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Original Article

Evaluation of the effectiveness of deworming and participatory hygiene education strategy in controlling anemia among children aged 6-15 years in Gadagau community, Giwa LGA, Kaduna, Nigeria

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Abstract

Background: Anemia is one of the most common and most serious health disorders worldwide. The World Health Organization (WHO) estimated that about 40% of the total world's population (more than 2 billion individuals) suffer from anemia. In developing countries, the prevalence rate of anemia is about 20% in school-aged children. More than 10 million African children are thought to be anemic (Hb <11 g/dl). Also, in Africa, it is estimated that more than half of all children over 5 years and pregnant women are anemic. Community-based estimates of anemia prevalence in settings where malaria is endemic range between 49% and 76%. In Nigeria, the prevalence rate for anemia among children was 29.4%. It was highest in the South-East (49.7%) and lowest in the North-East (11.1%).
Objective: The study aimed at evaluating the effectiveness of deworming and participatory hygiene education strategy in controlling anemia among children aged 6–15 years in the Gadagau community, north-western Nigeria.
Materials and Methods: A cross-sectional descriptive study of 306 children aged 6–15 years selected from two rural communities (Gadagau, which was the study group and Karau-Karau, which was the control group) in the Giwa Local Government Area of Kaduna State Nigeria using a multistage sampling technique. The studies involved parasitological examination and anemia evaluation before and at 3 months after the children were dewormed.
Results: Only 301 children (150 children in study group and 151 children in control group) were studied. The results showed that those who were dewormed and had participatory hygiene education lectures (study group) had significantly higher mean hemoglobin, from an initial 10.4 g/dl to a post-intervention of 12.4 g/dl (paired t-test = 13.96; $P = 0.00$). Also, there was a rise in the mean hemoglobin of the control group, but not as much as in the study group, from an initial mean hemoglobin of 10.5 g/dl to a post-intervention of 11.2 g/dl (paired t-test = 2.89; $P = 0.004$). Comparing the study and the control groups, those who were dewormed and also had participatory hygiene education lectures (study group) had a significantly higher reduction in the level of children who had ova of intestinal helminthes present in their stool than those in the control group ($\times^2 = 31.61$; df = 1, $P = 0.00$).
Conclusion: This study therefore concludes that including participatory hygiene education to deworming programmes will greatly improve the hemoglobin level of children in areas where there is a high prevalence of hookworm infections, especially as a short-term preventive measure for anemia in children.

Keywords: Anemia, children, deworming, evaluation, effectiveness, participatory hygiene education

Résumé

Fond: L'anémie est les plus courantes et la plus graves troubles de santé dans le monde entier. L'Organisation mondiale de la santé (OMS) estime qu'environ 40% de la population totale du monde (plus de 2 milliards de personnes) souffrent d'anémie. Dans les pays en développement, le taux de prévalence de l'anémie est d'environ 20% chez les enfants

d'âge scolaire. Plus de 10 millions d'enfants africains sont considérées comme anémiques (HB < 11 g/dl). En outre, en Afrique, on estime que plus de la moitié de tous les enfants de 5 ans et les femmes enceintes sont anémique.
Méthodes: Une étude descriptive transversale de 306 enfants âgés de 6–15years sélectionné des deux communautés rurales (Gadagau, qui était le groupe d'étude et Karau-Karau, qui était le groupe de contrôle) dans la Giwa Local gouvernement zone état de Kaduna nigérian à l'aide d'une technique d'échantillonnage à plusieurs étapes. Les études en cause parasitologique évaluation examen et à l'anémie, avant et pendant 3 mois après que les enfants étaient une.
Résultats: Les auteurs ont étudié les enfants seulement 301 (150 enfants dans le groupe d'étude) et 151 dans le groupe témoin. Les résultats ont montré que ceux qui ont une hygiène participative éducation conférences (groupe d'étude) étaient significativement plus élevée de l'hémoglobine moyenne, d'une initiale de 10,4 g/dl pour une intervention de 12,4 g/dl (appariés test t = 13.96 ; *P* = 0,00). En outre, il y avait une augmentation dans la moyenne de l'hémoglobine du groupe témoin, mais pas autant que dans le groupe d'étude, de l'hémoglobine moyenne initiale de 10,5 g/dl pour une intervention de 11.2 g/dl (appariés test t = 2,89 ; *P* = 0,004). Comparant l'étude et le contrôle groupes, ceux qui ont une et aussi hygiène participative éducation conférences (groupe d'étude) avaient eu une réduction significativement plus élevée dans le niveau des enfants qui avaient des ovules de helminthes intestinaux présents dans leurs selles que ceux du groupe témoin (X^2 = 31,61; df = 1, *P* = 0,00).
Conclusion: Cette étude conclut que notamment la formation en hygiène participative de déparasitage programmes améliorera grandement le niveau de l'hémoglobine des enfants dans les zones où il est une forte prévalence des infections de l'ankylostomiase, notamment à titre de mesure préventive à court terme pour l'anémie chez les enfants.

