Increased mining activities in the eastern Democratic Republic of Congo: an opportunity to improve the nutritional status of children under five-years-old

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Abstract

Introduction: Household poverty and poor access to health and other social amenities are key drivers of malnutrition and poor child health in most low-resources settings. The Democratic Republic of Congo (DRC), in the backdrop of past instability, experiences a host of socio-economic factors that effectively result in malnutrition among under-five children – despite immense natural resources. Recent stability and enormous mineral resource wealth has attracted mining companies to invest in the eastern provinces of the country, presenting an opportunity to improve the nutritional and overall health status of children in the region. We therefore sought to describe the prevalence of malnutrition in the region, cognisant of these developments.

Methods: Seven hundred and sixty-two under-five children from 420 households in two districts in the eastern DRC were assessed in this survey. We calculated their malnutrition indicators and made comparisons between semi-urban and rural children; taking semi-urban as a good proxy for populations within the coverage of mining activities. For each indicator, all children whose appropriate parameters were available were included in the evaluation with a plausible z-score.

Results: An estimated 21.5% (95% confidence interval [CI]: 18.5–24.5) of the children assessed were found to be underweight, with 6.8% being severely underweight. However, the prevalence of wasting among these children was estimated at 5.8% (95% CI: 4.1%–7.6%), which was lower than the national average of 16%. Of significance, the age groups six to 11 and 12 to 23 months were found to be more wasted compared to other age categories. Within the six- to 11-months age category, rural children fared better than their semi-urban counterparts at 5% (95% CI: 0%–13%) and 14.6% (95% CI: 13.6%–25.6%) respectively.

Conclusion: We conclude that malnutrition among under-five children is a significant problem in the eastern DRC. Business investment in the region offers real opportunities to comprehensively address these pressing challenges that face communities. Businesses keen to address malnutrition need to be cognisant of the prevalence of the problem and its contextual drivers, particularly on the socio-economic front, to be able to conceptualise appropriate responses.

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Introduction

Malnutrition remains one of the highest contributors to mortality among under-five children in developing countries.[1–3] In many underdeveloped parts of the world, there are a multitude of factors that predispose this age group to malnutrition.[2,3] Contributory factors include low levels of maternal education, poverty and concurrent child morbidity.[4,5] The interaction between malnutrition and inadequate access to health care services has deleterious consequences – making malnutrition one of the biggest underlying causes of death among under-five children in underdeveloped parts of the world.[4]

Frequent episodes of childhood illnesses and nutritional deficiency are reinforcing agents of the same vicious cycle.[6,7] Unless comprehensively addressed, these co-morbidities curtail the growth of affected children in the short term, with negative implications on their future mental and physical development. At the broader societal domain, the effects of malnutrition are known to trickle from the personal through the household to the community, and their sequela is a population bound in a state of poverty and despair.[3,5–7] This desperate situation is clearly depicted in most conflict and post-conflict communities in Africa, where longstanding conflicts (external and internal civil strife) have resulted in the destruction of basic health and social amenities.[8]

The DRC, a post-conflict country, is situated in the central African region (see Figure 1). It is reported to have average levels of acute malnutrition higher than the sub-regional average, at 16% and 10 % respectively, while levels of chronic malnutrition are comparable to the rest of sub-Saharan Africa, at 38%.[9] The relative return to normality (after the 2002 peace accord) presents an opportunity to address some of the most pressing health and social problems in

