies with a longitudinal design would be better suited to support the conclusions made in this study.

With most studies involving CHWs and SAM concentrating on CMAM as tertiary prevention strategy, more studies are needed with a focus on primary and secondary prevention, which is where community health care is expected to play a role.

Acknowledgements

Dr H.C. Lion-Cachet:	For supervision and guidance
Prof S Ellis:	Statistical analysis
Prof OB Omole:	For guidance and mentoring
Ms Eloïse Swanepoel:	Dietetics Department at Potchefstroom Hospital for assistance with data collection.
Ms Deidre Pretorius:	For guidance and support
Sr Petro Swanepoel:	For assistance and inspiration to make a difference

Competing interests

The author declares that he has no financial or personal relationships that may have inappropriately influenced him in writing this article.

Data Availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Disclaimer

The views expressed in the submitted article are my own and not an official position of the institution

References

1. World Health Organization. Malnutrition [homepage on the Internet]. [updated 2018 Feb 16; cited 2019 Oct 1]. Available from: https://www.who.int/news-room/fact-sheets/detail/malnutrition

2. Corkins MR. Why Is Diagnosing Pediatric Malnutrition Important? Nutr Clin Pract [serial online]. 2017 [cited 2019 Oct 01] ;32(1):15–8. Available from: https://doi.org/10.1177/0884533616678767

3. Green RJ, Coovadia HM, editors. Coovadia's paediatrics & child health: a manual for health professionals in developing countries. 7th ed. Cape Town: Oxford University Press Southern Africa; 2014. p. 255-276

4. Morgan K. The Cognitive Effects of Chronic Malnutrition and Environment on Working Memory and Executive Function in Children. ISP Collect [serial online]. 2015. [cited 2019 Oct 1]. Available from: https://digitalcollections.sit.edu/isp_collection/2053

5. Abessa TG, Bruckers L, Kolsteren P. Granitzer M. Developmental performance of hospitalized severely acutely malnourished under-six children in low- income setting. BMC Pediatr [serial online]. 2017 [cited 2019 Oct 15]. Available from: https://doi.org/ 10.1186/s12887-017-0950-5

6. Dwivedi D, Singh S, Singh J, Bajaj N, Singh HP. Neurodevelopmental Status of Children aged 6-30 months with Severe Acute Malnutrition. Indian Pediatr. 2018; 55(2):131–3

7. Corazza A. The social and economic consequences of malnutrition [homepage on the Internet]. 2009 [cited 2019 Oct 10]. Available from www.europarl.europa.eu/meetdocs/2009_2014/documents/acp/dv/background_/background_en.pdf

8. Lelijveld N, Seal A, Wells JC, Kirkby J, Opondo C, Chimwezi E, et al. Chronic disease outcomes after severe acute malnutrition in Malawian children (ChroSAM): a cohort study. Lancet Glob Health [serial online] 2016 [cited 2019 Oct 10]; 4(9):e654–62. Available from https://doi.org/10.1016/S2214-109X(16)30133-4.

9. Health Systems Trust. Health Indicators [homepage on the Internet]. No date [cited 2019 Oct 1] Available from: https://www.hst.org.za:443/healthindicators

10. Department of Health. Policy Framework and Strategy for Ward Based Primary Healthcare Outreach Teams. [homepage on the Internet] 2018 [cited 2019 Jul 23]. Available from: https://rhap.org.za/wp-content/uploads/2018/04/Policy-WBPHCOT-4-April-2018-1.pdf

11. Perry H, Zulliger R. How effective are community health workers? [homepage on the Internet] 2012 [cited 2020 May 21] Available from https://chwcentral.org/resources/how-effective-are-community-health-workers/

12. Basu D. Diseases of public health importance in South Africa. South Afr J Public Health [serial online]. 2018 [cited 2019 Oct 01]; 2(3):48–48. Available from: https://hdl.handle.net/10520/EJC-f50fefb60

13. Doherty T, Kroon M, Rhoda N, Sanders D. Ending preventable child deaths in South Africa: What role can ward-based outreach teams play? S Afr Med J [serial online]. 2016 [cited 2019 Oct 01]; 17;106(7):672-674–674. Available from: https://doi.org/10.7196/SAMJ.2016.v106i7.10790

14. le Roux IM, le Roux K, Comulada WS, et al. Home visits by neighborhood Mentor Mothers provide timely recovery from childhood malnutrition in South Africa: results from a randomized controlled trial. Nutr J [serial online]. 2010 [cited 2019 Oct 01]; 22;9:56. Available from: https://doi.org/10.1186/1475-2891-9-56

15. le Roux K, le Roux IM, Mbewu N, Davis E. The role of community health workers in the reengineering of primary health care in rural Eastern Cape. South Afr Fam Pract [serial online]. 2015 [cited 2019 Oct 01]; 19;44–44. Available from: https://doi.org/10.1080/20786190.2014.977063

16. le Roux IM, Rotheram-Borus MJ, Stein J, Tomlinson M. The impact of paraprofessional home visitors on infants' growth and health at 18 months. Vulnerable Child Youth Stud [serial online]. 2014 [cited 2019 Oct 01] ;9(4):291–304. Available from: https://doi.org/10.1080/17450128.2014.940413

17. Kozuki N, Tesfai C, van Boetzelaer E. Can low-literate community health workers treat severe acute malnutrition? A study of simplified algorithm and tools in South Sudan. Field Exch 59 [serial online]. 2019 [cited 2019 October 2019] p30. Available from: https://www.ennonline.net/fex/59/samtoolssudan

18. Saloojee H. Re-envisioning reengineered primary health care in South Africa. The KM Seedat Memorial Lecture presented at: 22nd National Family Practioners Congress; 2019 Aug 24; Johannesburg.