Mots clés: Évaluation, efficacité, vermifuges, formation en hygiène participative, l'anémie, enfants

Introduction

Anemia is one of the most common and most serious health disorders worldwide.[1,2] The World Health Organization (WHO) estimated that about 40% of the total world's population (more than 2 billion individuals) suffer from anemia.[2,3] In developing countries, the prevalence rate of anemia is about 20% in school-aged children.[3] More than 10 million African children are thought to be anemic (Hb <11 g/dl).[4] Also, in Africa, it is estimated that more than half of all children over 5 years and pregnant women are anemic.[1] Community-based estimates of anemia prevalence in settings where malaria is endemic range between 49% and 76%.[4] In Nigeria, the prevalence rate for anemia among children was 29.4%. It was highest in the South-East (49.7%) and lowest in the North-East (11.1%).[3]

Anemia impairs physical fitness and work capacity, while severe anemia (Hb <7 g/dl) is associated with an increased risk of death.[1] It is one of the largest killers of children admitted to hospitals in Sub-Saharan Africa.[4] Despite this, studies in Africa have shown that anemia is under-recognized in the community and that, unlike fever, is rarely identified by the caregiver as being a serious health problem requiring treatment. The diagnosis is easily missed by health care workers, and clinical management decisions are often made on the basis of inaccurate hemoglobin measurement, which may lead to unnecessary, and potentially lethal, exposure to human immunodeficiency virus (HIV) or other blood-borne diseases as a result of contaminated blood transfusion.[1] Anemia is almost always multifactorial in origin and the causes are interrelated in a complex way.[1,4] The relative importance of each factor varies in different settings and at different ages.[1,4]

Although intestinal helminthes plays a key etiological role in endemic countries, it is clear that nutritional deficiencies (iron, Vitamin A and other micronutrients), malaria, HIV infection and hemoglobinopathies also make important contributions. It is essential therefore to adopt an integrated, broad-based approach to anemia control as this would address the wide range of additional factors that cause anemia, especially in vulnerable groups.[1] Prevalence of anemia in a community is an indicator of iron deficiency in that community.[5]

These findings are supported by those of Stoltzfus and Dreyfuss.[6] They noted that prevalence of anemia is commonly used to assess the severity of iron deficiency in a population. The consequences of iron deficiency anemia are numerous; it can affect the mental and motor development of children with potential long-term consequences for productivity and wage-earning potential in adulthood.[3,7]

Parasitic worms contribute to anemia, especially iron-deficiency anemia, among children in Sub-Saharan Africa, the predominant species being the hookworms – *Ancylostoma duodenale* and *Necator americanus* (which inhabit the gut) and Schistosoma species (which inhabit the blood vessels surrounding the gut and bladder).[7] Blood loss resulting from iron deficiency anemia depends on the intensity of infection, the dietary intake of iron and the presence of other parasitic diseases that can cause blood loss or hemolysis, such as malaria and Trichuris trichiura infection.[7] School-aged children are particularly vulnerable to iron deficiency anemia exacerbated by parasitic infection because they typically harbor the heaviest worm loads in communities.[7] A recent analysis of the association between hookworm and anemia in school-aged children in Zanzibar suggested that 25% of all anemia cases, 35% of iron deficiency anemia cases and 73% of severe anemia cases could be attributed to hookworm infection.[7] Hookworm has been shown to contribute more than schistosomiasis or malaria to iron deficiency anemia in school-aged children.[7] Infections with intestinal worms and *Schistosoma* spp are widespread and common among school-aged children.[7] Worldwide, about 3 billion people are infected with helminthiasis.[8] In Nigeria, various studies that have been conducted to determine the degree of helminthiasis reported a prevalence between 2.4% and 73.3%.[8-13] Among the possible factors that could be responsible for the disparity are age, locality, climatic conditions, socioeconomic factors, population of the studied groups and differences in methods used for stool examinations. In school-aged children, iron deficiency anemia has been found to negatively affect attention and concentration.[3,7] To reduce the prevalence of anemia among children, many approaches were introduced. One of such programmes was regular deworming of children and participatory hygiene education. This achieved good results. The improvement of the anemia status of school-aged children is likely to have a positive effect on schooling and health, particularly through the use of deworming and participatory hygiene education strategy. For example, cognitive skills might be increased and hence the ability to understand education better, which will lead to better employment prospects and wage-earning capacity in adulthood. It would seem appropriate therefore to target the delivery of antihelminthes and other interventions against anemia at this age group.