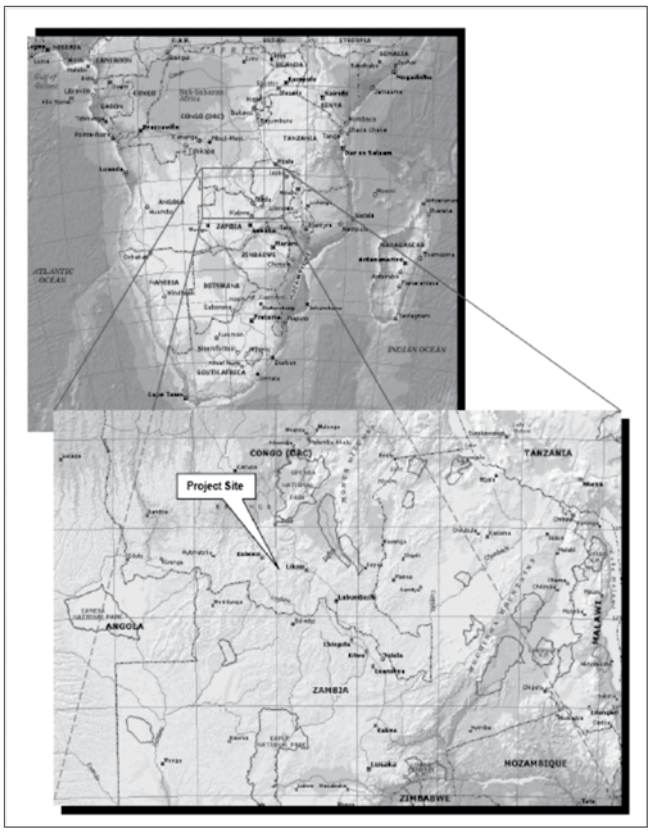

Figure 1: Map of the DRC (enlarged to show the location of the two districts in the study)

the country.[8,9] Indeed, estimates of under-five child mortality for the period 1990 to 2007 show a decline from 200 to 161 per 1 000 children respectively.[10]

However, the post-conflict public sector does not have the capacity to meet the basic needs of the population, calling for concurrent responses from other stakeholders such as business and civil society. In the mineral-rich Katanga province, located in the south-eastern part of the country (see Figure 1), a window of opportunity to address health issues such as malnutrition exists in the form of proactive mining companies establishing corporate social responsibility (CSR) projects, as well as offering direct and indirect employment opportunities to the local population.[11,12,13]

In this study, we describe the malnutrition situation for under-five children from two districts in a province where such a mining company has been in operation since early 2007.* At the time of the study the company's total staff complement was 3 100, with an approximate 2 500 drawn from the local community whose estimated population was 90 000. The presence of the company also offers trading opportunities for local businesses people, in particular relating to agricultural products and small retail shops. Through the CSR framework, the company provides preventive and curative health services for employees and their beneficiaries, potable water via community pumps and vector control for malaria.

Study objective

Our overall objective was to describe the malnutrition situation for under-five children from the two districts and to determine whether there were any significant differences in the malnutrition levels among under-five children from the semi-urban and rural localities. In this case, residence in a semi-urban locality was a good proxy for being within the coverage area of the mining company's operations.

Methods

This study was part of a larger baseline health survey that was conducted between May and July 2008. It was commissioned by a large mining company that was keen to establish health and social projects to meet some of the needs of the host community. In drawing the sample, we applied the World Health Organization (WHO) 30-cluster sampling method, according to which localities (from the two districts) were selected proportionate to their sizes.

The selected 20 semi-urban and 10 rural localities (30 clusters) had an estimated 9 531 households, from which a random sample of households (14 from each cluster) was selected. Eligible individuals were then selected from these households based on agreement with the set criterion – in this case, under-five children. Children from semi-urban areas differed from their rural counterparts in that one or both of their parents were directly or indirectly employed by the company and had access to the CSR interventions offered by the company. In the sample size calculation, we set the precision of 7% (to detect a difference with 95% confidence interval, CI), assuming that the prevalence of malnutrition in the community was 50%. With a sampling design effect of 2, this was estimated at 420 households.

All under-five children from the selected households were considered eligible to participate in the survey provided that they were accompanied by a guardian who could provide informed consent. A total of 802 children were considered eligible to participate in the study. However, 12 of the children were excluded from the study since they were found to be febrile and were referred for further treatment before their measurements could be taken. A further 28 were excluded because they were not accompanied by a guardian who could give proper consent for them to participate.

Convenient sites (such as local schools, churches and market places) within the reach of selected households were set up and anthropometric parameters (height and weight) of the selected 762 children were taken by three trained research assistants, supervised by a medical doctor. Measurements were taken once, with the supervisor re-taking measurements at random for a section of those children already measured to ensure quality. The measurements were recorded on a paper-based tool and then transferred to an electronic system, namely the WHO Anthro software (http://www.who.int/childgrowth/software/en/).[14] Data analysis was done using the same software.

* Despite the fact that there have been mining activities in the area for decades, this new company's management is the only one that sought to implement CSR projects targeting the community.