19. Marcus TS. COPC- A Practical Guide. Pretoria: Department of Family Medicine University of Pretoria; 2018. p. 401–402.

20. Dukhi N, Sartorius B, Taylor M. Mid-upper arm circumference (MUAC) performance versus weight for height in South African children (0–59 months) with acute malnutrition. South Afr J Clin Nutr [serial online]. 2017 [cited 2019 Jul 17]; 30(2). Available from: https://doi.org/10.1080/16070658.2016.1255483

21. Bliss J, Lelijveld N, Briend A, Kerac M, Manary M, McGrath M, et al. Use of Mid-Upper Arm Circumference by Novel Community Platforms to Detect, Diagnose, and Treat Severe Acute Malnutrition in Children: A Systematic Review. Glob Health Sci Pract [serial online]. 2018. [cited 2019 Oct 10] 6(3):552–64. Available from: https://doi.org/10.9745/GHSP-D-18-00105

22. Cologne, Germany: Institute for Quality and Efficiency in Health Care (IQWiG). Benefits and risks of screening tests [homepage on the Internet]. c2013 [updated 2019; cited 2020 Jun 2]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK279418/

23. World Health Organization. Weight-for-length/height [homepage on the Internet]. [cited 2019 Jul 23]. Available from: https://www.who.int/childgrowth/standards/weight_for_length_height/en/

24. Ellis SM, Steyn HS. Practical significance (effect sizes) versus or in combination with statistical significance (p-values) : research note. Manag Dyn J South Afr Inst Manag Sci. [serial online] 2003 [cited 2019 Oct 01] 12(4):51–3. Available from: https://www.researchgate.net/publication/293182482_Practical_significance_effect_sizes_versus_or_in_combination_with_statistical_significance_p-values

25. Jarolimova J, Baguma S, Patel P, Mian-McCarthy S, Ntaro M, Matte M, et al. Completion of community health worker initiated patient referrals in integrated community case management in rural Uganda. Malar J [Internet]. 2018 Oct 22 [cited 2020 Jun 30];17. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6198464/

26. Mambulu-Chikankheni FN, Eyles J, Ditlopo P. Exploring the roles and factors influencing community health workers' performance in managing and referring severe acute malnutrition cases in two subdistricts in South Africa. Health Soc Care Community [serial online]. 2018 [cited 2019 October 01];26(6):839–48. Available from: https://doi.org/10.1111/hsc.12595

27. Chiabi A, Mbanga C, Mah E, Nguefack Dongmo F, Nguefack S, Fru F, et al. Weight-for-Height Z Score and Mid-Upper Arm Circumference as Predictors of Mortality in Children with Severe Acute Malnutrition. J Trop Pediatr. 2017 Aug 1;63(4):260–6.

28. O'Brien KS, Amza A, Kadri B, Nassirou B, Cotter SY, Stoller NE, et al. Comparison of anthropometric indicators to predict mortality in a population-based prospective study of children under 5 in Niger. Public Health Nutr. 2020 Feb;23(3):538–43.

29. Wagnew F, Dessie G, Takele WW, et al. A meta-analysis of inpatient treatment outcomes of severe acute malnutrition and predictors of mortality among under-five children in Ethiopia. BMC Public Health [serial online]. 2019 [cited 2019 Oct 01];19(1):1175. Available from: https://doi.org/10.1186/s12889-019-7466-x

30. Jarso H, Workicho A, Alemseged F. Survival status and predictors of mortality in severely malnourished children admitted to Jimma University Specialized Hospital from 2010 to 2012, Jimma, Ethiopia: a retrospective longitudinal study. BMC Pediatr [serial online]. 2015 [cited 2019 Oct 01];15(1):76. Available from: https://doi.org/10.1186/s12887-015-0398-4

31. Benyera O, Hyera FLM. Outcomes in malnourished children at a tertiary hospital in Swaziland after implementation of the World Health Organization treatment guidelines. South Afr J Child Health. 2013 Nov 18;7(4):135-138–138.

32. Desyibelew HD, Fekadu A, Woldie H. Recovery rate and associated factors of children age 6 to 59 months admitted with severe acute malnutrition at inpatient unit of Bahir Dar Felege Hiwot Referral hospital therapeutic feeding unite, northwest Ethiopia. PLoS ONE [Internet]. 2017 Feb 6 [cited 2020 Jul 7];12(2). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293215/

33. Fergusson P, Tomkins A. HIV prevalence and mortality among children undergoing treatment for severe acute malnutrition in sub-Saharan Africa: a systematic review and meta-analysis. Trans R Soc Trop Med Hyg. 2009 Jun 1;103(6):541–8.

34. Chinkhumba J, Tomkins A, Banda T, Mkangama C, Fergusson P. The impact of HIV on mortality during in-patient rehabilitation of severely malnourished children in Malawi. Trans R Soc Trop Med Hyg. 2008 Jul 1;102(7):639–44.

Appendix A Ethical Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr Jurgens Staats

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M180816

NAME: (Principal Investigator)	Dr Jurgens Staats
DEPARTMENT:	School of Clinical Medicine Potchefstroom Hospital JB Marks Subdistrict, North West Province
PROJECT TITLE:	Characteristics and outcomes in children aged 6 to 60 months assessed as being malnourished by community health workers in the JB Marks Sub District
DATE CONSIDERED:	31/08/2018
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Carien Lion-Cachet
APPROVED BY:	Dr C Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	13/11/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed August and will therefore be due in the month of August each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix B Research Protocol with Updated Literature Review