Objective of the Study

The objective of this study is to evaluate the effectiveness of deworming and participatory hygiene education strategy in controlling anemia among children aged 6-15 years in Gadagau community of Giwa LGA Kaduna state.

Materials and Methods

This study was a community-based interventional study, which was carried out between January and April, 2005. It had a study group (intervention community) and a control group (controlled community). A health research team was formed comprising the researcher, two laboratory scientists (who estimated the hemoglobin and carried out stool microscopy), a research assistant who assisted in stool samples collection, two senior community health extension workers and five teachers from each primary school in the communities (these assisted in administering questionnaires to child–caregiver pairs in both the intervention and the control communities). Those from the intervention community also assisted the researcher in administering albendazole tablet and in given weekly participatory hygiene education lectures.

The teachers and the health workers from the intervention community were trained for 2 days before the study on how to administer the albendazole tablets and the participatory hygiene education lectures. Their involvement greatly enhanced the acceptability of the research programme by the communities and also improved their participation. A multistage sampling technique was used to obtain a representative sample size of 306. All children between the ages of 6 and 15 years, including their caregivers in both study and control communities, were enrolled for the study. Those excluded are children with severe anemia (Hb <7 g/dl), whose caregivers refused consent, whose samples could not be obtained and those who were dewormed in the last 3 months preceding the survey. Ethical approval for the study was obtained from the institutional review board of Ahmadu Bello University Teaching Hospital (ABUTH), Zaria.

Intervention was carried out in the study group. The children were dewormed using 400 mg of albendazole tablet (Zentel 2 tabs) as a single dose. Similarly, participatory hygiene education lecture was given once a week (on Mondays) by the researcher, teachers and Primary Health care Center (PHC) health workers to the eligible child–caregiver pairs for a period of 3 months (January to April, 2005). A total of 12 series of participatory hygiene education lectures were delivered to the eligible child–caregiver pairs in the study group.

A pre-test involving 30 randomly selected children in a community with similar characteristics with the intervention and controlled communities but in a different LGA was carried out by the research team to test the prepared questionnaire and also revised the methodology and logistics of data collection before the actual study began.

Written informed consent was obtained from the parents/caregivers. Then, structured interviewer-administered questionnaires were administered to these parents/caregivers in both the study and the control communities.

Each eligible child had his/her anthropometric measurements taken, i.e. height and weight to the nearest 0.1 cm and 0.1 kg, respectively, using a tape measure and a UNICEF electronic weighing scale. Then, an initial (baseline) blood sample was collected from each child by the finger-prick method using a sterile lancet after cleaning the finger with methylated spirit. Hemoglobin estimation was carried out on the spot by the laboratory scientist using a battery-powered Hemocue photometer and recorded in the appropriate questionnaire.

Fresh stool samples were also collected from the eligible children in the morning of data collection day, prior to which labeled, capped plastic containers were distributed to the eligible child–caregiver pairs. A direct thin-smear examination technique of the stool was used to identify the presence or otherwise of helminthes ova by the laboratory scientist using cover slip preparation of fecal emulsion in normal saline under light microscope using X10 and X40 objective lenses on the same day (in the night). All these investigations took place in both the intervention and the controlled communities and served as the basis for comparison post-intervention.

At the end of the research period (3 months), the same questionnaire was administered and another blood sample and stool sample were collected from each child in both the intervention and the control communities for post-intervention hemoglobin estimation and presence of intestinal helminthes ova in the stool. The blood and stool results were recorded in each child's questionnaire to avoid mix up.

Data Analysis

After the data collection, all completed questionnaires were checked properly for any error and edited. The data were then coded and entered into the computer using standardized coding instructions, a data entry guide and the programme. The data were analyzed using SPSS, version 11.0 USA, and EPI info version 6. Paired t-test, χ^2-test and other analysis (e.g. Z-test) were performed to compare between groups. For the graphics (tables, figures, charts etc.), Microsoft excel was used. The entire statistical calculations were performed at the 95% confidence interval.

Results

Although 306 children were enlisted for the study, only 301 met the inclusion criteria and had their consent forms duly filled and signed by their caregivers. Blood could not be obtained from one of the children while others had severe anemia (Hb <7 g/dl). Therefore, these results are based on the 301 children (150 in the intervention/study group and 151 in control group) who completed the study.