Table I: Comparison of malnutrition indicators between semi-urban and rural areas

Age in months	Semi-urban			Rural		
Weight-for-length/height (%)						
	n	% < -2 SD	(95% CI)	n	% < -2 SD	(95% CI)
Subtotal:	446	5.6	(3.4%, 7.9%)	309	6.1	(3.3%, 9.0%)
(0–5)	56	7.1	(0%, 14.8%)	40	10.0	(0%, 20.5%)
(6–11)	48	14.6	(3.6%, 25.6%)	40	5.0	(0%, 13.0%)
(12–23)	84	13.1	(5.3%, 20.9%)	67	13.4	(4.5%, 22.3%)
(24–35)	86	2.3	(0%, 6.1%)	59	1.7	(0%, 5.8%)
(36–47)	88	1.1	(0%, 3.9%)	52	1.9	(0%, 6.6%)
(48–60)	84	0	(0%, 0.6%)	51	3.9	(0%, 10.2%)
Length/height-for-age (%)						
	n	% < -2 SD	(95% CI)	n	% < -2 SD	(95% CI)
Subtotal:	443	41.3	(36.6%, 46%)	306	43.5	(37.7%, 49.2%)
(0–5)	56	12.5	(2.9%, 22.1%)	40	7.5	(0%, 16.9%)
(6–11)	47	17.0	(5.2%, 28.8%)	39	23.1	(8.6%, 37.6%)
(12–23)	83	39.8	(28.6%, 50.9%)	65	36.9	(24.4%, 49.4%)
(24–35)	85	58.8	(47.8%, 69.9%)	60	61.7	(48.5%, 74.8%)
(36–47)	87	49.4	(38.3%, 60.5%)	51	60.8	(46.4%, 75.2%)
(48–60)	85	49.4	(38.2%, 60.6%)	51	56.9	(42.3%, 71.4%)
Weight-for-age (%)						
		% < -2 SD	(95% CI)		% < -2 SD	(95% CI)
Subtotal:	450	21.1	(17.2%, 25%)	312	22.1	(17.3%, 26.9%)
(0–5)	59	6.8	(0%, 14.0%)	40	10.0	(0%, 20.5%)
(6–11)	48	18.8	(6.7%, 30.8%)	40	10.0	(0%, 20.5%)
(12–23)	83	27.7	(17.5%, 37.9%)	68	25.0	(14%, 36.0%)
(24–35)	86	31.4	(21.0%, 41.8%)	60	28.3	(16.1%, 40.6%)
(36–47)	89	18.0	(9.4%, 26.5%)	52	21.2	(9.1%, 33.2%)
(48–60)	85	18.8	(9.9%, 27.7%)	52	30.8	(17.3%, 44.3%)

Standard calculations were made for each child's nutritional state using the WHO Anthro software, unless some specific data for calculating the specific indicator in question were missing.* This meant that in the calculation of prevalence of various indicators in different age groups, slightly different denominators (N) were used. However, there were no systematic missing data between semi-urban and rural children and among different age groups that biased the results and their comparisons.** The decision to apply standard analysis instead of the restricted analysis was one of the study power considerations to ensure that we could be able to detect small differences among groups.

The WHO reference anthropometric standards used to determine the prevalence of stunting, wasting and underweight among the children assessed were as follows:

1. Wasting: low weight-for-height, z-score below -2 SD based on the median WHO reference population.[14]
2. Stunting: low height/length-for-age, z-score below -2 SD based on median WHO reference population.[14]
3. Underweight: low weight-for-age, z-score below -2 SD based on the WHO reference population.[14]

Further logistic regression analysis was done on Stata, Version 10 (http://www.stata.com/), where the influence of age, locality of residence and gender on malnutrition prevalence was assessed.

Results

Out of the 762 under-five children who were assessed, 316 were from the rural areas, while the rest resided in the semi-urban areas. The average age of children from the rural and semi-urban areas was 27.1 and 28.4 months respectively. The gender distribution of the sample was 339 males and 423 females and the average age for males and females was 27.6 and 28.1 months respectively.

* In a minority of cases, some children were very irritable and thus uncooperative and this limited the ability of the researchers to obtain valid results for one measurement, e.g. height/length, while still obtaining a valid measurement for weight.

** Restricted analysis only considers children who have both height, weight and age measurements and excludes all those who have either height or weight only. Please refer to the help section of the WHO Anthro software (http://www.who.int/childgrowth/software/en/).

The prevalence of wasting (below -2 z-scores of the median WHO growth standards) among all the children assessed was estimated at 5.8%. There were no significant differences noted among the rural and semi-urban children in terms of the prevalence of wasting. Approximately 1.2% of these children fell into the severely wasted category (below -3 z-scores of the median WHO growth standards for wasting). This category of severely malnourished children often suffered from other co-morbidities – a predisposing factor to higher mortality. For each indicator, all children were included in the evaluation with a plausible z-score.

Table I shows that the age categories six to 11 months and 12 to 23 months had a higher prevalence of wasting compared to the other age categories of under-five children. In particular, within the 12- to 23-month age category, the prevalence of wasting was estimated at 13.1% and 13.4% for semi-urban and rural children respectively. There was a difference in the estimated prevalence of wasting among rural and semi-urban children aged six to 11 months, which was 5% and 14.6% respectively.

Further analysis considering all age groups revealed that male children had a 12% greater likelihood to be wasted compared to their female counterparts. Similarly, children from the rural areas had a 15% greater chance of wasting in comparison with their semi-urban counterparts. However, at the 95% CI, none of these relationships were statistically significant, a fact likely to be attributable to a small sample size and few observations.

Of all the children sampled, 42.2% (95% CI: 38.6–45.8) were found to be stunted. There were no significant differences between urban and rural proportions of stunting, which averaged 41.3% and 43.5% respectively. Severe stunting (below -3 z-scores of the median WHO growth standards for stunting) was reported in 18.6% (95% CI: 15.7–21.4) of the children assessed.

It was further established that increasing the age of a child by one month led to a 1.5% increase in the chance of stunting. This relationship was significant at the 95% CI, p-value = 0.003. Similarly, residence in a rural locality increased the odds of stunting by 5%, but this relationship was statistically insignificant.

An estimated 21.5% (95% CI: 18.5–24.5) of the children measured were found to be underweight. Those identified as severely underweight (below -3 z-scores of the median WHO growth standards for underweight) represented 6.8% (95% CI: 5.0–8.7) of the sample. In tandem with stunting, there were no significant differences in the prevalence of those identified as underweight among the semi-urban and rural children.

Discussion

In interpreting the results presented in this article, some limitations are worth mentioning. Due to the study's small sample size and geographical scope, we cannot generalise the observations of this study to the rest of the country; neither can we firmly establish causal relationships using a cross-sectional design applied in this context. However, these results set the very basis for further research on the potential contribution of economic activities such as mining to the nutritional status and general wellbeing of under-five children. Positive lessons can be replicated in similar settings to address population health challenges, such as malnutrition, among this age group. Other potential limitations, such as observer errors, were mitigated for through rigorous training and supervision.

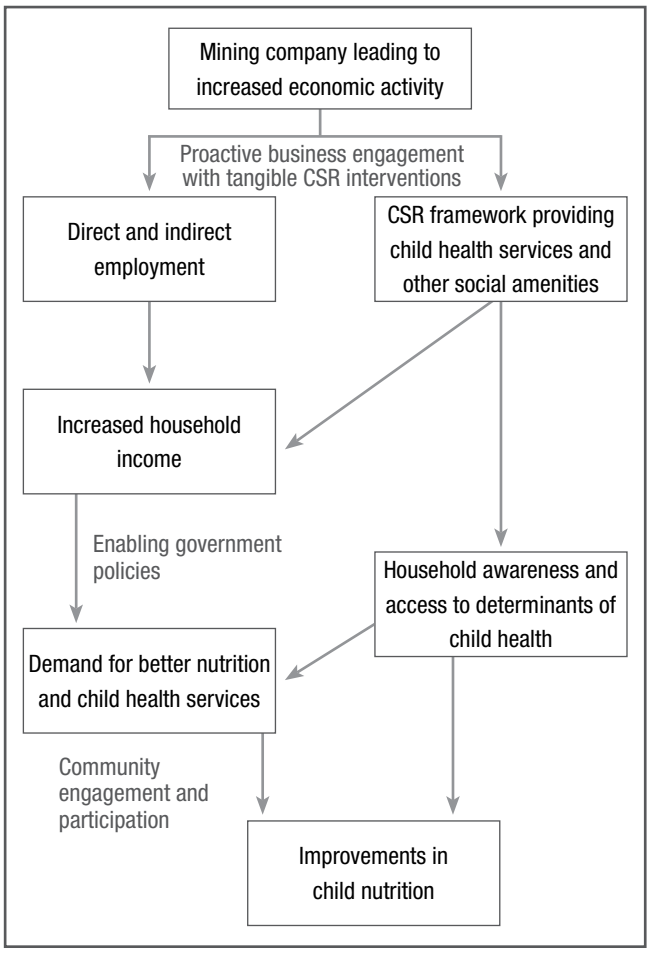

Figure 2: Influential pathways of improving child nutritional status through business engagement