The age distribution of the children is shown in Table 1. Sixty-six percent of the children in the study group fall within the age group of 5–9 years, while 51.7% of the children in the control group fall within the same age range. The mean age of the children in the study group is 8.9 years while in the control group it is 9.7 years.

Most of the children in both groups are males (76.0% in the study group and 70.9% in the control group). There is no significant difference in the male:female ratio between both the study and the control groups ($\chi^2 = 0.772$; df = 1; $P = 0.380$).

Most of the children in both the study and the control groups were enrolled in primary school (86.0% in the study group and 93.4% in the control group).

As depicted in Table 2, before intervention, 74% of the children in the study group were anemic (Hb <12 g/χho were anemic dropped to only 42.7%. Similarly, in the same study group before intervention, only 26% of the children had a normal hemoglobin level (Hb >12 g/dl). But, the percentage rose to 57.3% after intervention.

Also, in the control group, at baseline, 56% of the children were anemic (Hb <12 g/dl). But, post-

Table 1: Socio-demographic characteristics of respondents (n = 301)

Characteristics	Study Group		Control Group	
	Frequency	Percentage	Frequency	Percentage
Age group (years)				
5 – 9	99	66.0	78	51.7
10 – 15	51	34.0	73	48.3
Sex				
Males	114	76.0	107	70.6
Females	36	24.0	44	29.4
Educational Status				
None	21	14.0	10	6.6
Primary	129	86.0	141	93.4

Study group: Age range= 6-15 years; Mean= 8.9 yrs; S.D=2.61; Control Group: Age range= 6-15 years; Mean=9.7 yrs; S.D=1.70; Z=3.445; df=299; P = <0.001

Table 2: Haemoglobin level of children before and after intervention

Haemoglobin (g/dl)	Study Group		Control Group	
	Baseline result	Follow up	Baseline result	Follow up
< 12 (Anaemic)	111 (74.0%)	64 (42.7%)	84 (56.0%)	84 (52.3%)
>12 (Normal)	39 (26.0%)	86 (57.3%)	67 (44.0%)	71 (47.7%)
Total	150	150	151	149

Study Group: χ^2 = 29.02, df=1, P = 0.000 Control Group: χ^2=0.21, df=1, P = 0.650

intervention, the percentage of those who were anemic dropped to 52.3%. Similarly, in the same control group at baseline, 44% of the children had a normal hemoglobin level (Hb >12 g/dl). But, the percentage rose to 47.7% post-intervention.

As depicted in Table 3, before intervention, 29% of the children in the study group had ova of intestinal helminthes in their stool. But, after intervention, only 4% of the children had ova of intestinal helminthes present in their stool. Also, in the control group at baseline, 21% of the children had ova of intestinal helminthes present in their stool. But, post-intervention, only 16.1% of the children had ova of intestinal helminthes present in their stool.

Discussion

School enrolment rate among children is the percentage of children in a specific age group who are currently in school.[14] Table 1 shows that 86% of the children in the study group and 93.4% of the children in the control group are in school. This finding is even higher than the one found in 1999 NDHS of 61.9% in the age group of 6-15 years.[14] The finding from this study was probably due to the launching of Universal Basic Education (U.B.E.) in October 1999 in an effort to meet the nation's manpower requirement for national development.

It is increasingly recognized that intestinal helminthes may have a harmful impact on hemoglobin, growth and cognitive function of school-aged children.[15] Previous studies have demonstrated this for heavy infection with hookworm, *Schistosoma haematobium* and *Trichuris trichiura* and, to a lesser degree, *Ascaris lumbricoides*.[6] Routine deworming had been shown to work, especially in school-aged children, by many studies.[15-19] Although reinfection would rapidly appear unless there is a change in habit coupled with abundant safe water and sewage disposal facilities. The latter could only be effected hand in hand with health education. Thus, periodic deworming is not the end in itself; the real goal must be to eradicate the parasite by improved public health measures for disposal of feces and other hygienic practices.[17]

Many researchers have suggested including hygiene education in any deworming programme.[16,20] Health educations in general and hygiene education in particular must be universally taught and applied, particularly to the women folk. Education as a focal intervention tool could, in both short- and long-term control observed causes of parasitic infections, such as poor sanitary conditions, lack of personal hygiene, unhygienic sourcing and use of water and poor disposal of human waste.[21]