In making comparisons with the national average[9] of acute malnutrition among under-five children, those from the two mining districts faired favourably – taking wasting as an appropriate indicator. Increased levels of economic activity in the two districts would naturally translate into increased direct and indirect employment opportunities and hence household poverty reduction. We assume that increase in household income has a direct impact on demand and spending on nutrition and child health services. Similarly, through the CSR framework, the company strengthened the supply side of crucial child health determinants such as clean water supply and health services, which have a direct bearing on the general health and consequently nutritional status of under-five children. Figure 2 shows a model highlighting the possible causal/influential pathways in this relationship.

It is, however, important to note that the majority of those reported as wasted fell in the six- to 11- and 12- to 23-month categories. One probable explanation for this could be poor infant feeding practices in the two districts. In most low-resource settings, this is often linked

to inappropriate weaning practices due to a host of infant, maternal and societal factors. Infant factors include poor health and close child spacing, leading to premature weaning and neglect of the older infant. On the other hand, poor maternal health and low levels of awareness among caregivers often have negative consequences on infant nutrition.[5]

Focusing on socio-economic factors, the observation that children from semi-urban localities had higher rates of wasting compared to their rural counterparts could be explained by the fact that mothers and other caregivers were compelled to juggle between caring for (including breastfeeding) their children and working in formal employment (in this case the mine) to provide for their families. In rural settings, which are mostly dependent on subsistence agriculture, mothers are often able to carry their children to the farms where they work, which is not necessarily the case for semi-urban mothers working in more formalised or semi-formalised sectors. Because mining is a labour-intensive industry, it is therefore imperative to be cognisant of the interplay of such occupational factors and their effects on child nutrition and health.

The high prevalence of stunting (the national average is 38%)[9] among both semi-urban and rural children is an indicator of longstanding malnutrition attributable to various socio-economic factors, such as chronic instability and underdevelopment – given that the eastern part of the DRC continued to be unstable long after most parts of the country had returned to relative normality.[8,11] Similarly, the underweight levels, which reflect longstanding low-caloric intake, were notably high among the children surveyed, which further give credence to the assertion of chronic malnutrition attributable to broad socio-economic factors. Indeed, the effects of malnutrition are known to be multilevel and multidimensional, exerting negative pressures on individuals, households and society at large.

However, it is prudent to point out that the two districts experienced a steady influx of immigrants from other regions within the eastern DRC for economic and security considerations. This could have resulted in the blunting of the observed beneficial effects of increased economic activity on the region vis-à-vis child nutrition.

Conclusion

In conclusion, a significant proportion of under-five children in the two districts were found to be malnourished. This will have deleterious population health consequences both in the short and long term.

An effective response calls for multisectoral action involving all stakeholders. The business sector has demonstrated that it can play an active role as a partner with other actors in tackling the root causes of malnutrition and ill health.[13] The rapid growth in the mining industry in the eastern DRC offers a real opportunity to address some of the basic health and social issues such as malnutrition. However, this can only be successfully accomplished if there is sound awareness of the health situation of the target population as well as the underlying contextual factors.[11,12]

The up-scaling of proven health interventions through the CSR framework as well as the improvement of working conditions are some of the actions that could realise immediate gains in tackling child malnutrition in the region. Therefore, we recommend further research in this area with a specific focus on population-level impact in the intermediate and the long term. The emphasis should be on objective verification of the contribution of different business models to child health in the region.

Declarations

Ethical considerations

The ethical aspect of the study was considered to ensure congruency with internationally acceptable research standards and to secure the support of the community. Study protocol review and permission to conduct the study were obtained from the relevant district, regional and central health departments. Similar approval was obtained from the Lubumbashi University, Katanga province, DRC.

Informed consent for participation in the study was ensured, with guardians signing the consent form prior to the children's assessment. Those children for whom no proper consent was obtained were excluded from the assessment. The approved protocol stressed the adherence to scientific rigorous and proven methods, confidentiality of data and dissemination of the results for the betterment of the well-being of the study community.

Conflict of interest

T Achoki was previously an employee of a medical assistance company that supported mining companies in health programming in Africa. However, by the time of writing this article, he had moved on to the non-profit multilateral sector.

C Shilumani declares no conflict of interest.

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