In this study, a significant improvement was observed within the 3 months of a weekly participatory hygiene education lecture and a single dose of albendazole in the study group. There was a significant difference in the mean hemoglobin level of the study group after 3 months of intervention, when another blood sample was collected in the fourth month. The initial mean hemoglobin before intervention was 10.4 g/dl, while after intervention it rose to 12.4 g/dl (paired t-test=13.96; df = 298; P = 0.000) whereas such a significant difference was not observed in the control group because no intervention was given within the 3-months period. The initial mean hemoglobin of the control group at baseline was 10.5 g/dl, while post-intervention it rose to 11.2 g/dl (paired t-test = 2.89; df = 298; P = 0.0040). Even though there was a rise in the level of mean hemoglobin in the control group post-intervention, the extent was not enough to warrant any significant difference as in the study group.

Table 3: Presence of ova of intestinal helminthes in the stool of children before and after intervention

Ova presence	Study Group		Control Group	
	Baseline result	Follow up	Baseline result	Follow up
Yes	44 (29.0%)	6 (4.0%)	32 (21.0%)	24 (16.1%)
No	106 (71.0%)	144 (96.0%)	119 (79.0%)	125 (83.9%)
Total	150	150	151	149

Study Group: χ^2 = 31.61, df=1, P = 0.000 Control Group: χ^2 = 0.96, df=1, P = 0.326

Also, there were 111 (74%) children who were previously anemic in the study group. However, following intervention (i.e., deworming and participatory hygiene education), the number reduced to just 64 (42.7%). Those children with a normal hemoglobin value increased from 39 (26%) before intervention to 86 (57.3%) after intervention. There is a significant difference in the hemoglobin level of children in the study group before and after intervention ($\chi^2 = 29.02$; df = 1; $P = 0.000$), although an improvement was also observed in the control group among those who are anemic, from 84 (56%) at baseline to 78 (52.3%) post-intervention. The extent or rate of improvement is not as high as in the study group and thus it does not show any significant difference in the hemoglobin level of children in the control group at baseline and at post-intervention ($\chi^2 = 0.21$; df = 1; $P = 0.65$).

Similarly, the number of children who had ova of intestinal helminthes present in their stool in the study group dropped from 43 (29%) before intervention to 6 (4%) after intervention. Those with normal stool findings in the same study group increased from 107 (71%) before intervention to 144 (96%) after intervention. These changes are statistically significant ($\chi^2 = 31.61$; df = 1; $P = 0.000$), although improvement was also observed in the control group, from 32 (21%) children who had ova of intestinal helminthes in their stool at baseline to 24 (16.1%) children post-intervention. The rate of improvement is not as high as in the study group and, thus, there is no significant difference in the presence of ova of intestinal helminthes in the stool of children in the control group at baseline and post-intervention ($\chi^2 = 0.96$; df = 1; $P = 0.326$). Similar improvement on the knowledge of intestinal helminthiasis, anemia, presence of ova in stool, rise in hemoglobin level and proper environmental hygienic practices was also observed by Hassan *et al*.[22] after 3 months of introducing deworming and participatory hygiene education strategy in UNICEF's 18CD communities. However, in their study, levamisole (Ketrax) tablets was used for the deworming and participatory hygiene education lecture was given twice a week by school teachers, village health workers and community volunteers.

This study further confirms the importance of including hygiene education in deworming programmes, especially in communities with a high prevalence of anemia and helminthiasis.[21] This study was performed for 3 months, which shows that it was a short-term health intervention programme, and, for the rapid effect on hemoglobin, participatory hygiene education should be included, especially in deworming programmes. However, further research will be required to observe the long-term effect of participatory hygiene education and deworming.

Conclusion

This study has shown the benefit of deworming and participatory hygiene education strategy in the control of anemia in school-aged children. It has shown that including participatory hygiene education in the deworming programme for children and their caregivers can improve their knowledge of anemia and intestinal helminthiasis and their hemoglobin level, especially in the anemic children. The study has shown that school teachers, development volunteers in the community and caregivers when mobilized through a participatory process will develop, among other skills, better hygienic practices, both traditional and modern.

However, further research will be required to observe the long-term effect of participatory hygiene education and deworming. This is because the maximum effect of deworming alone may be observed 15–20 months post-intervention.[22] By this time, it may be interesting to know if there are still significant differences between the level of knowledge, the mean hemoglobin and the presence of ova in stools of the two groups. Also, further research will be required to observe the effect of including iron supplementation to deworming and participatory hygiene education because the most effective strategy for anemia control is to combine antihelminthic chemotherapy with iron supplementation, even in malaria-endemic regions.[23]

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